

10th IconSWM-CE 2020



Resource Efficiency through Circular Economy

Editor-in-Chief

Prof. Sadhan Kumar Ghosh

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International Society of Waste Management, Air and Water (ISWMAW)

Centre for Sustainable Development and Resource Efficiency Management, Jadavpur University, India

Centre for Sustainable Technology, Indian Institute of Science, India

Resource Efficiency through Circular Economy

Abstract Book

Editor-in-Chief

Prof. Sadhan Kumar Ghosh

**Professor, Mechanical Engineering Department, Jadavpur University,
Chief Coordinator, Centre for Sustainable Development and Resource Efficiency Management,
Jadavpur University, India
President, International Society of Waste Management, Air and Water, India**

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Sustainable Waste Management towards Circular Economy



ISWMAW

International Society of Waste Management, Air and Water (ISWMAW)
Kolkata 700041, iswmaw@gmail.com /
conference.iconswm@gmail.com;
www.iswmaw.com



Centre for Sustainable Development and Resource Efficiency Management, Jadavpur University, India
Jadavpur University, Blue Earth W/S, Kolkata 700 032
Website : www.iconswm.com / www.iswmaw.com; www.jadavpur.edu
E.Mail. iswmaw@gmail.com / ju.cqms@yahoo.com



Center for Sustainable Technology (CST)
Indian Institute of Science, Bengaluru
PIN Code: 560012, Karnataka, India

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For communication send mail to :

iswmaw@gmail.com;
qmccal41@gmail.com
10thiconswm.conference@gmail.com
publication.iconswm@gmail.com

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Forewords

The seventeen Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development adopted by world leaders of 193 countries in September 2015 at an historic UN Summit officially came into force. Over the next fifteen years, with these new Goals that universally apply to all, countries will mobilize efforts with strategies that build economic growth and address a range of social needs including education, health, social protection, and job opportunities, tackling climate change and environmental protection. On the other hand, the 3R Forum in Asia and the Pacific initiated by the United Nations Centre for Regional Development (UNCRD) helps in generating the awareness on reduce, reuse and recycle strengthening the implementation of SDGs. These are some of the global initiatives which enhance the effectiveness of global waste management and efficient resource utilization.

Very recently the initiative to formulate a roadmap for Sustainable Waste Management and Resources Circulation in South Asia' has been taken up jointly by South Asia Co-operative Environment Programme (SACEP), The IGES Center Collaborating with UNEP on Environmental Technologies (CCET) and the UN Environment – IETC where India, Nepal, Bhutan, Afghanistan, Sri Lanka and Maldives are participating to prepare an intergovernmental policy documents for implementation. ISWMAW has established its presence in the world scenario in the waste management and movement to promote 3R and Circular Economy worldwide through several research programme and publications.

In India, the Swachata Sarvekshan 2020 covered 4,242 cities to assess the effectiveness of SWM and to rank the top cities based on cleanliness including SWM initiatives starting with a total of 73 cities covered in the 2016, SBM is considered as the country's biggest-ever cleanliness drive costing over 10,600 million USD for 5 years involving 4,237 towns in India in 2019 and 4242 towns in 2020 with an objective of institutionalizing SWM, sanitation and resource efficiency and their assessment in 2021 based on 5R and circular economy concepts. September 2019, Heads of State and Governments convened review progress on their promises made after four years of working on Agenda 2030 for the first time in person at the United Nations in New York. While some countries are slowly moving forward with SDG-focused policies, they are not undergoing the major transformative change that is necessary to successfully achieve the goals by 2030. The Sustainable Development Report 2019 calls for six major transformations in every country to address skills and jobs, health, clean energy, biodiversity and land use, cities, and digital technology. All countries have a big job ahead to create SDG roadmaps and strategies for success." says Jeffrey D. Sachs, Director of the SDSN. "There is not much left of the historic promises made four years ago. We have to breathe life into the UN goals and transpose them into concrete measures. Poverty and unjust educational opportunities do not disappear by lip service, but only by action.", says Aart De Geus, CEO of the Bertelsmann Stiftung. World nations obtain their worst performance on SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land).

The IconSWM movement was initiated for better waste management, resource circulation and environmental protection since the year 2009 through generating awareness and bringing all the stakeholders together from all over the world under the aegis of the International Society of Waste Management, Air and Water (ISWMAW). It established a few research projects across the country those include the CST at Indian Institute of Science. Consortium of researchers in International collaboration (CRIC) and many other organisations across the world helping in the IconSWM movement. IconSWM has become significantly one of the biggest platforms in India for knowledge sharing, awareness generation and encouraging the Urban Local Bodies (ULBs), government departments, researchers, industries, NGOs, Communities and other stake holders in the area of waste management in the country. The primary agenda of this conference is to reduce the waste generation encouraging the implementation of 3R (Reduce, Reuse & Recycle) concept and management of the generated waste ensuring resource circulation. The conference will show a paradigm and provide holistic pathways to waste management and resource circulation conforming to urban mining and circular economy with the theme, "Zero Waste through Waste reduction and Resource Recovery Business".

I must thank the authors for submission of 240 abstracts and papers from 44 countries under this stressed pandemic situation. This volume of proceedings of abstracts will be useful for the ULBs, Researchers, Practitioners and the government. Few excellent papers will be selected for publication in special issues of the journals namely, Waste Management and Research, Journal of Material

Cycles and Waste Management and International Journal of Energy Sector Management through its own review process and for the theme based books.

The success of the 10th IconSWM-CE is the result of significant contribution of many organizations and individuals. I must thank to all of them who directly or indirectly help in making a meaningful event. IconSWM-ISWMAW Committee acknowledges the contribution and interest of all the sponsors, industry partners, Industries, co-organisers, Organising Partners around the world, specifically OSPCB, Govt of Odisha, Ministry of H&UA, Govt. of India, CMA, UNCRD, UNIDO, UNEP, CIPLA, the Vice Chancellor and all the professors and academic community of participating organizations, and the delegates and service providers for making a successful 10th IconSWM-CE. I specially mention the support by Jadavpur University, ISWMAW and CST, Indian Institute of Science, Bangalore, India.

I must specially mention the support and guidance by each of the members of the international scientific committee, CRIC members, the core group members, and the local organizing committee members, editorial board members and the coordinators of the special sessions in different countries all over the world, who are the pillars for the success of the programme. The editorial board members including the reviewers, authors and speakers and M/S. Springer India Pvt. Ltd., CRC Press for their collaboration and publication of special issues of WM&R, specifically Prof. P Agamuthu, deserve thanks for their support and cooperation.

I must mention the active participation of all the team members in IconSWM Secretariat across the country. I am thankful to my team members ISWMAW, Kolkata HQ and other part of the world for various activities for the success of the 10th IconSWM 2020. I express my special thanks to Sannidhya Kumar Ghosh, being the governing body member of ISWMAW supported the activities from USA. I am indebted to Mrs Pranati Ghosh who gave me guidance and moral support in achieving the success of the event. 10th IconSWM 2020 was attended by nearly 700 delegates from 44 countries.

Once again the IconSWM and ISWMAW express gratitude to all the stakeholders and delegates, speakers partners and sponsors who are the part of the success of 10th IconSWM 2020.

Hope to see you all in 10th IconSWM 2020 in December 2020 .

2nd December 2020
Jadavpur University, Kolkata, India

Prof. Sadhan Kumar Ghosh
Editor-in-Chief & Chairman, IconSWM-CE

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I. Bio Technology & Bio Process



Mycelial Growth Performance Of *Pleurotus Ostreatus* And *Volvariella Volvacea* In Common Kitchen Wastes

Joany Alyssa B. Abogado^{1*}, April Ann A. Cañal¹, and Arce D. Bellere¹

¹ Central Bicol State University of Agriculture, Research and Development Unit, Sipocot, Camarines Sur, Philippines

ABSTRACT: *Pleurotus ostreatus* (sideways oyster) and *Volvariella volvacea* (paddy straw) are two of the common mushroom species being cultivated throughout the world that thrives at tropical and sub-tropical countries. The common media used in mushroom cultivation is potato dextrose agar media, which is too expensive for small time mushroom growers. Thus, this study aimed to develop alternative culture media out of kitchen wastes such as Matured Coconut Water (MCW), Rice Wash (RW) and Corn Decoction (CD); specifically it intends to determine the mycelial performance of *P. ostreatus* and *V. volvacea* in common kitchen waste media and to evaluate the significant difference of the mycelial growth performance of *P. ostreatus* and *V. volvacea* in matured coconut water, rice wash and corn decoction. The pH levels of media were adjusted to 8.0. With 27.47 OC and 78.83% relative humidity, the fastest mycelial ramification of *P. ostreatus* was observed on rice wash within six days of incubation which is significantly higher than the two cultured media. However, matured coconut water and corn decoction revealed very thick mycelial density. In addition, all cultured media were fully colonized with *P. ostreatus*. On the other hand, shortest number of days of mycelial colonization of *V. volvacea* that took three days was noted in Rice wash (RW) which is significantly different among the evaluated media. In terms of mycelial density, the thickest mycelial ramifications were recorded in coconut water and corn decoction at 28.1 OC and 79.92% relative humidity. Moreover, all the evaluated media were completely ramified with *V. volvacea*. These results suggested that rice wash is an ideal media for *P. ostreatus* and *V. volvacea*, in addition, matured coconut water and corn decoction can be utilized as an alternative media for *P. ostreatus* and *V. volvacea*.

Keywords: *P. ostreatus*, *V. volvacea*, mycelial growth, matured coconut water, rice wash, corn decoction, matured coconut water, rice wash, corn decoction..



Antifungal Activity Of Fruits, Leaves, And Seeds Extract Of *Ceiba Pentandra* Against *Colletotrichum Coccodes*

James Carlo P. Frias^{1*}, Arce D. Bellere¹, Shiela Mae M. Alforte¹, Rica B. Sarit¹, Jeffrey S. Catubig¹

¹ Central Bicol State University of Agriculture – Sipocot, Philippines

ABSTRACT: This study examined and explored the antimicrobial activity of seeds, fruits, and leaves extract of silk-cotton tree (*Ceiba pentandra*) at 20% and 30% concentration against tomato anthracnose (*Colletotrichum coccodes*). It sought to attain the following objectives: (1) determine the level of effectiveness of seeds, fruits, and leaves extract of silk cotton tree; (2) evaluate the effectiveness of an extract at 20% and 30% concentration against tomato anthracnose; and (3) determine the significant difference in the level of effectiveness of antimicrobial activity of an extract among concentration and period of observation. The data of the study were obtained through an experimental-evaluative method. To analyze the gathered data, statistical treatment used was Analysis of Variance using Completely Randomized Design. Cultivation of *C. coccodes* was based on microscopic characteristics of conidia spores, acervulus, and microsclerotia. The plants were air-dried for two weeks, pulverized and macerated for 48 hours using ethyl acetate. Tomatoes (*Solanum lycopersicum*) to be treated were washed with distilled water mixed of 10% sodium hypochlorite. Seven treatments were prepared in this study. Application of extract was done in different treatments except for control group. Afterwards, 10% solution of *C. coccodes* was applied on all treatments. Tomatoes showing sign of infection were recorded on matrix form of observation for fifteen (15) days. Finding revealed that treatments with plant extracts exhibited antimicrobial activity. However, 20% seed extract was the most effective among other treatments. This signified that the seed extract could be a cheaper substitute for conventional drugs since it is locally abundant.

Keywords: antimicrobial activity, anthracnose, silk-cotton extract.



Decolorization and detoxification of Congo Red azo dye by Immobilized Laccase of *Streptomyces sviveus*

Uma Maheswari Devi Palempalli^{1*}, Bhoodevi Chakravarthi², Vani Mathkala³,

^{1,2,3}, Sri Padmavati Mahila Visvavidyalayam, Tirupati, Andhra Pradesh

ABSTRACT: The discharge of textile effluents enriched with reactive azo dyes is of critical importance due to inability of the dyes to degrade in waste water and their carcinogenic and mutagenic effects to various organisms. This study initiated based on the need to gaze into molecular mechanism of marine bacterial bioremediation process to develop strategies for the decolorization and detoxification of the synthetic azo dyes. The experimental work carried out to explore decolorization and degradation efficacy of laccase derived from marine actinobacteria, *Streptomyces sviveus* by considering Congo red-21 as model azo dye. The extracellular production of laccase was confirmed with plate assay in medium supplemented with ABTS as substrate. Laccase was purified to homogeneity from 72hrs culture of *Streptomyces sviveus* by Fast performance liquid chromatography and the molecular weight of laccase was found to be around 60 kDa. The purified laccase was immobilized with an efficiency of 82% by Calcium alginate method. The crude, purified and immobilized forms of the laccase enzyme were used to decolorize the Congo red-21. Crude laccase enzyme showed 69% of decolorization of Congo red-21 after 48h where as purified and immobilized laccase represented 78% and 92% of colour removal after 24 h respectively. FTIR, HPLC and GC-MS were used to unravel the molecular mechanism of dye detoxification and also identify nontoxic products released from Congo Red-21 upon administration with immobilized laccase. Based on GC-MS data, it may deduce that immobilized laccase of *Streptomyces sviveus* cleaves the Congo red-21 dye molecule through asymmetric cleavage, followed by oxidative cleavage, desulfonation, deamination, demethylation process.

Keywords: Marine bacteria, Reactive Azo dyes, Decolorization, *Streptomyces sviveus*, Immobilized Laccase.



Immobilization of Tannase from *Alternaria alternata* TUSGF1 on chitosan beads

Tapasi Polley¹, Uma Ghosh^{1*}

¹Department of Food Technology and Bio-Chemical Engineering, Jadavpur University, Kolkata, India

ABSTRACT: *The present need of the world's biotechnological industries is improvement in enzyme yield and enhancement of recent techniques designed for escalating their storage life. These requirements are predictable to make easy significant and cost-effective formulation. Enzyme immobilizations give an outstanding base for escalating accessibility of enzyme to the substrate with greater turnover over a substantial phase of time. A number of natural and synthetic supports have been estimate for their efficiency for enzyme immobilization. The current study deals with the potential application of tannase from *Alternaria alternata* TUSGF1 was immobilized on chitosan using glutaraldehyde as a cross linking agent. The immobilized enzyme was active at a higher temperature of 45 °C than the free enzyme 40 °C. The temperature stability and pH stability of the free enzyme were extensively enhanced by the immobilization process. The immobilized enzyme was active even after ten cycles of repeated use. Scanning electron microscope analyzes show the internal dispersal pattern of the tannase immobilization in chitosan beads.*

Keywords: Immobilization; Chitosan; tannase; glutaraldehyde.



Spent coffee grounds: efficient corrosion inhibitor and bioactive components source

Fatima Bouhlal¹, Ghita Amine Benabdellah¹, Mohammed Dalimi¹, Mohammed El Mahi¹, Souad El Hajjaji², Najoua Labjar^{1*}

^{1,2} Mohamed V University, Rabat, Morocco.

ABSTRACT: *The present work introduces the spent coffee ground, the product obtained after the brewing process, as an ignored waste with beneficial abilities.*

*The GC-MS analysis of the hydro alcoholic extract of spent coffee (Arabica and Robusta) grounds revealed the presence of components known with their biological functions, especially antioxidant and antibacterial. Also, the extract was found to be rich in polyphenolic compounds and a great antioxidant potential with an IC50 value ($11.95 \pm 0.96 \mu\text{g/mL}$). In addition, the antibacterial assay showed that all tested bacteria were sensitive against the hydroalcoholic spent coffee grounds extract (HECG), especially *Escherichia coli*. In the other hand, potentiodynamic polarization and electrochemical impedance spectroscopy assays revealed that the hydro alcoholic extract of spent coffee grounds has a great ability to inhibit C38 steel corrosion with an IE value of 97.4% and it acts as a mixed type inhibitor.*

All these results inevitably confirm that “HECG” is a potential source of important bioactive compounds and it’s a great inhibitor against corrosion of C38 steel in 1M HCl medium. This can expand the scope of its application in the industrial environment.

Keywords: *Spent coffee grounds, GC-MS, antioxidant activity, antibacterial activity, corrosion inhibition*



Fortification of tomato powder in dairy products

Srijeeta Saha*¹, Rajarshi Chakraborty²

¹ Guru Nanak Institute of Technology

² Dr.Sudhir Chandra Sur Institute of technology and Sports Complex ,Dum Dum ,Kolkata

ABSTRACT: *The antioxidant activities of two freeze-dried tomato powders as additives for food fortification and stabilization were studied. The two tomato powders were obtained from the whole fruit and from the pulp after “serum” separation, respectively. The antioxidant activity was studied by measuring (a) the inhibition of the singlet oxygen-catalyzed oxidation of α -linolenic acid, in the presence or absence of copper ions, as a model of the oxidative processes occurring in foods, and (b) the inhibition of xanthine oxidase (XOD)- and myeloperoxidase (MPO)-catalyzed reactions and copper-induced lipid per oxidation. The partial separation of “serum” decreased the freeze-drying time by 50%. The partially fractionated tomato powder had a 60% lower phenolic content and 11-fold higher lycopene content than the whole tomato powder, on a dry weight basis. Ascorbic acid was almost completely removed by fractionation. Both the powder obtained from the whole tomato and that obtained from the partially fractionated tomato had antioxidant activity in all the model systems used. Based on these results, we conclude that tomato powders have multifunctional properties, which could address the prevention of oxidative degradations both in foods and in vivo. Therefore, tomato can be regarded as source of food additives for fortification and stabilization, even if it is submitted to technological processes that can cause the loss of the more labile hydrophilic antioxidants.*

Keywords: *Tomato (*Lycopersicon esculentum*); singlet oxygen quenching; free radical scavenging; copper chelation.*



Studies on bioremediation of lead using lead resistant *Acinetobacter* sp 158 immobilized in calcium alginate beads

M. Bose*¹, S. Datta¹, P.Bhattacharya²

¹Jadavpur University, Kolkata

² Heritage Institute of Technology, Kolkata

ABSTRACT: Most of lead compounds have been deliberately introduced to the environment by industrial revolution. It is needless to mention that for environmental safety point of view several remediation techniques are currently being employed for mitigating lead from industrial run off. The present study deals with application of isolated lead resistant bacterium *Acinetobacter* sp 158 for bioremediation of lead in both batch and continuous mode. Experiments have been carried out in two consecutive steps. At the beginning of the investigation dry cells of *Acinetobacter* sp immobilized in sodium alginate beads. Then biosorption of lead has been performed in batch mode. Optimum condition of lead removal has been determined using response surface methodology. In case of continuous mode experiment heterogeneous biocatalyst has been prepared by immobilizing live cell in calcium alginate beads. Then the biocatalyst has been loaded as packing materials into the specially designed packed bed reactor column. A comprehensive experimental study has been carried out to study the reactor performance by varying different parameters viz., flowrate of feed and initial substrate concentration.

Keywords: lead compounds, biosorption, lead resistant bacterium, immobilization, heterogeneous biocatalyst, packed bed bioreactor.



Status of Biomass Utilization from Agricultural Wastes in the Philippines

Aries O. Ativo^{1*}, Lynlei L. Pintor²

¹ Central Bicol State University of Agriculture, Philippines

² Supervising Science Research Specialist, ERDB, Philippines

ABSTRACT: In the Philippines, renewable energy has been introduced in the country in the 70's. Biomass is one of the key renewable energy resources classified into wood-fuel and wood waste, cane trash and bagasse, coconut residues, rice residues, and animal wastes. This undertaking therefore analyzed the secondary data on the production of biomass as a renewable source of energy from agricultural wastes in the Philippines. Results of the study revealed that the country displays high potential for renewable energy production and establishment of biomass power plants despite the fact that only one-third of the total agricultural land is devoted to rice, coconut, and sugarcane. Such potential is attributed to the fact that the country produces sufficient amounts of renewable agricultural wastes such as rice hull, rice straw, coconut husk, coconut shell, coconut fronds, cane bagasse, and cane trash. Findings showed that there are 10 million rice farmers, 3.5 million coconut farmers, and 62,000 sugarcane farmers who produce biomass from these wastes throughout the year. Sugarcane yields the highest biomass per hectare at 29.5 to 31.6 tons/ha while agricultural wastes from coconut yield a higher electrical generation rate per kilogram than that of rice and sugarcane.

Despite the contribution of biomass, the lack of incentives and opportunities and the lack of institutional set-up serve as hindering factors. Moreover, sugarcane was not given utmost importance as the highest source of biomass as far as research and development is concerned. Hence, multi-disciplinary approach in the implementation of research and development, formulation of policies, and well-developed market are recommended



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II. Circular Economy



Management Insights for an Efficient Circular Built-Environment: Determining Factors and Framework Development

Purva Mhatre^{1*}, Vidyadhar Gedam¹, Seema Unnikrishnan¹

¹Centre for Environmental Studies, National Institute of Industrial Engineering, Mumbai, India

ABSTRACT: India, being a developing economy, has ensured sufficient share of gross domestic product be contributed to the development of infrastructure, so as to facilitate the social and economic development of the nation. The increasing number of construction projects lay a huge stress on the available raw materials. Also, the wastes generated during construction, as well as, at the end-of-life of infrastructure projects or buildings are usually disposed off in landfills or on open earth without treatment, causing pollution. The concept of circular economy is known to bring a sustainable approach in construction industry – its facets being repair & maintenance, refurbishment, reuse and recycle. With the onus of repair & maintenance on the users of the buildings or infrastructure projects, the construction industries are majorly is concerned with the refurbishments, reuse or recycle of various construction materials and structural components. In spite of the possibility to reuse or recycle various construction materials, numerous construction firms are reluctant to do so. This research article, using exploratory survey research, analyzes the factors which act as determinants for reuse of construction materials. The respondents for the survey include academia, practitioners, industry experts, as well as policy makers. The research categorizes the identified factors into eight dimensions as drawn from existing literature. The research further gives a framework for determinants of reuse of construction materials based on life-cycle stages of construction. Finally, based on the research, the article also gives policy suggestions for promoting reuse of construction materials.



Potential of Graphene reinforced Geopolymer composites towards Circular Economy and Sustainability

R.S. Krishna^{1,*}, J Mishra², S K Das³, B Nanda⁴, S K Patro⁵, S.M. Mustakim⁶

^{1,3,6} CSIR-Institute of Minerals & Materials Technology, Bhubaneswar, India

^{2,4,5} Veer Surendra Sai University of Technology, Burla, Sambalpur, India

ABSTRACT: Many of today's most utilized structural materials have confinements, particularly concerning their impact on the environment due to which there is always a need for a more advanced eco-friendly material. These construction materials have to showcase enhanced durability and mechanical performance and have to integrate functionalities that would satisfy multiple needs to be suitable for emerging construction applications while supporting sustainable development. Geopolymers are one such novel eco-friendly construction materials which are made up of aluminosilicate industrial waste such fly ash, ground granulated blast furnace slag (GGBFS), ferrochrome ash (FCA), rice husk ash (RHA), silica fume etc. along with an alkaline solution composed of sodium hydroxide and silicates. Implementation of geopolymer composites (GC) can support achieving sustainable waste management leading to accomplishment of a circular economy. The incorporation of nanomaterials in geopolymer composites has been recognized as a feasible technique to enhance its properties. There is a wide consensus in the research community that geopolymer composites which are also called green composites are the next face of construction material industry and have to be engineered at the nanoscale, where its chemical and physio mechanical properties can be truly enhanced. Graphene, a nanomaterial derived from graphite has been proved to enhance various crucial properties when combined with geopolymer composites. This paper discusses the significant benefits of graphene reinforced geopolymer composites while promoting the circular economy. An exclusive review of graphene implementation on geopolymer composites concerning their enhanced properties is provided, which could lead a long way in creating a more smart and sustainable future.

Keywords: Graphene; geopolymer; waste management; nanomaterial; sustainability; circular economy.



Sustainable Waste Management towards Circular Economy in Nigerian Context: Challenges, Prospects and Way Forward

Oluwadare Joshua OYEBODE*

Civil and Environmental Engineering Department, Afe Babalola University, Ado-Ekiti (ABUAD), Ekiti State, Nigeria

ABSTRACT: *Circular economy can be achieved through sustainable waste management; adequate attention to cleaner environment and waste to wealth approach. This paper examined sustainable waste management towards circular economy in Nigerian context. The methodology adopted includes inspection of disposal sites, surveys and data from literatures. There is urgent need for effective waste management in majority of rural and urban centers in Nigeria. Challenges, prospects and way forward were identified for sustainable waste management in the country. Entrepreneurship, recycling system and waste to wealth approach will improve the present situation. It has been concluded that waste management requires adequate attention by all and sundry for achievement of cleaner environment, circular economy and effective waste management. Involvement of government agencies, laws and guidelines for wastes minimization, industries, institutions, building owners, appropriate capacity building, and all stakeholders will yield tremendous rewards.*

Keywords: *Circular Economy, Sustainable Waste Management, Cleaner Environment, Waste to Wealth, Recycling.*



Management insights for Reuse of Materials in a Circular Built-Environment

Purva Mhatre^{1*}, Vidyadhar Gedam¹, Seema Unnikrishnan¹

¹Centre for Environmental Studies, National Institute of Industrial Engineering, Mumbai, India

ABSTRACT: India, being a developing economy, has ensured sufficient share of gross domestic product be contributed to the development of infrastructure, so as to facilitate the social and economic development of the nation. The increasing number of construction projects lay a huge stress on the available raw materials. Also, the wastes generated during construction, as well as, at the end-of-life of infrastructure projects or buildings are usually disposed off in landfills or on open earth without treatment, causing pollution. The concept of circular economy is known to bring a sustainable approach in construction industry – its facets being repair & maintenance, refurbishment, reuse and recycle. With the onus of repair & maintenance on the users of the buildings or infrastructure projects, the construction industries are majorly concerned with the refurbishments, reuse or recycle of various construction materials and structural components. In spite of the possibility to reuse or recycle various construction materials, numerous construction firms are reluctant to do so. This research article, using exploratory survey research, analyzes the factors which act as determinants for reuse of construction materials. The respondents for the survey include academia, practitioners, industry experts, as well as policy makers. The research categorizes the identified factors into eight dimensions as drawn from existing literature. The research further gives a framework for determinants of reuse of construction materials based on life-cycle stages of construction. Finally, based on the research, the article also gives policy suggestions for promoting reuse of construction materials.

Keywords: Circular economy; construction; built-environment; circular built-environment; reuse, factors, framework.



Water Efficiency and Circularity in Industry for Competitiveness and Resilience

René Van Berkel^{1,*}, Zinaida Fadeeva²

¹ Representative, United Nations Industrial Development Organisation, New Delhi, India

² Visiting Professor, Nalanda University, Nalanda, India

ABSTRACT: *Water is the lifeline for man and nature. Even though water, particularly clean water, has become an increasingly scarce commodity, consumers, producers, farmers and others continue to use water without consideration and attention for efficiency and circularity which are pivotal for safeguarding water for the future. In this paper we argue that responsible industrial water use may target the zeroing out of discharges of pollutants with effluents (as a water user) and of the net extractions of clean water from the environment (as a water steward). As a water user, industry can focus on improving water use efficiency, reduction of pollutant generation, improvement of waste water treatment and water recovery. There are already plenty good options to get started becoming waterless with potential for co-benefits in terms of energy savings, productivity and quality improvements, costs savings and safeguarding licence to markets, as we illustrate with practical examples from select enterprises in water intensive sectors like textile, leather, food and paper. Water also needs to be managed beyond firm boundaries, in terms of sourcing less precious water in the first place (such as taking sewerage as input water) and facilitating third party reuse and recycling of treated effluents, in symbiotic manner with other industries, communities, cities and other water users (symbiosis).*

Keywords: *water, waste water, resource efficiency, industrial symbiosis*



Locally Fabricated Technology to Contemplate Circular Economy in Faecal Sludge Management - A Case Study of Technology Maturation and its impact for Bangladesh

Sonia Shahid^{1,*}, Md Abid Hasan¹

¹ General Manager, Practical Action Consulting in Bangladesh

² Assistant Project Officer, Practical Action Consulting in Bangladesh

ABSTRACT: Bangladesh, the country once labelled as ‘bottomless basket’ is the ‘development miracle’ now, has achieved tremendous success in terms of reduction of the practice of open defecation. Ensuring almost zero practice of open defecation, this country has intertwined with another issue. As most of the population uses sanitary toilet at present time, managing the faecal sludge is the new problem for Bangladesh. In that connection, this qualitative paper attempts to analyse the case from five municipalities where the commencement of locally-fabricated technology strengthens the viability of the FSM service and contribute better to ensure circular economy. This case study also underlines why these local innovations are the best fit. After proper treatment, waste becomes asset which can contribute in manifold for a progressive developing country like Bangladesh. Finally, this paper emphasizes the correlation between the technology developed and the importance of human and institutional factors like the SLA, waste workers’ dignity and efficiency, commercialization process of FSM, prioritizing local demand, partnership modalities and policy level activities.

Keywords: Faecal Sludge Management; Circular Economy; Locally-fabricated Technology; Public-private partnership; Human centred design process; FSM policy.



Biomining: A Sustainable Solution for Reclamation of Open Landfills in India

Nabanita Ghosh¹, Dr. Tumpa Hazra^{2,*}, Dr. Anupam Debsarkar³

¹ Project Assistant, Global Change Programme, Jadavpur University, Kolkata, India

² Associate Professor, Civil Engineering Department, Jadavpur University, Kolkata, India

³ Professor, Civil Engineering Department, Jadavpur University, Kolkata, India

ABSTRACT: Statistically, urban India produced around 62 million ton of solid waste (450 gcapita-1day-1) in 2015. Approximately 82% of municipal solid waste (MSW) was collected and only 28% of the collected waste was treated, and the remaining 72% was openly dumped. Open dumping is the popular MSW disposal practice in India due to budget constraints and lack of technological advancement. Open dumpsites are considered a potential threat to environment and human health since they contaminate land and water resources during migration of leachate and create air pollution in terms of release of landfill gases (LFGs) with high percentages of greenhouse gases and thus contribute to climate change. It also consumes valuable land which could be converted into revenue generated assets. In 2011 India needed 380 km² areas for waste disposal which will be 590 km² by 2021. In 2016 the India Government has amended the Solid Waste Management Rules (SWM) for effective and proper management of MSW and reclaim the large old dumps by closure and recommend rehabilitate by a feasible solution in terms of reduction of waste by biomining. Biomining concept is an innovative, environmentally acceptable, economically and practically feasible, and rapid measure to remediate the old open landfill site to successfully bring to zero emission of LFGs and leachate, and also reclaim the land reusability and zero maintenance. In this study the concept and utility of biomining as a key part of sustainable landfill management especially for the rehabilitation of MSW dumpsites in different megacities in India has been discussed.

Keywords: Municipal solid waste, open dumping, environmental pollution, health hazard, biomining, sustainable landfill management, land reclamation, resource recovery, revenue generation.



Job Creation, Entrepreneurship and Capacity Building in Solid Waste Management: Panacea Towards Circular Economy

Oluwadare Joshua OYEBODE*

Civil and Environmental Engineering Department, Afe Babalola University, Ado-Ekiti, (ABUAD), Ekiti State, Nigeria

ABSTRACT: *Circular economy reduces greenhouse gas emissions, mitigates climate change impacts and eradication of environmental pollution in all nations of the world and this can be achievement through entrepreneurship and manpower development. This paper checked the feasibility of creating job opportunities, supporting entrepreneurship and capacity building in waste management agencies towards effective circular economy. The methodology adopted includes surveys, visitation to waste management authority and data from literature reviews. From various findings, it is obvious that job creation, entrepreneurship in waste recycling, environmental ethics and capacity building can serve as a way forward towards cleaner environment and circular economy. Funding and manpower development are major challenges that can be handled by government and private investors. Entrepreneurship, integrated recycling system we enhance waste to health, energy and wealth in developing countries. It has been concluded that circular economy can achieved if adequate attention is given to job creation, entrepreneurship, training of staff and capacity building in waste management sector. Waste management is never a curse but a blessing to developing and developed countries. Effective training, planning, proper job description, performance improvement and adequate motivation are essential in this regard. Circular economy is at the center of the blessing, job creation and sustainability actions. Government should support waste recycling projects and capacity building of workers in waste management agencies.*

Keywords: *Job Creation, Circular Economy, Entrepreneurship, Waste to Health, Capacity Building.*



Indonesia Main Waste Bank for Waste Management Towards Circular Economy

Ratnawati Kusuma Jaya¹ , Sari Viciawati Machdum¹

¹ University of Indonesia, Depok, West Java, Indonesia

ABSTRACT: This article will explain an share the role of main waste bank on solid waste management towards circular economy in Bandung City, Indonesia. The research adopting qualitative methods. The activity includes collecting primary data through in-depth interviews to 15 national and regional stakeholders and observed the role of main waste bank, Resik Waste Bank, in Bandung City Indonesia. The role of main waste bank for sustainable waste management towards circular economy is still weak. This paper examines that the main role of waste bank was not optimal for its unorganized and synergised policy and social supports. Main waste bank in Bandung City contributing approximately 0.625% on waste handling and reduction to the final landfills. It was classified as low. However, main waste bank is said to have contributed to making better social relations, economy welfare, and waste shifting paradigm. Overall, this means that Indonesia government has to put more attention to main waste bank policies and creating sufficient systems in order to support to maintain the sustainability of waste bank units. This paper examine the role of main waste bank in sustainable waste management towards circular economy through the contribution of main waste bank in responding the national target on waste reduction and waste handling in 2025, the role of main waste bank on empowering the waste bank units through circular economy paradigm and the impact of main waste bank on waste perception, economic welfare, and social relations.

Keywords: Solid waste management, Sustainability, Circular Economy, Governance, Waste bank



Circular Economy / Value Recovery / Enhanced Life Cycle – Today’s Solution to Sustainable Waste Management

M Rao Divi*,

Divi’s Laboratories Limited

ABSTRACT: Waste management is increasingly becoming a crucial challenge for mankind. The general conception of people on waste is that “It is an unwanted material derived from processes or activities which can no longer be utilised in an Economical manner and dealt through Waste Management”. The thought process on waste has to be changed i.e., “Consider Waste as a Valuable Resource”. Keeping in mind that resources are exhaustible - a new Design (thinking) for extracting the hidden value (Value Recovery) in the waste need to be adopted. Sustainable development and Circular Economy (CE) today calls for efficient system where reduction of waste and resources become the main focus. Minimisation of resources is possible only when “Resource Life cycle is extended” from single use to several uses. Reduce, Reuse, Recycle (3R) have become the necessity of the day.

This paper highlights the concepts of Value Recovery Management (VRM) at Divi’s Laboratories Limited (Divis) that are implemented, deriving the benefits like Value Addition, Life cycle enhancement, minimisation of resources, and in effect promote of circular economy.

Divis considers waste as a Valuable Resource and abides by the strategy of VRM – a holistic method involving the Circular approach and distancing from the “Take – Make – Use – Dispose” cycle (Linear approach). At Divis, the normal 3R approach is extended to 12R. Realising that value recovery management and circular economy play major roles in environmental degradation, resource depletion, enhance resource efficiency, energy conservation, over and above, creating opportunities to others, the company diligently applies it in numerous ways for various processes and activities while maintaining the original quality level. To put it another way, a specific “Hierarchy” in value recovery plays a prominent role in determining the amount of value generated from By-products, a euphemism for waste. This paper explains some of the Sustainable practices that are followed and several of the projects very successfully implemented in the organisation towards circular economy, apart from elaborating the strategy in creating value to quite a few agencies (Partnership for Green – P4G). Only a fraction of the resource that is not worthwhile for the company and other industries is considered as the Real Waste and it is disposed off in a safe and secure manner.

Keywords: Valuable Resource, Value Recovery, Circular Economy, Life cycle, Linear approach, Hierarchy, By-products, Partnership for Green, Real waste



Review On Recent Methodology Towards Epoxy Removal From E-Waste PCBs

Balaji R.^{1*}, Prabhakaran D.², Thirumarimurugan M.³,

^{1,2,3}, Coimbatore Institute of Technology, Coimbatore, Tamil Nadu, India

ABSTRACT: Each and every nation faces a danger towards draining renewable energy source. On one hand because of continuous substitution of electronic gadgets, for example, cell phones, laptops and its supporting accessories, the need or interest for the regular energy sources like metals, noble and rare earth metals continues expanding. On other hand, this urban mining from e-waste and furthermore from its Printed Circuit Boards (PCBs) could be an alternate for this expanding request. This urban mining helps in recuperation of oils, metals, metal combinations, noble metals, rare earth metals, metal Nanoparticles and carbon forms from e-waste. E-waste comprises of wires, Plastics, Glass, Ceramics, Rubbers and PCBs. Still gaps have been identified in urban mining for the metal recovery process. A few methods are effective in recycling yet it prompts contamination in different modes of the environment. To lessen contamination and harmfulness in climate, the epoxy resins over the PCBs must be stripped prior to using it for the metal recovery process. This paper helps in understanding the ongoing strategies and methods embraced in taking the epoxy from waste Printed Circuit Boards. It likewise helps in distinguishing the difficulties, limitations, environmental impacts, health impacts, social benefits as well as economic benefits in removing the epoxy resin from e-waste Printed Circuit Boards.

Keywords: Electronic waste (e-waste), Waste Printed Circuit Boards, Epoxy removal, Urban Mining



Upcycling Of Scraps From Industries – A New Dimension Of Circular Economy

Mohanty Rupashree^{1*}, Srikanta Patnaik²,

¹Jhadeswar Institute of Engineering and Technology, Balasore

²I.I.M.T, Bhubaneswar

ABSTRACT: Scrap generated by the industries everyday is a threat to the environment. It creates greenhouse effect, reduces fertility of the soil if mixed into it, causes water and soil pollution. It has distinct influence in the varying temperature of the earth.

In less than three decades we may need a land of the size of Delhi just to get rid of waste generated by the industries. The challenges in the industry faces today are the management of waste, up cycling and creating economy out of it.

Up cycling of scraps generated by the industries is a front line environmental challenge. Around 20ton scraps in Balasore Industrial area are generated from a general manufacturing industries every month Those scraps are collected and stored. By the process of recycling 60% of it is utilized successfully. Do recycle finished products are the only answer to the biggest challenges of scrap disposal.

We can also generate a handsome amount from this. We can create interior decorative pieces, toys and so many things depending upon the material. It creates a wonderful opportunity for the entrepreneurs of low investment and get maximum profit out of it. By this we can also enhance the creativity and the skill of our youth.



Advocating Circular Economy: Pili (*Canarium Ovatum*) Pulp Oil Isolation As Igp For Pili Processing Households In The Bicol Region Philippines

Ramona Isabel S Ramirez*

Professor, Central Bicol State University of Agriculture

ABSTRACT: *The undertaking is a research cum extension project that includes development of an alternative protocol for isolating oil from pili (*Canarium ovatum*) and disseminating the technology to the community for adoption by pili processing households.*

Alternative protocol for isolating oil from the would be wastes pulp in the processing of pili kernels was developed from the existing protocol such as the traditional method, DOST recommended method and the enzymatic extraction. Determining an alternative oil isolation protocol was conducted employing description matrix analysis based on the features for each protocol noted until the RPOIM (Ramirez Pili Oil Isolation Method), a house-hold based pili oil isolation method was developed.

RPOIM is consist of three major processes such as extraction and fractionation; oil isolation and oil recovery. Fermentation of pulp for 1-2 days after mechanized mixing and after extraction is a distinct feature of developed method. It was pilot tested using pili pulp samples from Bicol pili varieties obtained from the Department of Agriculture ROV. Results confirmed the presence of oil in pili pulp. It likewise revealed potential of the RPOIM as alternative protocol to be used in pili pulp oil isolation.

Dissemination of the technology was done through radio broadcast and Facebook live. Information on the isolation protocol and pili oil value adding and entrepreneurial initiatives were given as part of the project extension to promote economic empowerment among the pili processing households in the Region.

Keywords: *Pili (*Canarium ovatum*) pulp, pili oil, oil isolation protocol, circular economy*



Circular Economy in the Electronics and Cell Phones Industry: International practices and recommendations for Mexico

Yesenia Chavana-Castro¹, Ismael Aguilar-Barajas^{2,*}

¹Independent Consultant, MEXICO

²Tecnológico de Monterrey, MEXICO

ABSTRACT: *This paper presents an updated theoretical and international empirical discussion about circular economy, with special reference to Mexico, as a framework for a proposal to advance circularity in the electronics and cell-phone industry. More specifically, this research is based on an analysis of recent international patterns of generation and management of electronic and cell phone wastes. The purpose of this is to identify opportunities for and limitations of the country in this direction. Special emphasis is given to the avenue of circular economy by design, which represents not only a relatively new paradigm but also offers a wide range of business opportunities. We found a real need for more conceptual and empirical work, such as the elaboration of a more integral metric for circularity. This paper concludes with policy recommendations that could be of value not only for Mexico but for other latitudes as well.*



A Call for a Fashion Pact: Challenges and Opportunities for Circular Economy in the Brazilian Fashion Industry

Ana Fábria Ribas de Oliveira Ferraz Martins¹, Angela Cassia Costadello², Yasmin Pires Wolff³, Stella Maris da Cruz Bezerra^{4,*}

¹ Attorney-at-Law, Martins & Azeredo Law Firm, Curitiba, Brazil

² Professor and Attorney-at-Law, Law School, Federal University of Paraná, Curitiba, Brazil

³ Student, School of Architecture and Urbanism, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil

⁴ Professor, School of Architecture and Urbanism, Federal University of Technology-Paraná, Curitiba, Brazil

ABSTRACT: *The fashion industry comprises processes from manufacturing to retailing of a variety of products, such as clothes, shoes, and accessories. This multibillion-dollar global enterprise, in the last 20 years, has shown a significant change towards the model of just-in-time production, consolidating the concept of fast fashion. This results in higher production, lower costs, and more competitive prices, although less aligned with concepts of sustainable development. One of the challenges is the generation of higher volumes of solid waste, not always managed sustainably. This article focuses on the investigation of how the industry for clothes production in Brazil is dealing with its solid waste generation and management, from manufacturing to retail. The approach is an analysis if the legal instruments presented by the Brazilian National Solid Waste Management Policy are effectively contributing towards implementing the circular economy in this industry. Results show that although Brazil is provided with a very modern and comprehensive legislation regarding solid waste management, the Brazilian textile industry lacks a logistical project for allowing the circular economy in its full capacity. This scenario leads to some Brazilian recycling industries importing textile waste from other countries to supply their units with raw material, since the imported bales enter the country properly separated and classified. Therefore, compliance with the Brazilian policy need to be improved in order to insert our own textile solid wastes back into the production, effectively towards the circular economy. One possibility is the call for a fashion pact among stakeholders as discussed in this paper.*

Keywords: *Brazilian policies; Circular economy; Compliance; Fast fashion; Fashion industry.*



Towards a Circular Economy: A Sustainable Solid Waste Management System for Airports

BUPE .G. MWANZA*

University of Zambia, Graduate School of Business, Zambia

ABSTRACT: Achievement of a circular economy cannot isolate creation of sustainable systems for managing solid wastes (SWs). With the continuous increase in urbanization and globalization, the air transport industry has had a substantial increase in the number of flights across the global. The rapid increase in the air transport has contributed to the increase in the amount of SWs generated at airports. A formulative research was conducted to assess the current waste management systems at a local airport in Zambia. The study focused on designing a sustainable solid waste management (SSWM) system that can contribute to achieving a circular economy. Stakeholders relevant to participate in the study were identified and a structured approach of collecting information was implemented. The findings from the study revealed that the airport does not have a sustainable system for managing SWs. Based on the findings, a sustainable system has been recommended for implementation. The research findings are relevant to stakeholders in the waste management, manufacturing and policy-making sectors. The proposed system provides a roadmap for achieving a circular economy in the amidst of urbanisation and globalisation.

Keywords: Airports, circular economy, solid wastes, sustainability, globalization.



Strategies for Transition towards Circular Economy in Municipal Solid Waste Management System in India

Sarwani Budarayavalasa^{1*} and Richa Singh¹

¹Environmental Science and Engineering Department, Indian Institute of Technology Bombay, Powai, Mumbai.

ABSTRACT: *The sustainable management of solid waste has been a challenging task for developed as well as developing nations. Due to the Government of India's continuous efforts, the Municipalities and the Urban Local Bodies (ULBs) are now encouraged to manage the waste more effectively. However, the growing population and urbanization potentially contribute to a high quantum of municipal solid waste, causing long-term environmental and socio-economic concerns and making management even more difficult. In this contest, there is an urgent need to adopt circular economy strategies to reduce waste generation and manage the generated waste more sustainably and economically. The present paper attempts to discuss the circular economy strategies adopted by various nations and presents the potential strategies for achieving sustainable waste management practices through circular economy principles in India.*

Keywords: *Circular Economy, Municipal Solid Waste Management, Policies, 7Rs' strategies, Waste Management.*



Corporate Environmental Responsibility as an Important Aspect of Circular Economy

Ipatova D.A.*

National Research University "Higher School of Economics", Saint-Petersburg, Russia

ABSTRACT: *The ideas of circular economy are widely accepted around the world at the governmental level. In China legislative authorities involved now in developing laws related to circular economy principles, in the South Korea the Green Growth Strategy is adopted and Japan is building "Material cycle society". European Commission and Council are discussing implementation of advanced circular economy programs. In Russia it's still no legislation directly regulating this process, but some legislative acts could be considered as indirect attribution to the legislative framework for the circular economy. First of all, this refers to the sphere of waste management.*

To make the ideas of circular economy more viable, they need to be supported at the corporate level. In 2018 more than 40 partners signed the agreement to use Platform for Accelerating the Circular Economy (PACE), and such corporations as Coca-Cola and IKEA became the members. But some aspects should be developed to stimulate local Russian companies widely use the circular economy principles.

The need for adequate measurements of companies' involvement in carrying out responsibilities for environmental and social issues lead to the development of related systems, methods and instruments. By our opinion, along with CSR, it is important to introduce the concept of corporate environmental responsibility (CER).

The research question is how the CER influences of the distribution of the circular economy. The goal of the research is to underline the dependency between circular economy and CER. The methods of research conducting are the secondary data collection and the analysis, analogy and modeling.

It is reasonable to evaluate the same way, as CSR, the environmental responsibility. CER in this case will include the companies' fulfillment of environmental obligations prescribed by law, and their readiness to implement principles of circular economy. Also, CER will include the willingness to voluntarily bear extra expenses for environmental needs beyond the limits established by state environmental legislation. For example, expenses within the investment projects on involvement of industrial waste in the production cycle as material or energy resources. Russian companies are able to choose what elements of CER they are going to use and there is no unified standards for all the companies.

Keywords: *circular economy, corporate environmental responsibility (CER), company, environmental obligation, material and energy resource.*



Life Cycle Analysis – An Analysis Of Input, Output And Power Consumption For Small Scale Compressed Stabilized Soil Block Production

Mohamed Suhail Thayyil 1,*, Dr. Renu Pawels 2, K. Anagha Venugopal 3

¹ Research Scholar, School of Engineering, Cochin University of Science and Technology

² School of Engineering, Cochin University of Science and Technology, Kochi

³ M.Tech Scholar, MES College of Engineering

ABSTRACT: Unfired, hydraulically compressed Stabilized Soil Blocks (SSB) manufactured using natural binders are supposed to be a sustainable option compared to the conventional fired fly ash bricks. The production of these stabilized blocks involves a series of processes – from the raw material extraction to the end-of-life stage. From the initial phase, manual power is utilised for the digging or spading of soil to its sacking, loading and unloading. Followed by electricity requirement for steps like oven drying of the soil mixes during preparatory stages. The fuel requirement in the transportation stage and the machine power requirement subsequently for manufacturing and testing also needs to be regarded. The development of the final product of stabilized soil blocks in a small scale, is the aftermath of a number of such steps. There is power spent on each of them and the calculation of the same for SSB manufacturing is carried out in units of Watts. The cradle to grave analysis of stabilized soil blocks are thoughtfully significant for its detailed analysis of inputs and outputs. Also, the investigation is supposed to upscale the use of these blocks, an environmentally friendly solution in construction. Potential evaluation of the block in various levels as part of LCA (Life Cycle Analysis) drives the study

Keywords:



Red mud based geopolymer concrete for sustainable waste management: A review

Nikita Barik^{1*}, Jyotirmoy Mishra¹

¹ Bhubaneswar, Odisha, India

ABSTRACT: Sustainable waste management is essential so that every bit of waste can be managed in a structured manner, and the waste created is kept to a minimum. Thanks to the growing infrastructure call in the country, which is an excellent scope for the development of geopolymer concrete. Geopolymer Concrete is produced by copolymerization of aluminosilicate materials with alkaline solutions that exhibit higher mechanical strength and superior durability properties in comparison to traditional cement-based concrete, leading to a reduction in the greenhouse gas emissions at even lower operating costs. Presently there are several aluminosilicate industrial wastes such as fly ash, ground granulated blast furnace slag (GGBFS), metakaolin, red mud (RM) etc. which can be used as source materials for geopolymer concrete production. This paper carries out a thorough review of past research works based on red mud which is the tailings generated from the alumina refining industry and is considered hazardous due to its high alkalinity. Red mud contains a significant amount of aluminium, silicon and iron oxides which are considered to be beneficial for geopolymerization while its large-scale recycling will result in realizing sustainability goals. The rapid utilization of red mud in the production of geopolymer concrete is highly anticipated in the near future. The paper outlines the mechanical and durability properties of red mud-based geopolymer concrete from past literature which will provide a technical framework for conducting future experimental works.

Keywords: geopolymer concrete; waste management; industrial waste; red mud; strength development.



Bio-Utilization Of Agri And House Hold Waste In Solid State Fermentative Production Of Anti-Cancer Enzyme

M.Bhargavi ^{1*}, R. Jaya madhuri ¹

¹ Sri Padmavati Mahila Visvavidyalayam, Tirupati

ABSTRACT: *L-asparaginase is an essential enzyme used in the pharmaceutical and food manufacturing industry, which can be produced by different microorganisms using low cost feedstock through fermentative production. A variety of fermentation parameters like types of agro material used as carbon source, particle size, solid substrate concentration, inoculum level, moisture content, temperature and incubation period which influence the rate of enzyme production under Solid State fermentation (SSF) were optimized. Different substrates was used in the present study such as brans of wheat, bajra, black gram, green gram.; oil cakes of coconut, groundnut, cotton, sunflower; Molasses; Mixture, tea waste and ground nut shell powder. The maximum yield of L-asparaginase (33.9 U/ml) was achieved with the following optimized fermentation parameters: Solid substrate (sun flower oil cake) concentration (5gms), particle size (3mm), inoculums concentration (1ml of 3 day old fungal culture), moisture content (50%v/w), alkaline pH 9.0, temperature (37°C), and incubation period (96 hrs). These results indicate that the marine fungal BKJM2 strain utilized Sun flower oil cake for the production of L-asparaginase.*

Keywords: *L-Asparaginase, Fungal culture, Solid state fermentation, Sun flower oil cake and Agri-house hold waste material.*



Mycelial Growth Performance of Paddy Straw Mushroom (*Volvariella volvacea*) in Banana Wastes

Maria Shiena Beri^{1*}, Aldhem N. Aldave², Elizabeth Q. Cabrera³, Tom A. Rodriguez⁴, Cristine B. Besmonte⁵, Kenneth Niel B. Abergos⁶ and Arce D. Bellere⁷

¹⁻⁷Central Bicol State University of Agriculture, Sipocot, Camarines Sur, 4408, Philippines

ABSTRACT: *Saba banana (Musa balbasiana)* is a nutritious and the most popular banana in Philippine market. Once utilized, its fruit generates huge amount of agricultural waste. On the other hand, paddy straw mushroom (*Volvariella volvacea*) was known as the third most cultivated mushroom in the world due to its nutrients and pleasant flavor. This study aimed to determine the paddy straw mushroom mycelial production in banana (peeling, leaves and pseudo stem) wastes media. Banana wastes media were obtained by decocting banana parts in one liter and 500 ml of tap water to produce 50% and 100% concentrations of decoction and adding 20 g of white gulaman bar and 10 g of white table sugar until homologous solution were attained; pH was adjusted into pH 8 using NaOH and HCl. For sterilization, the media was autoclaved for 20 min at 121°C at 15 psi. Completely Randomized Design was the statistical design used. At an average temperature of 28.6°C and 74.77% relative humidity, paddy straw mushroom showed the highest mycelial run in T4-Banana Leaves 50% compared to other banana wastes media. The T2-Banana Peel 50% and T3-Banana Peel 100% had the thickest (+++) mycelia among all evaluated media. T4-Banana Leaves 50% was recorded with the shortest period of ramification within 3 days and was considered as the ideal culture media for paddy straw mushroom among banana wastes media since the faster the mycelial grows, the quicker the mushroom production.

Keywords: *Volvariella volvacea*, *Musa balbasiana*, mycelial growth performance, mycelial density.



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III. Climate Change & Environmental Protection



Economics of Nutrient Filtering Service of Mangrove Ecosystem of Karnataka, India

Balamurugan, S.*, Muthukrishnan, L., Karthi, N., Niruban Chakkaravarthy, D., Yoganandhi, A., Asir Ramesh, D.

Integrated Social Sciences and Economics Division, National Centre for Sustainable Coastal Management, Chennai, India

ABSTRACT: *Mangrove ecosystem provides to the dependent coastal community various services which are categorised as provisioning, regulating and cultural services by System of Environmental Economic Accounting Framework (SEEA- CF – 2012) for the purpose of incorporating the values of environmental goods and services to national accounting structure. Protection from natural hazards and calamities, aiding wastewater treatment through nutrient filtering and carbon sequestration are the important regulation services provided by the mangroves. A study was conducted on mangroves of Karnataka coastal stretch to estimate the economic benefit from mangroves with special reference to nutrient filtering from wastewater runoff as a regulation service. The InVEST's nutrient delivery ratio model has helped to predict that mangroves with 70–80% of retention capacity, accumulates 17 - 40 kg of nitrogen/ha/yr and 7 - 13 kg of phosphorous/ha/yr. The InVEST model output also quantified that 41.94 tonne/yr nutrient load has been retained/utilised by the mangroves of Karnataka, thereby improving the quality of water for aquatic life and fisheries. The economic value of nutrient filtering service of mangroves is estimated at US\$ 249.3/ha/yr by applying replacement cost method.*

Keywords: *Mangroves, Nutrient retention, Water quality maintenance, Economic valuation, Environmental sustainability.*



Carbon Neutral Farming: Pathway for Climate Change Mitigation

Dineshkumar M ^{1*}, Vijay Nepolean A ¹, Bharani Priya A ¹

¹ Centre for Rural Energy, Gandhigram Rural Institute Deemed to be University, Gandhigram, Tamil Nadu

ABSTRACT: The increasing population and their growing needs lead to devastating impacts on nature, resulting in climate change and global warming. This global warming generally occurs due to an increase in the level of greenhouse gases such as carbon dioxide(CO₂), water vapor(H₂O), methane(CH₄), nitrous oxide(N₂), chlorofluorocarbons(CFC) in the atmosphere. These gases generally trap the sun's reflected beam from the earth's surface and retrieve it back to the planet, leading to an increase in world average temperature, which may harm people, animals, plants, and the environment. India, which is the second-largest populated country contributing about 6.55% of global greenhouse gas emission (GHG), which is nearly equal to 3,202 million metric tons of carbon dioxide per year, and the contributing sectors are energy (68.7%), agriculture (19.6%), industrial processes (6.0%), forestry (3.8%) and from waste (1.9%). The above data signifies that the agriculture sector acts as a source for GHG emission, followed by the energy sector. Even though the plants grown in these farmlands can consume the GHG and trap them in their life form as energy. They still couldn't absorb the excess GHGs produced due to anthropogenic activities carried out in the land. This paper attempts to make this agriculture sector a carbon-free sector by adopting farming practices such as manure management, soil conservation by reduced tillage practices, optimizing irrigation practices, fuel management through renewable energy sources, and crop cover management. By doing so, we can reduce the carbon footprint in the agriculture sector, and it will also bring the farmers a passive source of income for being a part of a carbon-neutral initiative.

Keywords: climate change, global warming, greenhouse gas, carbon footprint, carbon neutral initiative.



Aquatic Biodiversity Status : The Dolphin as Natural Indicator Sucharita Bhattacharyya*

Guru Nanak Institute of Technology, Sodepur, Panihati, Kolkata

ABSTRACT: Biodiversity measures in general the variations of life in different ecosystems on earth. Because of rich biodiversity, a healthy aquatic ecosystem is a subject matter of interest for many years. But the change of climate, due to some natural as well as man-made factors, like residential, agricultural, and industrial runoff emit increased greenhouse gases in the atmosphere. These results in global warming, accelerating the melting of ice at the earth's poles and rising in sea levels which affects the habitats of several species, more prominently of aquatic animals. To survive, the species either have to adapt or migrate to areas with more favourable conditions. At this point, as an ecology indicator, one can highlight the act of the Dolphin, one of the top-level predators of aquatic food-chain to maintain balance in its environment. With a natural hydrodynamical body system, it can identify the decrease in oxygen levels in its surroundings and thus leave the place to indicate the so-called dead zone for fish and other marine animals. Dolphin's SONAR system for its underwater communication as well as navigation, is an example of natural communication technology. Aquatic noise pollution affects both of these activities indicating danger and so ocean noise is linked to loss of habitat for the Dolphin and its neighbours. Injured Dolphins signal about illegal hunting, attempted capture or fishing activities. Presence of marine debris, particularly the plastics also affect the biodiversity largely. So reappearance of the Dolphin species in numbers during COVID-19 lockdown clearly indicates the status of pollution in the hydrosphere including both freshwater rivers as well as oceans.



A Study on the Annual and Seasonal Variation of the Air Quality index of NCR-Delhi

Baishali Chakraborty^{1,*}, Srimanta Ray^{2,*}

¹ Civil Engineering Department, National Institute of Technology, Agartala, Tripura, India.

² Chemical Engineering Department, National Institute of Technology, Agartala, Tripura, India

ABSTRACT: *The study reports of the annual and seasonal variation of air quality index (AQI) in NCR-Delhi for a period of 5 years (2015-2020) based on daily average concentration data of criteria air pollutants. The AQI was determined based on the measurements for the three monitoring sites in NCR-Delhi. For in depth study of trend for the study areas the maximum value of sub-indices (of each pollutant) is taken as the overall AQI. The mathematical functions for calculating sub-indices are proposed based on health criteria of the established air quality standards. From the data collected for Delhi it has been observed that increase in traffic density seems to have resulted into the worst air quality in the city. Over the period of study, the AQI has shifted towards the worst from winter to summer season. These change for worst AQI from winter to summer may also be likely due to increase in photochemical reactions Several key factors change in emission due to CNG implementation, shift to LPG in domestic sector can be well correlated. An attempt has been made to quantify the reasons that lead to the changes in the values of the AQI. The study showed the significance of traffic control and city planning on the control of AQI. However, the research is limited to available data of the AQI Delhi for the period of the study. AQI is linked with health issues, therefore the variation of AQI can be well correlated with the reported health consequences.*

Keywords: *Air pollution, air quality index, annual variation, seasonal effect, trend analysis.*



Techno-economic and life-cycle assessments of small-scale biorefineries for butyric acid, isobutanol and isobutene production

Andrés Suazo^{1,*}, Fidel Tapia¹, Germán Aroca¹, Julián Quintero²

¹ School of Biochemical Engineering, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile

² Department of Chemical Engineering, Universidad de Santiago de Chile, Santiago, Chile

ABSTRACT: *This work presents a comparative simulation study involving the techno-economic and environmental assessment of lignocellulosic-based small-scale biorefineries, integrated with a piggery waste-based anaerobic digestion platform located in La Araucanía, Chile.*

A main product is obtained for each case: butyric-acid (BA), isobutanol (I-BOH) or isobutene (I-BE), meanwhile the byproduct obtained is stabilized sludge. The bioproduction of BA, I-BOH or I-BE using a genetically engineered organism; Clostridium tyrobutyricum, Saccharomyces cerevisiae or Escherichia coli, respectively, coupled with a cogeneration system using xylo-oligosaccharides and lignin, obtained after a feedstock hydrothermal pre-treatment and enzymatic hydrolysis, was evaluated. The lignocellulosic agricultural waste selected was wheat straw for all scenarios. All processes were simulated and economically evaluated using the AspenPlus v10.0 simulation software. The simulation results were validated with experimental data from the literature. A cradle-to-gate life-cycle assessments (LCA) was also applied to evaluate the differences between environmental impacts for each case.

The results showed that the BA, I-BOH and I-BE biorefineries were economically viable in Chile. The biorefinery has lower production costs for I-BOH (0.83 US\$/kg), then BA (0.92 US\$/kg), meanwhile the highest was for I-BE (1.14 US\$/kg). Conversely, I-BOH biorefinery leads to more environmental impacts than the other study cases. Climate Change (CC) impact were in range of 196 - 198 kgCO₂eq/ton wheat straw for all cases, which means similar climate change impact.

This study provides positive projections on the development of biorefineries for Chile that could also propose solutions to agroindustrial-waste handling, in order to achieve a process design based on circular economy framework.

Keywords: *integrated biorefineries, butyric acid, isobutanol, isobutene, life-cycle assessment, lignocellulosic biomass, circular economy.*



Estimation Of Particulate Matter Pollution On Different Major Roadways In Khulna Using Geospatial & Environmental Analysis

Prottay Mazumder*¹, Jobaer Ahmed Saju², and Q. H. Bari³

¹Khulna University of Engineering & Technology, Khulna, Bangladesh

²European University of Bangladesh, Dhaka

ABSTRACT: Emissions of an unseen mixture of solid particles and liquid droplets known as Particulate matter (PM) are causing health difficulties and visibility problems while travelling around major roads in Bangladesh. Different previous studies presented that particulate matter concentration tends to surpass the restricted values in many significant roads of Khulna City in Bangladesh. Therefore, the proper evaluation of particulate matter concentration in concerned areas has become very crucial for the risk assessment of human health. The concentration of PM varies in between seasons and site to site. Wind velocity, direction, and census area density play a vital role in alternating values for an analogous point location. In this research, various observation sites of Khulna City are divided into several zones for every source point. The average concentration of PM less than 10 micrometers (PM₁₀) for specific sites are estimated using the relationship between GIS spatial analysis and Digital elevation model (DEM). The statistical assessment was performed for different mean concentrations of PM₁₀ regarding seven selected road sites. The observed seasonal mean values of PM₁₀ were used to predict future values. The predicted PM₁₀ values found 120 µg/m³, 170 µg/m³, 155 µg/m³, 108 µg/m³, 90 µg/m³, 222 µg/m³, 133 µg/m³ respectfully for Phultola, Fulbari-gate, Khalishpur, New-market, Dak-Bangla, Shonadanga, Rupsha point. The correlation coefficient ($r^2=0.82$) and the relative percentile error 5.38%-10.38% are found comparing to all observed road-site PM₁₀ values. The ascending PM₁₀ values are detected due to the high volume of traffic. The outcome of this research proves that the GIS applied spatial analysis with DEM acted well in estimating different seasonal variation of PM₁₀ concentration. This study makes a generous contribution to understanding the sources of PM₁₀ around significant roads of Khulna City and estimating for missing values. It requires further research to test concentration predictions in greater detail and to analyze uncertainties.

Keywords: Particulate Matter; Spatial Analysis; GIS; Digital Elevation Model (DEM); Air pollution.



Consideration climate change in the protection of the Environment in Georgia

Liana Kartvelishvil^{*1}, Lashari Kurdashvili¹

¹ National Environmental Agency of Georgia

ABSTRACT: *The natural fluctuations of the climate are amplified by the anthropogenic activity causing global change in the atmosphere. This has a significant negative impact on the composition of natural and regulated ecosystems, the functioning of socio-economic systems.*

One of the most pressing issues facing humanity is climate change, to which UN summits are periodically dedicated. Our country has been actively involved in the implementation of the UN Framework Convention on Climate Change since 1996. Studies on climate change are reflected in ongoing national communications to the Climate Change Convention.

The expected climate change may have significant influence as from ecological as well as from material point of view on different natural ecosystems and also on the development of the most branches of economy.

Climate indexes are used for the assessment of environmental and recreation resources.

Complex Climate Index was accepted by World Meteorological Organization. The climate indexes represent complex of different weather elements and well describe combined effect of their values.

We have assessed the impact climate change on the environmental area for Georgia. According of this method was defined the variety between two periods.

Keywords: *Environment Protection, Climate change, Complex Climate index.2e.*



Highly Cost-effective Cryogenic Capture of Industrial Emissions for Clean Energy-Environment

Sadhan K Ghosh^{1,*}, Idowu Oduniyi²

¹ Professor, Jadavpur University, Kolkata, India,

² Icaland Global Services Limited, Ogun State, Nigeria

ABSTRACT: In this paper we disclose very briefly, for the first time, methods of our newly invented state-of-the-art cryogenic technology for the most cost-effective and energy efficient capture of each known component of entire emissions (nearly 100%) such as carbon dioxide (CO₂), sulfur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), any other acid vapor, mercury, steam from industrial plants (coal and natural gas fired power plants, cement plants etc.), in a liquefied or frozen/solidified form, such that each of the components is captured separately and is industrially useful. This new technology includes a novel NH₃ power plant to generate auxiliary electrical power from the heat energy of the flue gas to further improve the energy efficiency and cost effectiveness of the capture processes. It uses turbine expansion to cool N₂ gas of the flue gas to temperature ~-194 C, which is used to cool the incoming flue gas under pressure. The turbine expansion work is utilized to drive some of the compressor pumps and thus to reduce the net energy expenditure to 235 MJ or \$8 per ton of CO₂ avoided from coal power plant and nearly zero per ton of CO₂ avoided from natural gas power plant. For natural gas plant the technology turns out to be profitable at -234 MJ per ton of CO₂ avoided. It is the most cost effective of all existing emission capture technologies. It does not require use of any chemicals/reagents/external cryogenics, unlike the current technologies. It uses only a fixed amount of water needed for the cooling process which can be used repeatedly. It does not need any chemical/reagent for the said capture.

Keywords: Cryogenic technology; most cost-effective; energy efficient; carbon capture; toxic components; auxiliary energy generation; turbine expansion work; cold N₂ gas.



A Study on Theories of Plasticity and their Applicability to Soils under Environmental Engineering

Maaz Allah Khan^{1,*}, Syed Tabin Rushad²

¹ PhD Research Scholar, Department of Civil Engineering, Maharishi University of Information Technology, Lucknow, India

² Asstt. Prof. & Co-Supervisor, Department of Civil Engineering, Birla Institute of Technology, Mesra (Patna Campus) Patna, India

ABSTRACT: A survey of the sorts of rate autonomous speculations for soils is given, along with a more nitty gritty review of pliancy speculations. The commitments of particulate mechanics are quickly summed up. The rest of the paper is partitioned into two sections, managing individually with a hypothetical and trial investigation of the relevance of pliancy hypothesis to soils. Some extra data is surrendered Addendums. The material for trial study is portrayed, and the sorts of test for the materialness of versatility hypothesis talked about. An examination of the impact of pressure and of stress history on a thick sand in triaxle pressure, program of pressure cycle tests, LS plot. A PC controlled triaxle machine essential for the tests is portrayed, with subtleties of the data logging and control framework also, the example readiness system. The strategy for examination for the tests is given, including a technique for fitting versatile and plastic properties to the information. The consequences of the tests are introduced. The flexible properties are anisotropic and. rely upon pressure and stress history. The plastic properties are unequivocally history subordinate, and critical optional plastic strains on emptying were watched. At long last a few ends from both the hypothetical and trial work are drawn together and a few themes for future work recommended. The utilization of the thermomechanical approach in portraying soils is underscored.

Keywords: Soil Testing, Environmental Effects on Soil.



Air Purification Unit for Fecal Sludge Emptying to Protect the Operators and the Neighborhood from Toxic Gas Exposure – A Conceptual Design Approach

Sajib Kar¹, Tanweer Ahmed¹, A. F. Abrar Ibn Monabbar¹, Nur Alam Mondal^{1,*}, Md Abid Hasan²

¹ Hajee Mohammad Danesh Science & Technology University, Dinajpur, Bangladesh

² Assistant Project Officer, Practical Action Consulting in Bangladesh

ABSTRACT: As Bangladesh is at present undergoing a rapid transition to a developed country, modern sanitation methods are being introduced as well to ensure more healthy and eco-friendly fecal sludge management. Today, almost all household residents of this country are using sanitary toilets, but some challenges are being faced during the emptying process of these septic tanks. Toxic gas, harmful bacteria and odor emission is one of the major problems that causes serious health damage to the authorized cleaning operators and the other residents. In that connection, this poster attempts to represent a conceptual design of air purification unit (APU) as well as its effectiveness and limitations. It also underlines the necessity of this type of APU in current Fecal Sludge Management (FSM) to ensure the safety of the staffs related to the emptying and transportation of fecal sludge and environmental protection.

Keywords: Fecal Sludge Management, Air Purification Unit, Toxic material emission, Filtration, Chemical treatment, Locally fabricated technology, Pollution Protection.



Chemical Characterization of Fine Atmospheric Particles of Water-Soluble Ions in a Semi-Urban Atmosphere (Kharagpur)

Tanya Gupta¹, Kanistha Dubey², Dr. Shubha Verma^{2*}

¹ Asutosh College, University of Calcutta, Kolkata

² Indian Institute of Technology Kharagpur, Kharagpur

ABSTRACT: The study investigates the chemical composition and probable sources of aerosol originating at a semi-urban (Kharagpur–Kgp) region during the period February 2015 to January 2016. A submicron aerosol sampler (SAS) with two stage stacked filter units (SFU) was devised for simultaneous and discrete collection of Water-soluble inorganic ions (WSII) and carbonaceous aerosols. Major water-soluble inorganic aerosols (WSII) were determined using Ion chromatography and carbonaceous aerosols (CA) using OC–EC analyser. Seasonal analysis of WSII at Kgp indicated relative dominance of calcium followed by sodium, chloride, and magnesium ions. Non-sea salt potassium ($nss-K^+$), a biomass burning tracer was found higher during November and May at Kgp. Sum of secondary aerosols (sulphate (SO_4^{2-}), nitrate (NO_3^-) and ammonium (NH_4^+)) were highest during winter months, December and January at Kgp with relative concentration of SO_4^{2-} being higher than NO_3^- . Examination of carbonaceous aerosols showed three times higher concentration of organic carbon (OC) than elemental carbon (EC) with monthly mean of OC/EC ratio > 2 , indicating likely formation of secondary organic carbon formation. Seasonal influence of biomass burning inferred from $nss-K^+$ (OC/EC) ratio relationship indicated dissimilarity in seasonality of biomass burning at Kgp. Correlation analysis between measured chemical constituents and target species shows significant correlation of Ca^{2+} and Mg^{2+} with Na^+ and K^+ indicating their multiple sources to be crustal dust, marine and biomass burning. Cl^- showed significant correlation with Na^+ and K^+ indicating possible sources to be marine and biomass burning.

Key Words: Water-soluble inorganic ions (WSII), Submicron Aerosol sampler (SAS), Polytetrafluoroethylene (PTFE), Source apportionment.



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IV. Covid 19 & Bio-Medical Waste



Psychological Trauma faced during the Pandemic Outburst of COVID-19 Disease

K.R. Padma^{1,*}, P. Josthna², K.R. Don³

^{1&2} Assistant Professor, Department of Biotechnology, Sri Padmavati Mahila VisvaVidyalayam (Women's) University, Tirupati, AP, India

³ Department of Oral Pathology, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Velappanchavadi, Chennai, Tamil Nadu, India

ABSTRACT: *The Pandemic threat caused by novel SARS-CoV-2 has materialized candidly arduous menace to humankind's existence. The immense unpredictable global state made by COVID-19 and the trauma it lead to affected people in diverse manner, collectively caused changes in mental health for many. Nevertheless, day to day broadcast about increasing COVID-19 cases as well as increasing death rates and difficult times faced due to spread of COVID-19 through television, social media, newspapers, family and friends as well as other sources has resulted in emotional drift as well as panic situation. Although, lack of kits proper medical safety guards as well as beds created anxiety, panicky and can even possibly led to think what happens next? How, when will appropriate normal circumstances would return? Therefore several Health care systems need to address the stress faced by each individual providers and provide psychosocial support through various helplines. In conclusion, our review portrays the severe mental health trauma faced by people during COVID-19 pandemic and how much disturbance it bought to normal life style. Therefore, our review highlighted particularly on those affected countries of COVID-19 and trauma they are facing till today and measures to be taken to manage stress which ultimately keep our mental health stress free.*

Keywords: COVID-19, Mental Health Trauma, Social media, Helplines, Boost Immunity, Panic situation.



Protection of Conservancy Workers Against COVID-19: Case of Waste Bengal

Dr. M.N. Roy^{1,*}, Dr. Debasri Mukherjee²

¹ President, SIGMA Foundation, New Town, Kolkata, India

² Senior Research Officer, SIGMA Foundation, New Town, Kolkata, India

ABSTRACT: *The novel corona virus makes the waste of COVID patients an additional risk for those handling municipal waste. While bio-medical waste of the hospitals is to be handled by specialized organizations but according to the NGT out of 2.7 lakh Health Care Facilities identified in India, only 1.1 lakh of those are authorized under the BMW Management Rules, 2016. Waste from many health establishments are handled by the municipal conservancy workers. Further, they collect wastes from households having COVID patients and in many cases without knowledge. Also, such wastes are not generally segregated for safe handling. Waste of COVID patients get mixed with other municipal waste and often disposed of untreated due to inadequate treatment facilities. So, the conservancy workers also remain very vulnerable to acquiring COVID infection and yet there remains gap in ensuring their protection through appropriate safety measures. Recently West Bengal had an experience of 42 conservancy workers of Howrah Municipal Corporations residing at Harijan Bustee tested positive for COVID-19. It highlights that there is need for a system of preventing infection for protecting these 'key workers'. The COVID-19 pandemic has provided an opportunity to relook at the system of solid waste management and safety of the workers handling solid waste. This paper assesses the current gaps in such measures in West Bengal and elaborates on the required protection, related governance including monitoring tools, funding as well as behaviour change of the waste generators to protect the health of the conservancy workers and the ragpickers.*

Keywords: *Bio medical waste; Conservancy workers; Novel corona virus; Pandemic; Ragpickers.*



The Impact of Environmental Waste due to Aftermath COVID-19 Pandemic

K.R.Padma^{1,*}, K.R. Don²

¹ Department of Biotechnology, Sri Padmavati Mahila VisvaVidyalayam (Women's) University, Tirupati, AP, India

² Department of Oral Pathology, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Velappanchavadi, Chennai, Tamil Nadu, India

ABSTRACT: *Aim of the Study:* The purpose of our current study is to address the aftermath of COVID-19 pandemic which augments the enormity of medical waste clearance which in turn threatens the society along with greater impact on the environment.

Methodology: In spite of inadequate literature on controlling health care squander has instigated global emergency to find out alternative approaches to mitigate the environmental hazards.

Results and Discussion: The disposal of solid waste such as PPEs, single-use plastics, tested kits and needles of tested persons have upsurged concerns regarding the environmental issues. However, data collected from several case study along with review articles created conception to recognize measures in mitigation of waste disposal without any damage to environment.

Conclusion: Amidst the pandemic virus infection, discarding the solid waste with safety measures is imperative along with substitute level of management. Our current review article stress on salvaging of waste, refurbishment measures with help of AI technology which prevents spread of the disease. Thus artificial intelligence is best method to dispose solid waste hazards.

Keywords: Artificial Intelligence, Solid waste, Medical waste, Environmental hazards, COVID-19.



Waste Management Initiatives in West Bengal for Health and Environment during COVID-19 pandemic

Debaprasad Sarkar^{1*}, Sutripta Sarkar¹, Poulami Mukhopadhyay¹

¹ Barrackpore Rastraguru Surendranath College

ABSTRACT: During COVID-19 global emergency, waste management sector has faced tremendous disorder and that has made serious impacts on health and environmental issues along with consequential social and economic concerns. The present paper deals with the perception for the usefulness of the existing waste management practices in controlling health and environment issues during COVID-19 pandemic with some plausible suggestions to improve the waste management practices in urban West Bengal. This empirical paper uses primary data and information collected from 250 respondent and 35 waste controlling personnel from different municipalities in urban North 24 parganas district. As major proportion (85%) of the MSW generated in urban West Bengal is generally disposed off in landfills, dumps sites and ends up in rivers, respondents have perceived that existing waste management system is inefficient in controlling its impact on health and environmental issues. Moreover, due to COVID pandemic protocol and lockdown, 74% disruption of essential and routine management of Municipal waste play key role in intensifying infectious disease transmission (66%) and that has made a serious health and environmental issues (57%). More than 250% increase in medical waste can augment the risk of infection (51%). Infrequent collection and improper disposal of mixed waste could increase the probability of transmission of COVID infection (69%). A total of 76% participants agreed with the fact that water and air pollution has decreased by 8% during pandemic but mismanagement of waste partially nullifies the positive effect on environment. Waste litter can increase serious health risk (from 45% to 48.5%) around landfill area. In absence of required treatment facility, the transmission of COVID-19 infection be reduced by thermal treatment (87%), 28% in favour of composting for non-infectious bio-degradable waste and 30% in favour of recycling and reuse for non-infectious non bio-degradable.

Keywords: COVID-19, Pandemic, Environmental impact, Health impact, Waste Management

JEL Classification: I12, I18, K32, Q53



Environmental Sound Management of Biomedical Waste Generated During COVID Pandemic Crisis in India

Richa Singh^{1*}, Sarwani Budarayavalasa¹

¹ Indian Institute of Technology Bombay, Powai, Mumbai

ABSTRACT: With a population of 1.35 billion, India currently ranks second in terms of COVID cases after the United States. As a result, the environmental sound management of biomedical waste generated due to the COVID pandemic (also referred to as COVID waste) is one of the prominent challenges the municipal corporations and the pollution control authorities are facing. – which has been given prompt attention due to the various short and long-term hazards it can potentially cause to the public health and the environment. The present paper aims to highlight the policy and technological interventions for effective management of COVID waste in India. The study also discusses the potential treatment technologies that can be used to manage biomedical waste generated during this pandemic crisis.

Keywords: COVID waste, Treatment Technologies, Regulations



Protection of Conservancy Workers Against COVID-19: Case of Waste Bengal

Dr. M.N. Roy^{1,*}, Dr. Debasri Mukherjee²

¹ President, SIGMA Foundation, Kolkata, India

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ABSTRACT: *The novel corona virus makes the waste of COVID patients an additional risk for those handling municipal waste. Bio-medical wastes of the hospitals are to be handled by specialized organizations but according to the NGT out of 2.7 lakh Health Care Facilities identified in India, only 1.1 lakh of those are authorized under the BMW Management Rules, 2016. Waste from many health establishments are handled by the municipal conservancy workers. Further, they collect wastes from households having COVID patients and in many cases without knowledge. Also, such wastes are not always segregated for safe handling. Waste of COVID patients get mixed with other municipal waste and often disposed of untreated due to inadequate treatment facilities. So, the conservancy workers remain very vulnerable to acquiring COVID infection. Yet, there remain gaps in ensuring their protection through appropriate safety measures. The COVID-19 pandemic has provided an opportunity to relook at the municipal waste disposal system and safety of both municipal workers and informal workers, such as rag pickers, handling solid waste. This paper assesses the current practices in light of the existing guidelines and the gaps in taking such measures in West Bengal and elaborates on required improvement in governance including monitoring tools, funding as well as behaviour change of the waste generators to protect the health of the conservancy workers and the ragpickers.*

Keywords: *Bio medical waste; Conservancy workers; Novel corona virus; Pandemic; Ragpickers.*



Direct and indirect effects of COVID 19 pandemic on the environment and public health: Rethinking the strategies for plastic wastes, hospital wastes, and waste water management

Ritwija Bhattacharya, Aniruddha Mukhopadhyay, Pritha Bhattacharjee

Department of Environmental Science, University of Calcutta, Kolkata, India

ABSTRACT: *Purpose: The COVID 19 pandemic has given rise to emerging environmental consequences related to waste generation. The sudden increase in plastic wastes underlines the crucial need to reinforce plastic reduction policies. The discharge of hospital wastes and wastewater has increased due to the pandemic; especially those without appropriate treatment would increase the danger of infection. Besides, the practice of disinfection resulted in the entry of disinfectants and their by-products into the drainage system and their subsequent release into rivers and other aquatic ecosystems which can hamper the ecology and pose threat to public health.*

Approach: The urgent health issue has overshadowed the potential impact of the pandemic on our environment. In this article, we have collated several studies that have been reported on the impact of the COVID 19 pandemic on the massive amount of waste generation and the recent advances in waste management. This study gives a prospective outlook on how the disruption caused by the pandemic can act as a catalyst for short term and long term changes in waste management practices throughout the world.

Findings: The study gives an overall idea to develop a dynamic and responsive solution for the waste management system. Amidst the negative effects, some researchers have reported a significant association that was found with the COVID 19 pandemic and improvement in air quality, aquatic system, and environmental noise reduction.

Social implications: The scientific suggestions and techniques for plastic wastes, hospital wastes management, and wastewater disinfection have been discussed thoroughly which will help to reduce the risk to public health and geo-environment.

Originality: In this endeavour, we have discussed the potential changes in the strategies of waste management undertaken throughout the world among different research communities highlighting the positive and negative effects on public health and our environment.

Keywords: Covid 19, hospital wastes, plastic, waste management, wastewater.



COVID Related Biomedical Wastes:Emerging Challenges and Future Directions

Ipsita Maity^{1,2}, Sudeshna Ghoshal¹, Aniruddha Mukhopadhyay²

¹.Department of Zoology, Vijaygarh Jyotish Ray College, Kolkata, India

².Department of Environmental Science, University of Calcutta, , Kolkata, India

ABSTRACT: Covid-19 pandemic has become a matter of global concern with regards to society, health, economy and environment. It has affected the quality of life and already caused deaths to lakhs of people globally. Humans, though social by instinct have become largely affected by social distancing. Medical practitioners are not fully adapted to treat this newly emerged viral disease, whereas, the treatment protocol is not fully known. Presently, International community is largely dependent on vaccine options. Global economy has also been affected severely due to the pandemic related lockdown and other issues. As the disease is primarily caused by virus, it requires certain mandatory protections including personal physical hygiene and sanitization protocol. But these preventive -protective equipment that are used for covid prevention and treatment are generating huge amount of biomedical wastes. Disposal of such biomedical wastes has become a matter of great concern to the international community. Transportation and disposal have become difficult due to enormous generation of this waste materials. The current facilities for disposal and treatment of biomedical waste are not enough to dispose this large amount of infective covid related biomedical wastes. The regulatory mechanisms, urban and rural bodies and health facilities have a role to play to develop an integrated system to manage the covid related infective biomedical waste. Proper evaluation and assessment of different types of these wastes should be studied and appropriate measures to control the infectivity should be implemented. As these wastes are hazardous, utmost care should be taken so that the ecological health of our surrounding components is not disturbed. Finally, covid related biomedical management is a newly emerged concern. It is expected that through proper regulatory mechanism, good governance and proper responsible community participation, this problem will be solved for the sake of health and environment.

Keywords: COVID, pandemic, biomedical waste, biomedical management.



Resonance of COVID-19 pandemic on municipal solid waste management: An Empirical assessment from West Bengal, India

Debaprasad Sarkar¹, Sutripta Sarkar^{1*}, Arpita Ghosh¹, Ananya Mukherjee¹

¹ Barrackpore Rastraguru Surendranath College

ABSTRACT: For almost a year, the COVID-19 pandemic has caused global emergency and has raised social and economic concerns, along with environmental issues. The current study evaluates any change in prevailing municipal solid waste (MSW) management practices during COVID-19 pandemic with the emphasis on MSW collection, segregation, treatment, disposal facilities, related health and environmental awareness in West Bengal.

As there was limited literature on MSW management during such pandemics, this present article examines various aspects of MSW management during COVID-19 outbreak in several municipal areas of West Bengal. This paper used data and information from 390 respondents from different sections of the society to assess a summary situation on waste collection, treatment activities during the lockdown.

There was a slight fall of waste generation (around 1kg per day per household), food and plastic waste increased (6%) significantly in the composition replacing others. Due to new pandemic protocol, normal scheduled for collection, recycle, reuse and treatment of waste has been hampered a lot (74%) and related measures are insufficient (52%) for COVID-19 related health and safety issues (65%). The probability of transmission of COVID-19 infection through non segregate waste has increased a lot (yes-56%). The treatment of MSW is not well organized (yes-51%, don't know-32%) as landfill is the main way of disposal (yes-80%) and thus waste dumped in landfill are mostly non-segregated mixed waste category (90%). A total of 67% participants agreed with the fact that water and air pollution has decreased by 6 - 10% during pandemic as a whole but mismanagement of waste nullifies the positive effect on environment in some extent. Improper disposal could increase the probability of transmission of COVID-19 infection (69%).

Keywords: COVID-19, Pandemic, MSW, Waste management JEL Classification: I12, K32, Q53



Presence of SARS-CoV-2 on urban catabolites and the role of waste management. An Italian case study

Francesco Di Maria^{1,*}, Alberto Pivato²

¹ University of Perugia, Perugia, Italy

² DICEA – University of Padua, Padova, Italy

ABSTRACT: *Urban areas can be considered as organisms that consume energy, materials, resources for the needs of their metabolism and returns both meta- and catabolites. Most known catabolites are represented by wastewater, air pollutant and waste. The quality of these streams are also representative of the life style and of the health condition of the communities living in urban areas. Use of licit and illicit drugs along with the presences of specific disease can be detected by appropriate analysis of the catabolites. During the current COVID-19 pandemic a lot of research activity was performed for assessing the presence of SARS-CoV-2 on these catabolites and on the role that they can have on the spreading of the virus. Even if the scientific evidence is currently limited to the detection of SARS-CoV-2 RNA on several samples and materials gathered from the urban environment, there still a lack of definitive agreement on their effective role in contributing to the diffusion of the infection. In any case some specific measures were introduced in particular concerning household waste management, in particular those generated by patients in quarantine and treated at home. The present paper depicts the current level of knowledge and scientific evidence and also describes the main measure introduced in Italy, one of the first and most affected countries by the COVID-19 pandemic.*

Keywords: *COVID-19, household waste management, particulate matter, wastewater.*



Escalated Use Of Plastics On The Verge Of Covid-19 Pandemic In Nepal: Challenges And Recommendations

D. KC^{1*}, I. Shrestha², Y. Dahal³, B. Thapa⁴, and A. Ghimire⁵

¹²³⁴Soil Water and Air Testing Laboratory Pvt. Ltd

⁵ Kathmandu University, Dhulikhel, Nepal

ABSTRACT: use plastic has always been threat to the environment whereas COVID-19 pandemic is adding fuel to intensify the plastic pollution through protective measures (masks, protective wears). Since the covid-19 outbreak, the effort to control single use plastic has shrunk. Since the world has been trying to mitigate the contagion of the virus which is increasing the demand of protective measures. This assessment is aimed to furnish the overview on the potential implications on the environment due to excessive production of masks, protective suits and plastic bags. Assessment of these products from cradle to grave has been done through literature review, questionnaire surveys and interviews were performed with the concerned authorities to figure out the production and demand of the plastic products and challenges faced in proper management of used plastic product specially masks, protective suits and other plastics products. Although we have been benefited in the battle field with covid-19 with the help of protective gears (Masks, Personal protective suits) made from plastics, future measures involved in such health crisis must reflect balance between health as well as environmental safety. Through this study we have been able to know the percentage of the plastic used in this products and what happens to these products after use and management challenges of these products. Our dependency on the plastic product must shift towards sustainable alternatives like bio-plastics. Cutting off the plastic production must be prioritized by the governing bodies. Adequate funds should be allocated for the research and innovations which promote sustainable growth and bring balance between green and blue economies.

Keywords: COVID-19, Plastic pollution pandemic, Single-use plastic, Solid Waste Management, Sustainable alternatives



Study Of Hospital Waste And Management Practices In The Isolation Wards Of The Kathmandu Valley During Covid-19

I. Shrestha^{1*}, D. KC², Y. Dahal³, B. Thapa⁴ and A. Ghimire⁵

¹²³⁴Soil Water and Air Testing Laboratory Pvt. Ltd

⁵ Kathmandu University, Dhulikhel, Nepal

ABSTRACT: The outbreak of the novel Coronavirus (COVID-19) in the Kathmandu valley resulted in huge overflow of patients in isolation wards of the hospitals thereby significantly increasing hospital waste production. Primarily, hospital waste comprises infectious waste, sharps, chemical wastes, pharmaceutical wastes, pathological wastes, and radioactive wastes. In view of potential transmission from these wastes, a proper disposal of hospital waste is therefore immediately required to lower the threat of pandemic spread and sustainable management of the waste. Thus, understanding the quantity and composition of hospital waste in isolation wards and prevailing waste management practices is a key to appraise the seriousness of the hospitals towards the spread of the virus. Keeping this in mind, this study aims to estimate the quantity and composition of hospital waste generation, and study the waste management practices opted by the hospitals in the isolation wards. It has been anticipated that this study will assist in ranking hospitals in terms of secure and promising waste management practices. For this, Questionnaire Survey, Key Informant Interviews (KIIs) with the concerned authorities and employees will be done to comprehend about the current scenario, problems and possible solutions for effective pandemic waste management practices. As per research, the waste generation rate for hospital waste is 1.72kg/day/bed and therefore the estimated daily generation of hospital waste is 86kg/day. Furthermore, the ongoing research will help to access change in the waste generation rate amidst this pandemic in the hospitals and the techniques they have developed or implemented in correctly disposing the wastes. In addition, it will help concerned authorities to make plans and policies regarding pandemic waste management to cope with unprecedented pandemic like this in future.

Keywords: Hospital, Novel corona virus, Pandemic, Solid Waste Management



Health Care Waste Management in Nepal: Pre-COVID and Post-COVID-19 Scenario

Binaya Sapkota*

Nobel College Faculty of Health Sciences, Sinamangal, Kathmandu, Pokhara University, Nepal

ABSTRACT: *Healthcare waste management (HCWM) is a coordinated and holistic approach starting from the generation of wastes to their safe disposal to protect the health professionals, patients, caretakers and the community people from their health and environment hazards. The chapter aimed to provide information on HCWs categories and their management scenario, pre- and post-COVID scenarios of HCWM and important legislative measures for HCWM in Nepal. Relevant articles were extracted from PubMed, Google Scholar, ResearchGate and relevant websites using the key terms such as 'healthcare waste management' or 'medical waste management' or 'biomedical waste management' or 'clinical waste management' and 'COVID-19' or 'Coronavirus' or 'SARS-CoV-2' in Nepal. Public hospitals generated more HCWs than the private hospitals due to the high patient flow in the former. Liquid wastes are generated in from different departments of hospitals such as operation theatres, medical laboratories, medical wards, gynecology-obstetrics procedures and other sources. Nepal has banned purchase and use of mercury devices in all HCFs to minimize or avoid the mercury hazards on health and environment. Government of Nepal introduced some guiding principles for COVID-19 related HCWM and some interim guidance documents in Nepal for the management of HCWs in the COVID periods.*

Keywords: *Health Care Waste Management; COVID-19; legislation; hazard; Nepal.*



Biomedical Waste Management: Need of the hour in the present COVID -19 pandemic scenario

Shilpa Bose^{1*}, Ruchira Mukherjee², Tina Basu²

¹Department of Bioengineering, Birla Institute of Technology, Mesra-835215, Ranchi, India.

²Department of Basic Sciences and Humanities, Faculty of Science, Management House, D-1, SectorV, Saltlake Electronics Complex Kolkata, West Bengal, India.

ABSTRACT: *The outbreak of novel coronavirus disease (COVID-19) in the late 2019 is far more than a global health crisis. It is affecting our societies, our economies and creating a deep impact on our day to day lives. While protecting lives and livelihoods are at the core of national and local policies and actions, proper management of waste, including household, healthcare and other hazardous wastes should be considered to be an essential civic service. This will minimize the probable secondary impacts upon health and the environment. Biomedical waste is a result of medicinal services that incorporates sharps, non-sharps, pathological, infectious, chemical, pharmaceuticals, cytotoxic, radioactive materials, clinical gadgets and non hazardous or general waste. Discharge of this new category of biomedical waste or COVID-waste is of great global concern to public health and environmental sustainability. Its main purpose is to spread awareness among health care personnel to prevent transmission of any infectious disease and also to protect public health and environment. In this article, various methods for treatment and disposal of biomedical wastes have been reviewed including different disinfection techniques which in the long run can be effectively applied to reduce both health and environmental risks This paper provides some direction for strategy development which might give us some directives as to handling of similar types of pandemic in the near future.*

Keywords: *Biomedical waste, waste management, COVID-19, pandemic, chemical treatment, health.*



A critical analysis of the impacts of COVID-19 on the Indian economy and ecosystems and opportunities for circular economy strategies

Anaya Ghosh ^{1*}, Sadhan Kumar Ghosh ², Jyoti Prakas Sarkar ¹, Bimal Das ¹

¹ Department of Chemical Engineering, National Institute of Technology Durgapur, Durgapur, India.

² Department of Mechanical Engineering, Jadavpur University, Kolkata, India.

ABSTRACT: India was performing quite well in the circular economy segment and in few other sectors. India continued to be the leading nation with respect to collection and recycling of PET plastic waste as the country was collecting 60 per cent of its total PET consumption and these were recycled as well. But this scenario changed due to the impact of COVID-19. This sudden outburst has stopped the secondary segregation and resource recovery completely. On the one hand, environmental conditions are improving under lockdown as its impact on air and water can be observed. But the waste management sector might face the worst time in coming days due to various reasons. Since 20 April 2020, many waste management agencies, those that were working on ground and providing door-to-door waste collection services to societies, stopped their services. Now only municipalities are collecting waste that too on different frequencies and that are also being disposed either in landfills or dumping yards or at a very few occasions to waste-to-energy plants.

These measures have however shattered the core sustaining pillars of the modern world economies as global trade as well as have high impacts on national economy and become more challenging due to insufficient supplies. Against this background, this paper presents a critical analysis of the catalogue of negative and positive impacts of the pandemic on circular economy (CE) and recommends few standpoints on how it can be influenced to wrestle towards a better, sustainable and more resilient low-carbon economy.

Keywords: COVID-19, Climate Change, Circular Economy, Sustainable Development, Supply Chain Flexibility



Exercise in Immune Health Management and Rehabilitation against COVID 19

Dr. AparupKonar¹, Prof. Samiran Mondal²

¹ Jadavpur University, Kolkata

² Visva Bharati (Central University), Santiniketan

ABSTRACT: *There is a challenging time to adopt the 'New Normal' of living for the survival of humanity to fight against the pandemic of COVID 19. The new emerging infectious disease caused by severe acute respiratory syndrome (SARS) leads to serious public health risk that resulting to damage immune function within a host. Body has a specific and nonspecific immune mechanism to recognize & eliminate the viral infection. Since it is difficult to avoid completely from being in contact with those who are asymptomatic with positive (active infection), indispensably the host defense mechanism has to be strengthen enough to get optimum functional health by enhancing the body's natural immunity in the population.*

Regular moderate exercise possibly has the potential to play a significant role in immune health care in terms of devising policies of prevention, management and rehabilitation to deal with the deadly virus. Several studies proved the efficacy of moderate physical exercise in control and management of some lifestyle diseases like diabetes, hypertension, lung disease, cardiac disease, obesity, cancer etc. which are also co-morbid conditions in patients with Covid 19. Exercise seems a strong relevance to be useful in vulnerable population such as children, elderly and immunocompromised persons. Exercise favorably could be a powerful tool of healthy living when people apparently is becoming re-infected and there is no evidence around how long people might remain immune protected after exposure to Covid 19 for which herd immunity has not been achieved by the recovered population.

An ideal moderate exercises programme has a great impact on the normal functioning of the immune system for supporting a strong resistance to fight infections against any virus and if infected recover quicker. Exercise is not an alternative to medicines but as supplementary, preventive, therapeutic and rehabilitative measures to keep Covid 19 type of diseases away when there is no vaccine and medicine for this deadly virus as of now.

Keywords: *Moderate exercise, Immune health management, Covid 19*



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V. Energy Recovery Process



Optimization of Saccharification Process Parameters for Bioethanol Production from Waste Broken Rice

Payel Mondal¹, Anup Kumar Sadhukhan^{1,*}, Amit Ganguly², Parthapratim Gupta¹

¹Department of Chemical Engineering, National Institute of Technology, Durgapur, India

²Energy Research Technology, CSIR - Central Mechanical Engineering Research Institute (CMERI), Durgapur, India

ABSTRACT: Global competition and rapid economic growth have led to faster industrialization, which intern enhanced world energy demands several folds. Energy is an essential factor for progress and the overall development of any country. Mostly, the combustion of fossil fuel is the primary source of energy in today's world. The utilization of fossil fuels generates a considerable quantity of green-house gases, thereby causing an ecological imbalance. The rate of depletion of fossil fuel is another primary concern for energy sources for the future generation. The higher price of conventional fossil fuels is the growing concern over national energy security, dependency on foreign oil imports, negative impacts on the environment by utilization of fossil fuel are the leading factors to focus on alternative sources of energy. Production of bio-fuel, like bio-ethanol, is considered to be one of the most reliable renewable energy sources, which is also environmentally friendly. The added advantage to the usage of bio-ethanol as fuel is that the supply of raw materials available for production is abundant and sufficiently available from most of the starchy materials i.e. waste broken rice, waste potatoes, sugarcane bagasse, corncob, agricultural waste, vegetable waste etc.

In this study, broken rice was used for the production of bioethanol using the fermentation process, followed by the saccharification of processed broken rice. The saccharification process was carried out using the enzyme, commercial alpha-amylase, while the waste brewer's yeast was used for the fermentation process. The enzyme-treated saccharification process parameters were optimized through the Artificial Neural Network (ANN). The three independent parameters were identified- the enzyme loading, system pH and time of saccharification. The optimized conditions were 1.5 (ml/kg) enzyme loading, pH 6 and 250 min time with the final yield of reducing sugar of 0.65 (g/g). The experimental data for time-dependent ethanol concentration was used to study the fermentation kinetics and follow the Monod kinetics reasonably well.

Keywords: Broken rice, Artificial Neural Network, Monod kinetics and bio-ethanol.



A Study of the Processes, Parameters, and Optimization of Anaerobic Digestion for Food Waste

Dr. Jyothilakshmi. R^{1,*}, Sumangala Patil¹, Hemanth Kumar. K. J², Dr. Sadhan Kumar Ghosh³, Dr. Sandya Jayakumar⁴

¹ Assistant Professor, Department of Mechanical Engineering, M S Engineering College, Bengaluru, India

² Assistant Professor, Department of Mechanical Engineering VVCE, Mysore, India

³ President, International Society of Waste Management, Air and Water (ISWMAW-IconSWM) and Professor, Mechanical Engineering, JadHAVpur University Kolkata, India.

⁴ Nodal Officer (Manager Health Care), MOH, BBMP, Bengaluru, India

ABSTRACT: *Anaerobic digestion is a technology that has been used by humans for centuries. Anaerobic digestion is considered to be a useful tool that can generate renewable energy and significant research interest has arisen recently. The underlying theory of anaerobic digestion has been established for decades; however, a great deal of current research is directed towards the optimization of anaerobic digestion under diverse digestion conditions. This review provides a summary of the processes underlying anaerobic digestion, commonly-utilized measurements of anaerobic sludge, operating parameters of anaerobic digesters, and methods of acceleration and optimization used to improve process efficiency. Recent developments in addition to older research are considered to provide a general but comprehensive summary of accumulated knowledge in the theory of anaerobic digestion, as well as considerations in the efficient operation of digesters. We have determined that the numerous factors pertinent to the design and operation of batch-based anaerobic digesters must each be considered to ensure the maximum efficiency and cost-effectiveness of a digester provided its respective operating conditions.*

Keywords: *Anaerobic digestion, biogas, energy, food waste, optimization, parameters, processes, pretreatment.*



Upgrading Landfill Gas to Biomethane and the Potential Use in Urban Bus Fleets

Mauro D. Berni¹, Paulo C. Manduca¹, Ivo L. Dorileo², Leonardo G. de Vasconcelos²

¹ Interdisciplinary Center of Energy Planning, NIPE, State University of Campinas (UNICAMP), Campinas, Brazil

² Interdisciplinary Center of Studies on Energy Planning, NIEPE, Federal University of Mato Grosso, Cuiabá, Brazil

ABSTRACT: *This work discusses the potential use of biomethane from MSW landfills to fuel urban transport buses in six cities from Administrative Region of Campinas (ARC). Biomethane is produced by removing impurities from biogas. Anaerobic digestion is one of the main production routes for production of this fuel. The ARC has approximately 6 million inhabitants in 92 cities, its GDP is around US\$ 20,000/per capita. In 2016, the RAC was generated 5740 tons per day of waste. Campinas, Jundiaí, Piracicaba, Limeira, Sumaré and Americana, they accounted for 40% of the total population and 45.8% of the total daily produced MSW. The availability of MSW landfills in order to produce biomethane and the use in urban bus fleets in six cities of the ARC would make it possible to generate the quantity of fuel necessary for the supply of 435 buses annually with a significant reduction in the emission of GHG.*

Keywords: *Urban transport, Landfill, MSW, Biomethane, GHG.*



Cost optimization, feasibility, and reliability of hybrid renewable energy water pumping system for the climatic conditions of Haldia using HOMER: A case study

Madhumita Das¹, Ratan Mandal^{2,*}

¹ AEIE Department, Haldia Institute of Technology, Haldia, India.

² School of Energy Studies, Jadavpur University, Kolkata, India

ABSTRACT: PV and Wind energy resources are complementary to each other. This paper analyses the cost, feasibility, and reliability of a hybrid renewable energy (HRE) water pumping system using HOMER software for Haldia. The objective of the study is to find out the optimum renewable energy sources combination for a 1.5 HP pump for irrigation for 4 and 12 hours of daily operation. The various combinations of the hybrid renewable energy sources that are considered in this study are solar photovoltaic (PV), horizontal axis wind turbine, battery bank, and supercapacitor bank. These different topologies of hybrid renewable energy systems are cost-optimized using the net present cost (NPC) of the system. The solar radiation data, wind speed data, hourly load data, and unit cost of the components of the HRES are given input to the HOMER software. The feasibility of the system is studied for the lowest cost of energy (COE). The reliability of the system is measured in terms of lower unmet load. It is found that the combinations of PV and battery systems give the most cost-effective system due to the fall in prices of the solar PV panel for 4 and 12 hours of operation of the pump. The PV, Wind, and battery systems have better reliability in terms of lower unmet load. The unmet electric load for PV and battery system is 0.0349 % whereas, for PV, Wind and battery is 0.0175 % for the operation of 1.5 HP pump for 12 hours. PV and supercapacitor system is feasible for lower energy demand load or can be used for only peak energy demand.

Keywords: Water pumping, HRES, HOMER, PV, Wind, Battery, Supercapacitor.



Production of Ethanol from Food Waste

Shubhangi S. Pati*, Pushpendra Ghylot, Shubham Sonawane, Piyush Patil, Sadique Ali Mujawar

D. Y. Patil Institute of Engineering, Management & Research, Pune, India

ABSTRACT: One third of food produced for human consumption is disposed as food waste that poses a hazard for the global market and surroundings. Considering the physiochemical and biological nature, the food waste could be used as a unprocessed raw material for fuel and energy production. This will facilitate the bio-circular economy and reduce the environmental impacts. However, the conventional technologies (i.e., composting and anaerobic digestion) are irreplaceable to maximize the benefits of food waste recycling but require detailed techno-economic scrutiny for commercialization.

Alcoholic fermentation of sugar syrup observed to be associated with physical and chemical changes. Now sciences are directing the life processes of yeast, bacteria and molds to produce chemicals. Fermentation of food waste to get ethanol was done and distillation was followed to cleanse and purify the product.

In the present study, alcoholic fermentation from vegetable waste by using yeast is carried out for 72 hrs. at 30 to 35°C in the fermenter. Rate of fermentation is found to be 1.515×10^{-4} mole/lit.hr. Through the material balance it is found that conversion of sugar by stoichiometry is 55 %.

Keywords: Ethanol, Food waste, Fermentation, Yeast, Distillation.



Waste to energy as an alternative energy source for waste management in Nepal

Bindu Malla Thakuri¹, Sadhan Kumar Ghosh², Sun Jin Yun³

^{1,3} Department of environmental planning, Graduate school of environmental studies,
Seoul National University, Seoul, South Korea

² Jadavpur University, Kolkata, India

ABSTRACT: Nepal is one of the developing countries in the world. The increases in population, rapid expansion of sprawling urban municipalities, commercial activities and economic growth, have significantly contributed to increases in both municipal solid waste (MSW) and energy demand in Nepal. Nepal relies heavily on the traditional energy (78 %), petroleum products (12%) and renewable energy (3%). Currently Nepal depends mainly upon imported fossil fuels and thus has to pay a huge bill to India. The dependency on imported fossil fuels in Nepal is continuously growing every year so there is a need to find alternative sources of energy. Despite the existence of distinct link between waste and energy, the practical use is still viewed as an inferior in Nepal. A population of 28 million is generating 0.34 kg/ person/day. This, sums up to a huge pile of waste, which is mostly landfilled in the most unhygienic manner possible. This can lead to extreme environmental degradation, public health risks and the downfall of an economy. This paper presents 1) current status of MSW management, 2) waste to energy (WTE) as an alternative energy source in achieving our goal of waste management as well as energy security. This paper will help researchers, stakeholders and policy makers aware of current status, challenges of waste management, further planning and better understand the importance of WTE technology for sustainable waste management. There is a need of investments for pilot projects of WTE to ensure energy security by exploiting the energy potential of waste management.

Keywords: Waste to energy, alternative energy, waste management, developing country.



Feasibility Study of Commercialized Self Circulating Biogas Generators: A Circular Economy Approach

Bhuvana Varadha V. P., Devanand B., Thavasivamanikandan T., Selva Nandhini S., Kirubakaran V.

Gandhigram Rural Institute – Deemed to be University, Gandhigram, India

ABSTRACT: *Most countries still in their developing phase. On the one hand, they struggle with the energy crisis, inequality, poverty, and low human development indicators. While on the other, they are dealing with environmental problems and ecological destruction. The availability of Biomass in India is estimated at around 500 million metric tonnes per year. To get a sustainable solution to India's energy crisis and waste disposal problems, we need to use the available biomass resources effectively. Issues related to resource management and the non-intervention approach of authorities are the key factors hindering the expansion of the biomass industry. So, to overcome this situation and to use these available waste resources wisely. Here suggesting a social business model of sustainable development using a wide range of locally generated Biomass (agriculture / municipal and animal waste) with the help of renewable energy generation techniques of self-circulating biogas generator and solar still with the idea of waste as a source of income as well as a source of energy. Also proposing the concept of public-private people participation (4P model) for effective implementation of the business plan.*

Keywords: *Biomass, Biogas plant, Solar still, 4P Model, self-circulating biogas generator.*



Effect of the electrode on the treatment of coconut industry effluent using Microbial Fuel Cell

Sanju Sreedharan^{1,*}, Dr. Renu Pawels²

¹ Research Scholar, School of Engineering, CUSAT, South Kalamassery, Kochi, Kerala, India,

² Professor, School of Engineering, CUSAT, South Kalamassery, Kochi, Kerala, India

ABSTRACT: Resulting in the globalization of the Indian economy, the coconut market economy has also been elevated to the situation of competition. A large number of various value-added products are introduced into the market along with traditional products such as copra, coconut oil, etc. These industries generate a huge amount of wastewater; mainly waste coconut water from mature coconuts. Wasted coconut water builds a high level of contamination, because of the high concentration of organic compounds such as glucose, amino acids, proteins, vitamins, etc., present in it. Microbial fuel cell (MFC) is a bio-electrochemical reactor that effectively degrades organic compounds with zero energy usage. During the reaction, fuel cells extract bioenergy from the degraded organic compounds, which enhances the biodegradation.

The present study focused on the effect of the electrode on the efficiency of treating waste coconut water from coconut processing industries using a dual-chambered MFC in batch mode. MFC using a plain Aluminium electrode of 50 mm x 50 mm produced a reduction in COD from 46218 mg/L to 20732 mg/L, within 102 hours of detention period using KMnO₄ concentration of 2000 mg/L at pH 5 as Catholyte. On comparing Aluminium electrode with Steel and conductive carbon cloth electrodes, maximum efficiency was achieved for carbon cloth. On spatial distribution of carbon cloth electrode in Anolyte, COD of waste coconut water reduced from 49597 mg/L to 18487 mg/L within 102 hours of detention period with a maximum power density of 325.96 mW/m². According to treatment efficiency achieved, the system is effective in the treatment of small-scale coconut processing industries compared to conventional anaerobic bioreactors.

Keywords: Coconut industry effluent; Treatment efficiency; Waste coconut water; Electrodes; Microbial Fuel Cell.



Biofuels and Health Hazards – An Overview

Swapan Banerjee^{1,*}, Soumen Ghosh², Gourav Dhar Bhowmick³, Ronit Mondal⁴,
Ashim Kumar Giri⁵

¹ Department of Nutrition, Seacom Skills University, Kendradangal-731236, Birbhum, West Bengal, India

² Department of Health & Family Welfare (District Food Safety Cell), Hooghly-, Govt. of West Bengal, India

³ Department of Agricultural & Food Engineering, IIT Kharagpur, West Bengal, India

⁴ Food Process Engineering Lab, Faculty of Land and Food Systems, University of British Columbia, Vancouver, BC Canada V6T 1Z4

⁵ Department of Nutrition, Vivekananda Mission Seva Pratisthan, Ariadaha, West Bengal, India

ABSTRACT: *Biofuels are the most suitable and sufficient substitutes for other conventional fuels such as coal and oil, globally, since the last few years in the energy sector. For decades, entire populations have been suffering from deforestation, global warming, and carbon mono-oxide issues. Biofuel production is an eco-friendly process that is having health hazards for manufacturing unit workers. That is due to flammable and combustible raw materials and their chemical reactions. Bioethanol, a flammable biofuel prepared by cellulose items and the fermentation of grains. Biodiesel, another combustible liquid-based biofuel produced by the action of alcohol and glyceride present in vegetable oil duly catalyzed by strong alkaline like caustic soda. The biofuel plants or trees are the biggest producers of isoprene, which come in contact with the ozone present in the earth's atmosphere. Excess isoprene, while combining with ozone, always cause many health hazards for manufacturing-units employees despite several safety measures. One of the significant consequences is that some factory workers often have asthma, allergy, and lung disorders for ozone attacks only. Hence, this study aims to review and analyze the potential health hazards of biofuel plants and possible waste-based alternatives often used for biofuel production. We surveyed the electronic search of various open-access literature from 2000 to 2020. The database, mainly PubMed, Google Scholar, etc. were considered for searching purposes with some precise keywords. Finally, biofuels are useful, but that should ensure low health hazards for the well-being of society.*

Keywords: *Biofuel, Bioethanol, Flammable, Health hazard, Isoprene, Ozone attack.*



Valorization of Organic solid waste Using Anaerobic digestion

R.Balamurugan^{1,*}, Dr.S.Sankaran²

¹Research Scholar, Annamalai University,Chidambaram,Tamil Nadu, India

²Associate Professor, Annamalai University, Chidambaram, TamilNadu, India

ABSTRACT: Solid waste Management is one of the major problems faced by different countries all over the world. To control the solid waste to be improper disposal, the first step is to carry out waste characterization studies. In this paper are reported the results of a waste characterization study performed in Srimushnam area, Cuddalore district, TamilNadu. The aim of this study was to set the implementation of a reuse, reduction and recycling waste management program at the centre. It was found that the Srimushnam area produces 1.3 Metric ton of solid wastes per day; more than 48 % of these wastes are recyclable. This result shows that the way for segregation and recycling the waste products into usable one is feasible on an area. This study comprises of percentage of waste water generated in Srimushnam area. The study also showed that the local market for recyclable waste like reusable plastics, metals and other usable materials, under present conditions.

The technology of anaerobic digestion of organic solid wastes is used in many condition in the absence of oxygen. Digestion with other substrates and its relation to composting technology are examined. Special attention is paid to the advantages of anaerobic digestion in limiting the emission of greenhouse gases. Municipal solid waste management (MSWM) is one of the major environmental problems of Indian cities. Improper management of municipal solid waste causes hazards to both human beings & Environment. Many studies reveals that about 75% of MSW is disposed of unscientifically in open dumps and landfills in and around the municipal area, creating problems to public health and the environment. In this paper, an attempt has been made to provide a comprehensive review of the characteristics, generation, collection and transportation, disposal and treatment technologies of MSW to be implementing in Srimushnam area to control unwanted disposals.

Keywords: 3R, Leachate, Anaerobic digestion process.



Anaerobic Co-Digestion of Drain Sludge with Fermentescible Municipal Waste of Sokode (Togo)

Nitale M'Balikine KROU^{1,*}; Gnon BABA^{1,2}; Oguvidé AKPAKI¹

¹ Laboratory of Sanitation Water Science and Environment(LSWSE), Faculty of Science and Technology, University of Kara (Togo), PO BOX 404-Kara

² Laboratory of Waste Management (GTVD), Faculty of Science, University of Lomé (Togo), 01PO BOX.4574 Lomé

ABSTRACT: *The problem of management of sludge and urban solid waste has not yet found an adequate solution in Togo. In the city of Sokodé, this waste is often dumped around rivers, leading to risks of pollution of surface water. Optimizing their management is therefore more than necessary. A more in-depth characterization of this waste was carried out with a view to guiding its recovery. In the case of sewage sludge, the BOD5/COD, COD/BOD5, N-NH4+/NTotal ratios were calculated in order to assess their methanogenic potential. The results of a modeling of biogas production from this sewage sludge have shown that with 40.39 m³ of sludge produced per day, one can obtain in 29 days of anaerobic digestion, 25.24 m³ of biogas. The biogas produced showed a CH₄ composition of 60% against 40% of CO₂. These results show that the sludge is almost stabilized from the point of view of energy recovery. Thus, anaerobic Co-digestion of this sludge with fermentable municipal solid waste has been formulated. The objective of this work is to optimize the production of biogas by the Co-digestion of sewage sludge and fermentable solid waste. Criterion "ratio : Volatil dry matter from sewage sludge/volatile organic matter of fermentable waste" which is the biomass- substrate ratio was set to quantitatively assess the value of their Co-digestion. Five scenarios were formulated and the best scenario (ratio= 0.3) allowed an improvement in biogas production yield compared to the digestion of sewage sludge alone. This study brings added value to the solution to the problem of energy crisis which is also far-reaching in Togo. It shows that sludge and fermentable municipal waste can be considered as an energy resource and not as a problem.*

Keywords: *Sustainable agriculture ; renewable energy ; Anaerobic Co-digestion ; Organic solid waste ; Energy recovery.*



Utilization of Banana Peels Waste with Rice Washing Water as a substrate in Microbial Fuel Cell Technology

Nurul Khaerani Anwar*

Department of Physics UIN Alauddin Makassar, Indonesia

ABSTRACT: *The microbial fuel cell is a system that converts chemical energy into electrical energy through the degradation of the substrate by bacteria into carbon dioxide (CO₂), protons (H⁺), and electrons (e⁻). The MFC system used is dual-chamber, which has anode and cathode spaces separated by a salt bridge. The anode chamber contains banana peel waste that has high carbohydrate, fat, protein and also contains acetic acid that can be an electrical conductor so that it can generate electric current. Rice washing water waste is the encounter in the household sector, which still has a carbohydrate content of 90% and a high enough protein and fat content so that when combined as a substrate, it has the potential to be used as the primary food for bacteria in MFC. Bacteria using *Saccharomyces Cerevisiae* can degrade complex and simple carbohydrates. The cathode space is filled with water because oxygen is a great electron acceptor. Research on MFC usually uses an electrolyte solution in the cathode space. However, this can be a new environmental problem due to the rest of the process of making the electrolyte solution so in this studied an innovation was carried out using an aerator to help the process of moving oxygen in the cathode space to improve the electron transfer. The problems of environmental pollution due to food and household waste will be resolve by using it as a renewable energy source. So in this studied not only solve environmental problems of pollution due to wastes but also resolve the environmental pollution due to the use of fossil energy that produces emissions and harms the environment. The results of this research to overcome the wastes treatment solutions and contribute to cleaner renewable energy innovations because the emission produced is H₂O is environmentally friendly and has the opportunity to become affordable energy so that it also has an impact on the circular economy.*

Keywords: *Banana peels, rice washing water, MFC, waste treatment, electrical energy.*



Valorization of Organic solid waste Using Anaerobic digestion

R.Balamurugan^{1,*}, Dr.S.Sankaran²

¹ Research Scholar, Annamalai University, Chidambaram, Tamil Nadu, India

² Associate Professor, Annamalai University, Chidambaram, Tamil Nadu, India

ABSTRACT: Solid waste Management is one of the major problems faced by different countries all over the world. To control the solid waste to be improper disposal, the first step is to carry out waste characterization studies. In this paper are reported the results of a waste characterization study performed in Srimushnam area, Cuddalore district, TamilNadu. The aim of this study was to set the implementation of a reuse, reduction and recycling waste management program at the centre. It was found that the Srimushnam area produces 1.3 Metric ton of solid wastes per day; more than 48 % of these wastes are recyclable. This result shows that the way for segregation and recycling the waste products into usable one is feasible on an area. This study comprises of percentage of waste water generated in Srimushnam area. The study also showed that the local market for recyclable waste like reusable plastics, metals and other usable materials, under present conditions.

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Keuwords: 3R, Leachate, Anaerobic digestion process.



Modelling and simulation of a farm-scale biogas digester operated with crop residues

Preseela Satpathy^{1,2,*}, Frank Uhlenhut², Chinmay Pradhan¹

¹ P. G. Department of Botany, Utkal University, Bhubaneswar, Odisha

² Emden Institut für Umwelttechnik (EUTECH), University of Applied Sciences, Emden, Germany

ABSTRACT: Farmers resort to stubble burning post-harvest as a cheap and fast method before sowing their new crop. The result is pollution that severely impacts the air quality and inevitably the health of the population. In this research study, we propose rather utilizing such crop leftovers to generate biogas, a renewable source of energy. The Anaerobic Digestion Model No. 1 (ADM1) was employed to design a cost-effective, crop residue-based, direct on-farm biogas plant (with a digester volume of 10 m³), keeping small-scale farmers in mind. A virtual plant was prepared in SIMBA platform and the model was tested with different crop residues like from rice, wheat, maize, sugar cane etc. that are frequently subjected to open burning in India. Simulations were performed for 600 days with each crop residue to determine the optimal feeding volumes in order to attain maximum biogas and process stability.

The model demonstrated competence in handling the different types of stubble and indicated digester stability when the carbohydrate-rich crop residues were co-fermented with animal manure. When fed with 0.05 m³ of residues from rice fields, maximum methane generation of nearly 9 m³ was predicted. Any increase beyond this organic load was predicted to cause digester and pH abnormalities. However, crop leftovers from cotton fields were allowed higher feeding volumes by the model resulting in a methane production of nearly 10 m³. This research encourages individual farmers to explore biogas production as a sustainable approach that could help generate extra revenues than burning these energy-rich crop residues.

Keywords: Biogas; Anaerobic Digestion Model No. 1 (ADM1); crop residue; stubble burning; mathematical modelling.



Study and Analysis of Solar Radiation in Tropical Region of India

P. Narendra Mohan¹, Md. Touseef Ahamad^{1*}

Assistant Professor, Department of Mechanical Engineering, University College of Engineering & Technology, Acharya Nagarjuna University, India

ABSTRACT: *The precise knowledge about solar radiation in a region is of essential significance. Accurate knowledge about solar radiation is useful for monitoring solar energy systems is a pre-requisite for proficient planning and execution of any solar project. This work plans to present the closeness of the relationship between the forecasted and measured values of global horizontal radiance and direct solar irradiance to carry out an analysis on the weather condition of area taken from Guntur Region.*

The solar station which was considered is from ANU GERMI Research Centre located in Acharya Nagarjuna University, Guntur for the solar radiation of area taken from Guntur region on the basis of collected data. The data was monitoring for the duration of one week. The validation is brought out by the significance of the regression coefficients in which the regression coefficient approaches to unity declaring the fitness of the model.

Keywords: *Solar radiation, Global horizontal radiance, Direct solar irradiance, Regression coefficient, ANU GERMI.*



Prospects of Introduction of Solid Waste as a Renewable Energy Source in Russia

Liubarskaia M.A.*

Saint-Petersburg State University of Economics, Saint-Petersburg, Russia

ABSTRACT: *The problems of improving the solid waste management system and the transition to circular economy becomes one of the priorities in Russia. This fact is evidenced by a large number of recently adopted regulatory documents at the federal and regional levels. But lack of financial resources hinders the active implementation of the planned activities.*

The circular economy development requires the involvement of waste in the production cycle in the form of material and energy resources. The COVID-19 pandemic, due to the epidemiological danger, has significantly complicated the recycling and extraction of useful fractions from the waste stream. Most of the waste in Russia is currently going to landfills.

A way out of this situation with irrecoverable loss of resources is seen in attracting large corporations with investment resources to finance projects for collecting biogas at landfills. And this role could be given to oil and gas companies. Their development strategies are now switching to increase the share of renewable energy sources in the balance and reduce the carbon footprint. The reason for such rectification of the strategies is adoption of major international initiatives, including Sustainable Development Goals, Paris Agreement and European Green Deal. One of the mechanisms for reducing the carbon footprint is offset. For example, oil and gas companies could implement actions to prevent or compensate carbon emissions in the same or greater amount than CO₂ emitted by burning hydrocarbons they supplied to the market. Such actions could include planting forests and so on. But for Russian realities, since the most used technology for waste handling is landfilling, projects of collection of biogas at landfills are better way to offset the carbon footprint.

In St. Petersburg and the Leningrad Region, since the early 2000s, several projects have been implemented to organize the collection of biogas at landfills. In 2013-2015, "Prodex" group of companies implemented at the "Novy Svet-ECO" landfill at Gatchinsky district of the Leningrad region a pilot investment project for creating a generation facility operating on landfill gas as a renewable energy source. The volume of electricity generation is 4.8 MW. The generated energy is transmitted to the power grids of PJSC "Lenenergo" and purchased at the approved tariff.

In the future, oil and gas companies could act as investors in similar projects, using these mechanism as a tool to offset their carbon footprint, and introducing solid waste as a renewable energy source to the Russian market at the same time.

Keywords: *circular economy, solid waste management, oil and gas companies, renewable energy, investment project.*



Design and Fabrication of a Novel Triphasic Anaerobic Bioreactor for the Co-treatment of Organic Municipal Solid Waste and Slaughterhouse Waste

Atun Roy Choudhury^{1,3}, P. Sankar Ganesh^{1*}, Prasenjit Mondal², Namita Banka³, Rajarshi Banerjee³

¹Environmental Biotechnology Laboratory, Department of Biological Sciences, BITS Pilani, Hyderabad

²Indian Institute of Technology Roorkee, Roorkee - Haridwar Highway, Roorkee, Uttarakhand

³Chadwick's FSM Laboratory, Banka BioLoo Limited

ABSTRACT: Accessibility of suitable substrates and further segregation requirement are the primary constraints associated with wet biomethanation process. Though, the wet process is highly regarded for its effectivity and efficacy in municipal solid waste management manual 2016, the process grievously goofs to cater the desired output when loaded with substrates containing relatively high oil and fatty acid content. Therefore, secondary segregation becomes mandatory, prior to anaerobic digestion, leaving behind a partly degraded moist cake which is undoubtedly difficult to handle. This triggered the idea of hybrid dry biomethanation to overcome the challenges of the wet process and enhance the product recovery. A triphasic capsuled gravity flow batch bioreactor (TCGBR) comprising aerobic pretreatment unit, thermophilic anaerobic/anoxic pressure chamber, and aerobic post-treatment unit is designed. The lab-scale reactor is designed for a capacity of 5 kg. The first chamber is designed to receive the shredded mixed waste from a rotary shredder mounted on the top of the chamber. The mixed waste will be aerobically digested and pre-treated with the help of indigenous microbes over a week. The chamber would be facilitated with aeration and mechanical turning to enhance the degradation rate. The overall air requirement and turning frequency in the first chamber is ascertained as 0.05m³ per hour, for 20 min in every 72 h. An air tight valve would be affixed between the chambers to facilitate downward movement of the substrate. Pre-treated biomass would be further subjected to anaerobic/anoxic digestion for 21 days. Biogas generated from this chamber would be trapped and reinjected back into the same chamber, to enhance the gas pressure required for increased biogas production. Once the methane potential of the substrate gets over, it shall be moved to the final aerobic stabilization chamber. The third chamber also would receive an equivalent air supply and turning frequency as that of the first one. The leachate generated from the entire process shall be collected and recirculated back into the first chamber to ensure zero discharge. The modular design, minimal pumping requirement & power consumption, and concomitant by-product recovery are the salient features of TCGBR.

Keywords: Dry biomethanation, TCGBR, pre-treatment, post-treatment, organic municipal solid waste, slaughterhouse waste



An environmentally friendly process pathway for safe disposal of paddy stubble

Abhijit Hazra^{a,b}, Saikat Das^a, Naresh Chandra Murmu^{a,b}, Sadhan Kumar Ghosh^{cd*}, Priyabrata Banerjee^{a,b*}

^a CSIR-Central Mechanical Engineering Research Institute,

^bAcademy of Scientific and Innovative Research (AcSIR), AcSIR Headquarters CSIR-HRDC Campus, Uttar Pradesh, India

^cJadavpur University, Kolkata 700032, West Bengal, India.

^dInternational Society of Waste Management, Air and Water, Kolkata, India

ABSTRACT: Cultivation is one of the primary sources that provide ultimate resources to human civilization. Moreover, it can be visualized throughout the globe that cultivation of crops like rice and wheat are prioritized utmost, which finally generates a great heap of rice straw and paddy stubble. Open burning is the easiest practice to get rid of the heap of paddy stubble but that brings the severe consequences of massive air pollution. India, being one of the biggest agricultural countries generates piles of rice straw and paddy stubble. The practice of open burning has been raised significantly, which is a dangerous environmental issues for the country like India due to possessing brutal air pollution. There are some alternative paths for management of these kinds of waste material through the generation of value-added products from it. In view of getting environment friendly technology, Plasma arc driven technology found to be suitable for efficient disposal of waste material with the generation of energy efficient by-product. In this review, the focus is on the status of the worldwide generation of paddy stubble and rice straw and the consequences of open burning of these waste products. The dangerous effects of air pollution caused by this practice are monitored, especially in India. The other process pathways for management of paddy stubble and rice straw are also discussed. Finally, A next-generation intermediate pyrolysis based disposal process is being proposed for a potential way out for the environmentally friendly disposal of paddy stubble with the generation of energy efficient product.



Fluid catalytic cracking catalyst driven production of bio fuel from waste plastic pyrolysis oil: A sustainable way of Waste Valorization

Abhijit Hazra^{a,b}, Priyabrata Banerjee^{a,b*}, Sadhan Kumar Ghosh^{c,d*}, Harish Hirani^{a*}

^aCSIR-Central Mechanical Engineering Research Institute, Mahatma Gandhi Avenue, Durgapur

^bAcademy of Scientific and Innovative Research (AcSIR), AcSIR Headquarters CSIR-HRDC Campus, Uttar Pradesh, India

^cJadavpur University, Kolkata

^dInternational Society of Waste Management, Air and Water, Kolkata, India

ABSTRACT: Plastic waste generation is rapidly escalated owing to industrialization and urbanisation causing severe environmental degradation. Pyrolysis is employed to generate value added energy efficient products i.e., pyrolysis oil from waste plastics and subsequent reduction in quantity. The initial pyrolysis oil quality cannot meet the commercial requirement. Consequently, Fluid catalytic cracking (FCC) is an efficient technology for enhancement of oil quality. Nowadays, FCC has become a key technology for petroleum crude oil conversion to commercial grade oil and petroleum products. Therefore, this technology is employed for non-conventional fuel production from waste pyrolysis oil. This review provides a brief introduction about plastic waste generation and management through pyrolysis. The influence of waste plastic feedstock types and pyrolysis condition on produced pyrolysis oil composition is discussed. Furthermore, the viable application of efficient catalyst produced from waste or naturally abundant material benefits commercial utility of FCC technology. This work provides comprehension about FCC technology and its utilisation towards catalytic conversion of waste pyrolysis oil to value-added bio-fuels. It enlightens the integration of Pyrolysis and FCC technology together assists to mitigate plastic wastes and production of high quality bio fuel. The present technology could be an efficient and sustainable approach towards Waste Valorization pathway.



Biogas recovery from poultry and piggery waste: A review

David O. Olukanni^{1*}, Chukwuebuka N. Ojukwu¹

¹ Covenant University, Canaan land, Ota, Nigeria

ABSTRACT: Fossil fuel is the current major source of energy globally. This source of energy meets 88% of the energy demand and has a negative effect on the atmosphere through the release of greenhouse gases. Consequently, this has led to an all-out search for alternative clean sources of energy. Among the streams of solid wastes, livestock waste has been reported to have potential for energy and resource recovery. The focus of this study is to investigate the improvements made in biogas production from poultry and piggery wastes with different digestion techniques involved. The study analysed the biogas production procedures of poultry and piggery waste in the last decade (from 2010 to 2020). Thirty literature on recovery of energy from this organic wastes were carefully studied with specific objectives to: extract the improvements made through co-digestion with various substrates; explore the different anaerobic digestion methods and possible results in the literature, considering recent developments; and examine the different models adopted in the literature with the factors that affects the model sensitivity. It was observed after analysis that substrates co-digested with poultry and piggery waste and models used, greatly influenced the amount of biogas released. The study answers the question regarding various other factors influencing production of biogas with values of 25 – 50oC for temperature, pH used from 6.3 – 8.7, hydraulic retention time 25 – 350 days, and total solids concentration of 2 – 90 percent across the literature reviewed. The improvement in biogas production in majority of the literature ranged from 11.04% to 28.78%. This work has contributed in no small measure on the efficacy of biogas production from poultry and piggery waste, and will contribute to United Nations Sustainable Development Goals with specific emphasis on Goal 7: Affordable and clean energy, Goal 12: Responsible consumption and production, and Goal 13: Climate Action, which will boost the drive of government of nations towards sustainability.

Keywords: Solid Waste Management, Anaerobic digestion, Livestock Waste, Poultry and Piggery Waste, Sustainability, Energy Recovery.



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VI. Industrial Waste



Coal Fly Ash Utilization in India: A Review

Dipankar Das^{1*}, Prasanta Kumar Rout¹

Department of Material Science and Engineering, Tripura University (A Central University),
Suryamaninagar, Tripura, India

ABSTRACT: *The electricity generation in India is mainly depends on coal based thermal power plants, which result in a generation of a large amount of fly ash. Every year million tons of fly ash are being generated worldwide. This fly ash possesses various environmental concerns, and it should be utilized in a proper way. The current fly ash utilization in India for the year 2018 to 2019 is 168.40 million tons. This paper presents a review of the current production and utilization of coal fly ash in India for the year 2018 to 2019. This paper also described the commercial usage of fly ash in various industries, the regulation, and the initiation for fly ash utilization in India.*

Keywords: *Fly ash; Coal; Thermal power plants; Environment.*



Demonstration of Recycling Potential of Fly Ash and GGBS as Geopolymeric Binder for Construction of Utility Building

Dr R. Jeyalakshmi^{1,*}, R Bharath², T Revathy², Baskara Sundararaj³, Rajamane N P³

¹ Professor, Department of chemistry, Faculty of Engineering and Technology, SRM Institute of Science and Technology, Kattankulathur, India

² Research fellow, Faculty of Engineering and Technology, SRM Institute of Science and Technology, Kattankulathur, India

³ Technical Officer, CACR, SRM Institute of science and technology, Kattankulathur, India

ABSTRACT: Ordinary Portland cement has been continually criticized for their energy intensive production and release of carbon di oxide. In view of the sustainable construction material, geopolymers derived from industrial wastes fly ash –GGBS based geopolymer concrete (GPC) are regarded as an alternative for ordinary Portland cement concrete. Previous extensive research on their engineering properties, structural characteristics evidenced their potential as binder in place of Portland cement concrete but very limited field demonstrative projects and application progress in modern GP materials reported. Therefore this paper discussed a field demonstrative project by systematic approach on design of ambient cured geopolymeric formulation with desirable workability and compressive strength for the production GPC. Two source binders Fly ash and GGBS in 3:2 blend ratio activated with industry made activated silicate solution of silica modulus Ms 0.8, made up of sodium silicate and sodium hydroxide. Different Pre cast elements for the construction of toilet fabricated in a factory by optimising the paste volume, liquid/solid and slump values. The grade of concrete with compressive strength of M10 at early curing age of 18 h to demould the products and M20 for 28 d curing for the finished products. The demonstration of erection of toilet completed within 5 h and hence it saves time, energy and cost.

Keywords: Fly ash, GGBS, Geopolymer, regular construction, precast toilet blocks.



Ferrochrome Ash-based Geopolymer Concrete Incorporating Fly Ash and Lime Water

Jyotirmoy Mishra^{1,*}, Bharadwaj Nanda¹, Sanjaya Ku. Patro¹, Shaswat Ku. Das², R.S. Krishna¹, Syed M. Mustakim³

¹ Veer Surendra Sai University of Technology, Burla, India

² Green tech concrete and research, Bhubaneswar, India

³ CSIR-Institute of Minerals and Materials Technology, Bhubaneswar, India

ABSTRACT: To reduce carbon footprints in the atmosphere and to address the issue of climate change due to global warming, efforts are necessary to develop eco-friendly construction materials such as geopolymers. Geopolymer belongs to a new class of inorganic polymer formed by alkali activation of aluminosilicate source materials such as fly ash (FA), slag, ferrochrome ash (FCA) etc. This study presents the development of a new class of geopolymer binder/concrete utilizing FCA in addition with FA as source material composition. FCA is regarded as waste from ferroalloys industries and poses a threat to the environment. Though FCA contains a low amount of aluminium and silicon oxides, it has other potential mineral oxides, namely magnesium and iron oxides that are reported to assist in the strength development of the geopolymer samples. FA was blended with FCA to increase the aluminium and silicon content of the source material composition. For the preparation of the proposed geopolymer concrete, an alkaline solution consisting of sodium hydroxide (NaOH) and sodium silicate (Na₂SiO₃) was used. To increase the alkalinity of the mixes, saturated lime water was utilized during the mixing instead of potable water. The properties such as workability and compressive strength of the geopolymer concrete samples were investigated under standard room temperature curing conditions. The result of this study reveals that the FCA based geopolymer concrete with FA could be a key construction material and an effective route for industrial solid waste management.

Keywords: Geopolymer concrete; ferrochrome ash; lime; compressive strength; waste management; magnesium oxide.



The Role of Automation in Eco-Industrial Parks Development in Russia

Yaroslavtsev D.A.*

Baltic Academy of Tourism and Entrepreneurship, Saint-Petersburg, Russia

ABSTRACT: *In modern conditions, there is a need for the formation of an innovative infrastructure for a modern large cities focused on the integration of industries, science and education with the aim of solving existing problems. An important element of this infrastructure is eco-industrial parks. Eco-industrial parks development become a trend in the most of European countries, United States of America, Japan and China. These parks implement the principles of circular economy, such as industrial symbiosis, waste recycling, energy saving, etc.*

Russia is just at the beginning of the process of elaboration of eco-industrial parks development policy. The mission of the eco-industrial parks in Russia is to fulfill the role of a laboratory for advanced researches on improving energy efficiency, resource saving and obtaining synergies through pooling the assets and intellectual capital of residents in the eco-industrial park and sharing the infrastructural subsystems.

For the successful operation of eco-industrial parks, combining industrial, research and educational activities, it is necessary to attract and use resources efficiently. First, we are talking about material, financial and labor resources. Equally important is the creation of an advanced information system in the form of constantly functioning monitoring that provides an eco-industrial park with complete, reliable and up-to-date information on modern innovation processes. Also, at this point, it is important to use consulting and actively involve innovative technologies to enhance the efficiency of the functioning of eco-industrial parks in Russia. The main task of automation is the execution of cyclic processes, or processes running according to a strictly defined algorithm. Automation processes are widely developed all over the world, and South Korea is one of the world leaders. According to the latest data, there are 476 robots per 10,000 workers in Korean enterprises.

At the initial stage it is very important to establish the process of automating the movement of secondary resources between temporary storage and processing zones. The development of services for automating the management of material and information flows in eco-industrial parks will improve the efficiency of their warehouse and logistics infrastructure, as well as create the basis for sound management decisions.

In addition to the introduction of automation systems, the author suggests the active use of consulting services. For this purpose, the world's leading companies are identified, cases in similar areas are analyzed, and the attractiveness of implementing consulting services in the activities of eco-industrial parks is assessed.

Keywords: *circular economy, eco-industrial parks, solid waste, automation, consulting*



Industrial Solid Waste Management Practices in Ota, Ogun State, Nigeria

David O. Olukanni*¹, Essien E. Mmenieabasi¹,

¹ Covenant University, Canaan land, Ota, Nigeria

ABSTRACT: Industrialization is a necessity for a nation's economic growth. One of the targets in goal eleven of the United Nation's Sustainable Development Agenda is to reduce the adverse per capita environmental impact of cities and paying special attention to air quality, municipal and other waste management practices. The focus of this study is to characterize the components of industrial solid waste generated in Ota, Ogun State, Nigeria, and identify the solid waste management practices adopted in Ota. The Town is attributed to be the 3rd largest concentration of industries in Nigeria and boast of 189 manufacturing establishments in operation. Due to the high rate of industrial activities – increase in population is inevitable and considerably leads to the generation of enormous waste products. Data was collected from both primary and secondary sources. Sample size was extracted and cluster sampling technique was adopted by classifying them into eight (8) sectors namely: chemical & pharmaceuticals, food/beverage & tobacco, domestic & industrial plastics/rubber/foam, metal/steel, non-metallic mineral products, electrical & electronics, pulp & paper and motor vehicle assembly. The study showed that the production processes associated with all the industries involved, generate significant quantity of solid waste. The result showed that plastic and rubber waste comprising mainly remnants of packaging materials had the highest volume of (38%) while (23%) was recorded for readily compostable waste. Other components identified were paper (10%), glass and ceramics (9%), metals (9%), aluminum (7%), and others (4%). Concerning the method of solid waste management adopted, a greater number of industries (31%) practiced open dumping, (23%) made use of incineration, (13%) open burning whereas a few employed landfilling (12%), burying (7%) and (14%) claim to have contracted this activity to the services of the private collectors. It is recommended that the Ogun State government should establish laws than barn industries from disposing recyclable waste at dumping sites and the amount of waste generated annually must be required by law to be reported and the reports must be audited. It is also important that recycling centers be established in industrial zones to ensure a cost-effective means of waste disposal for solid waste.

Keywords: Industrial Solid Waste, Waste Composition, Industry Classification, Waste Management, Environmental Pollution, Sustainable Development.



Adsorption Of Organic Contaminants By Fly Ash In A Multi-Solute System

Kashinath Banerjee ^{1*}, Srikanth Muddasani ^{1*}, and Tapas K. Das²

¹ Veolia Water Technologies, 250 Airside Drive, Moon Township, Pennsylvania 15108 USA

² Saint Martin's University, School of Engineering, Olympia, Washington 98503 USA

ABSTRACT: The adsorption characteristics of fly ash in a multi-solute system are evaluated in this study. The adsorption equilibria of two binary mixtures consisting of *o*-xylene/butanol and *o*-xylene/MIBK, and one ternary mixture of *o*-xylene/MIBK/butanol are determined at 20°C using fly ash as the sorbent material. The results of this research demonstrate that the adsorption capacity of fly ash for each of the solutes is decreased by the presence of the other solutes. Competition for the available adsorption sites increases with the increasing number of solutes. A simplified competitive equilibrium adsorption model that is based on the ideal adsorbed solution theory is used in this research to predict competitive adsorption equilibria. The model predicted the adsorption behavior of fly ash more accurately for the binary mixtures than that of the ternary mixture within the concentration ranges studied in this research.

KEY WORDS: fly ash, multi-solute adsorption, *o*-xylene, MIBK, butanol, simplified competitive adsorption model.



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VII. Industrial Aspect



Presenteeism and Productivity loss in Working Women of India, Thailand & Bangladesh due to Menstrual problems

Suneetha, Kandi.^{1*}, Ismat, Rahman.², Debashree De.³, Monica, Khanna⁴, Asawin Pasutham.⁵, & Dey, K, Prasanta.⁶

¹ GITAM (Deemed to be University)

² Dhaka University, Bangladesh

³ University of Essex, UK

⁴ K J Somaiya Institute of Management Studies & Research, India

⁵ University of the Thai Chamber of Commerce, Thailand

⁶ Aston University, UK

ABSTRACT: Purpose: The objectives of the study are to assess the menstrual problems of working women in India, Bangladesh & Thailand, to explore the impact of these problems on presenteeism & productivity, and to study the impact of working hours and strenuous nature of the job on the extent of presenteeism and productivity loss.

Methodology: Data was collected using the convenience sampling method from the working women of India, Bangladesh, and Thailand. Working women who satisfied the inclusion criteria filled up an online survey that included items of the Menstrual Distress Questionnaire and the Stanford Presenteeism Scale along with demographical and a few work-from-home questions. A total of 185 (India - 81; Bangladesh - 48; Thailand - 55) participants constituted the sample.

Findings: Structural Equation Modelling (SEM) was used to analyze the data. The results suggested that working women suffer from varying levels of menstrual problems, and they lead to a significant reduction in productivity and a slight increase in employee presenteeism. It is found that longer working hours lead to higher productivity loss, although it does not directly impact presenteeism. Apart from identifying a few differences among the working women of the three countries, the study found that the strenuous nature of the job has a negative impact on both presentism and productivity.

Study Implications: This research study contributes to understanding the menstrual health issues of working women, which are highly prevalent and neglected, resulting in women becoming the 'silent sufferers' both at home and at work. The study findings can help provide impetus to better the working conditions of women facing such problems. It can help bring about policy changes to enable women to contribute their best by lowering presenteeism and increasing well-being. The productivity levels of the organization can be increased by adequately addressing these neglected issues.

Originality value: This study throws light on the relatively unexplored area of menstrual problems of working women. Current studies focused on identifying certain contributing factors for presenteeism but have not explored the impact of menstrual problems. This study is original in that for the first time, it has explored the menstrual problems of working women, especially from the ODA countries, with an understanding of their impact on presenteeism and productivity.

Keywords: Presenteeism; Productivity loss; Working Women; Menstrual problems; ODA countries.



Transforming Indian SMEs through Circular Economy Approach – An Exploratory Study in Greater Viskhapatnam

Nudurupati, S. S., Kondala, M., Pappu, R. P. and Dey, P. K.

ABSTRACT: Over the last few decades, there was an increasing awareness amongst consumers and society on sustainable products. There is a massive difference between the older industrial processes and current industrial processes of manufacturing and service sectors, in which sustainability is a common aspect. In this context, the circular economy (CE) concept has emerged as a significant paradigm shift in how humans interact in society. For reasons of environmental sustainability, there is a need to create a thriving economy by moving away from this traditional economic model to CE. The target to become carbon neutral is not achievable unless all organisations join their forces together in the supply chain within their carbon reduction programs. While several larger organisations have well integrated CE practices to reduce resource usage and extend the life of products and components through reduce, recover, and recycle, SMEs struggle to barely sustain market demand with their poor infrastructure, lack of know-how and access to technology. Hence, studies on SMEs adoption of CE is scant, particularly at micro level. The purpose of this paper is to develop a framework to facilitate SMEs in achieving greater sustainability through CE approach. Exploratory research is adopted in 12 cases and data collected through personal interviews. The finding suggests that most SMEs in India focus on fulfilling their daily chores of fulfilling demand for economic sustainability. While most SMEs do not have access to know-how on CE practices and its impact on sustainability, few SMEs have started adopting CE practices. Most SMEs are aiming for extended product life including better design and encouraging eco-friendly products with eco-manufacturing practices. Most of their manufacturing facilities are efficient in converting raw-material to finished products with reduced energy consumption. Most of these SMEs are also encouraging local sourcing where available it meets quality requirements. While these SMEs are following above practices, their primary goal is for economic gains. However these practices are contributing to the environmental gains, coincidentally. While most facilities are aiming for zero waste, they are failing to achieve due to lack of knowledge on the standard processes and practices. They are unable to use renewable energy or undertake carbon offset projects because of lack of financial resources, subsidies or drive from the government. While most SMEs are providing safety manuals for their products, there are no specific trainings or consulting programs for customers on safe disposals of products when they reach the end of life or end of use. To summarise the findings, SMEs are economically focused due to huge competition along with demanding customers as they strongly believe environmental and social projects are cost intensive. In driving these SMEs to adopt CE practices, firstly, the drive should come from government initiatives in the form of regulations and policies with strict implementation. Secondly, new business models that can derive value from CE practices. Thirdly, customers should pull these CE practices from SMEs through discrimination on sustainable products, which needs a lot of awareness of CE practices and their impact on society.

Key Words: Circular Economy, Small and Medium Enterprises, Sustainability, Environmental Performance, Practices



Circular Economy Implementation in SMEs in India

R. Dasgupta^{1*}, I. Saha¹, S.K Ghosh¹

¹ Jadavpur University, Kolkata, India

ABSTRACT: *The need for transition to sustainable socio-technical systems, environmentally friendly industrial and economic development has showed signs to become a necessity in the last decade. Some of the most serious environmental problems like, biodiversity loss, waste of fresh water resources soil desertification from excessive land use for food production, increasing air pollution in urban areas, plastic pollution in the oceans, and dramatic climate changes, are encountered, investigated and researched on ,more than ever before on the last decade. The main strategic tools to battle with this problem on a global level have come to be achieving a sustainable Circular Economy. Circular Economy can be a system of resources utilization where reduction, reuse and recycling (3R principles) of elements prevails, cutting down waste to a minimum and with the use of biodegradable products recycle the rejected products back to the environment. It aims to replace the traditional linear economy model of fast and cheap production and cheap disposal with the production of long lasting goods that can be repaired, or easily dismantled and recycled. Various international economic organizations estimated that the global economy would benefit 1,000 billion US dollars annually through this replacement from linear to circular economy.*

The purpose of this paper is three fold. First, it offers a literature review on Circular economy essentially encompassing the reputed manufacturing industry. Secondly, to take stock of the status of implementing the Circular economy in Indian SMEs in particular for its better sustainability through overcoming the inherent weaknesses in the system against the international scenario. Thirdly develop a model through factor analysis and identify the vital few parameters for implementing circular economy in the context of Indian industry. It is expected that both the theoreticians and practitioners will be benefited immensely through this article to transcend their existing confines in this regard

Key Words: *Circular Economy, Sustainable Development, Factor Analysis, Value stream mapping.*



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VIII.

Waste Management



Studies on Bioremediation of lead in a packed bed Bioreactor using lead Resistant *Acinetobacter* sp 158 immobilized in Calcium Alginate Beads

M. Bose^{1,*}, S. Datta, P.Bhattacharya²

¹Department of Chemical Engineering, Jadavpur University, Kolkata, India

²Department of Chemical Engineering, Heritage Institute of Technology, Kolkata, India

ABSTRACT: Most of lead compounds have been deliberately introduced to the environment by industrial revolution. It is needless to mention that for environmental safety point of view several remediation techniques are currently being employed for mitigating lead from industrial run off. The present study deals with application of isolated lead resistant bacterium *Acinetobacter* sp 158 for bioremediation of lead from simulated waste water. Entire investigation has been carried out in continuous mode packed bed bioreactor. In the beginning heterogeneous biocatalyst has been prepared by immobilizing candidate cell in calcium alginate beads. Then the biocatalyst has been loaded as packing materials into the specially designed packed bed reactor column. A comprehensive experimental study has been carried out to study the reactor performance by varying different parameters viz., flowrate of feed and initial substrate concentration.

Keywords: Lead compounds, waste water, lead resistant bacterium, immobilization, heterogeneous biocatalyst, packed bed bioreactor gas.



Generic Model of Sustainable E-Waste Management of Kolkata

Dr. Shelly De (Pandit)^{1,*}, Dr. Subhasis Mukhopadhyay², Dr. Dipankar Dey³

¹Bijoy Krishna Girls' College, Howrah, India

^{2,3}University of Calcutta, India

ABSTRACT: Absence of formal e-waste management firms and awareness among people are the main reasons why the informal economy of Kolkata and its suburbs play an important role in e-waste management. Accumulation (collection of e-waste) and removal (i.e. pollutants and toxins) are the two major challenges faced by the informal economy for sustainable e-waste management. The purpose of the study is to give an outline of activities adopted by informal economy to create a prosperous and sustainable circular e-waste economy. It aims to determine an optimal policy of informal economy based e-waste management by creating a generic model. Exploratory survey was conducted in places where e-waste of the city gets managed by informal economy. The generic model is prepared to show the visual tools along with its social implementation by which the informal economy based e-waste management of Kolkata will get sustained. The generic model demonstrates how the 'skill pool' turns into 'knowledge pool' to create an e-waste economy of its own. Recovery system of e-waste by the informal economy of the city is gradually replacing the conventional "take-make-dispose" economic model and adopting the 'circular e-waste economy' where wastes are considered as resources. The model is human intensive with the aim to reuse second-hand products, product components and extract metals as well as plastics, to the maximum extent, thus reducing waste and generating employment. Thus the study, by suggesting a solution to get resource from waste, has replaced the old paradigm 'waste to be managed' by the newly suggested paradigm 'resources to be optimized'.

Keywords: Sustainable e-waste management; Kolkata; Informal economy; Circular e-waste economy; Generic model.



Physicochemical Characterisation and Toxicity Study of Poultry Litter Biochar

Anjali T.B^{1*}, Anand M¹

¹ School of Environmental Studies, Cochin University of Science and Technology, Kochi, Kerala, India

ABSTRACT: A study was conducted to examine the physicochemical characteristics of poultry litter derived biochar prepared at 3000C (PLB300) and 6000C (PLB600) followed by a toxicity study under four application rates of 2%, 4%, 5%, and 6%. The proximate and ultimate analyses were carried out to assess the physicochemical properties of poultry litter biochar. The moisture content (%), volatile matter (%), and biochar yield (%) are found high in PLB300. While, the bulk density (g/cm³), ash content (%), and fixed carbon (%) were maximum in PLB600. The alkalinity and Electrical conductivity values increased with increasing temperature. The percentage of elements such as Carbon (%), Hydrogen (%), and Sulfur (%) in PLB600 was higher than that of PLB300. A seed germination trial was conducted to analyze the toxicity of biochar under four different application rates (2%, 4%, 5%, and 10%) with control. The results showed that PLB300 at a 2% rate of application exhibited the highest percentage in seed germination (%) and Seedling Vigor Index (SVI) compared to the PLB600. Hence, it can be concluded that biochar from poultry litter at a suitable temperature and appropriate application rate, will enhance the agricultural soil fertility. Further investigations are required to understand the effects of temperature ranges from 2000C to 6000C in the physicochemical and toxic properties of prepared biochar before large scale, long term supplementations in soil. This piece of work provides insight into the conversion of poultry litter to biochar as a sustainable method for managing these organic wastes from the poultry sector.

Keywords: Poultry litter, Biochar, Pyrolysis, Feedstock, Organic Wastes, Soil fertility.



Impact Assessment of Open Dumping and Garbage Farming on Human Health and Adjacent Ecosystem: A Case Study

Ria Ghosh¹, Dr. Tumpa Hazra^{2,*}

¹ Post Graduate Student, Civil Engineering Department, Jadavpur University, Kolkata, India

² Associate Professor, Civil Engineering Department, Jadavpur University, Kolkata, India

ABSTRACT: *Non-controlled Municipal Solid Waste (MSW) disposal as open dumping causes significant heavy metal (HM) pollution mainly in developing countries including India. In 2016, Indian Government imposed stringent rules against open dumping of solid waste without source segregation and treatment. However 60% of the MSW still disposed in open dumping because of simplicity in operation and lack of budget. Rapid urbanization and growth of population promote garbage farming adjacent to landfill area in urban India due to lack of agricultural field and high demand of food crops. The objective of the present study is to investigate the concentration of HMs in soil and ground water adjacent to landfill site at Dhapa, Kolkata. Finally the ecological risk and health risk were calculated to study the impact of HM pollution on adjacent ecosystem and human health.*

The results clearly indicate that the surface soil adjacent to leachate generation points and agricultural fields are heavily contaminated by HMs. The geo-accumulation index also supports the HMs pollution by MSW dumping. Ground water collected from the villages adjacent to landfill sites contained HMs concentration more than permissible drinking standard. The mobility of HMs from soil to crops was investigated by calculating biological accumulation concentration since the crops grown in the agricultural fields adjacent to Dhapa landfill site meet the demands of more than 40% of Kolkata city. The study supports the necessity of sustainable MSW disposal plan and immediate remediation of contaminated soil and groundwater to prevent dissemination of HMs and potential health and ecological disaster.

Keywords: *Municipal solid waste disposal, open dumping, garbage farming, water contamination, soil contamination, heavy metals, geoaccumulation index, bioaccumulation concentration, ecological risk, health risk.*



A Mini- Review on Economic Aspects of Market Waste Valorization in India

Sutripta Sarkar^{1,*}, Debaprasad Sarkar²

¹Department of Food and Nutrition, Barrackpore Rastraguru Surendranath College, Barrackpore, India

²Department of Economics, Barrackpore Rastraguru Surendranath College, Barrackpore, India

ABSTRACT: India, a densely populated country with an ever increasing population rate, a lot of waste is generated especially in cities and towns. Waste disposal and management is one of the major problems facing the municipal authorities with increase in urbanisation process. Treatment of waste and scientific disposal of urban waste is not only absolutely necessary for the preservation and improvement of public health but it has an immense potential for resource recovery. Moreover, a quantum of the waste generated is dumped into the landfills where it releases greenhouse gases and also pollutes the environment. Improper degradation leads to foul odour and pathogenic bacteria thrive to a large extent. Leaching from improperly built landfills pollutes the underground aquifers. Studies on composition of wastes have revealed that around 65% to 75% of the waste generated is either biodegradable or recyclable which provides an opportunity for composting. It reduces the waste through biological processes and the end product can be used as soil vitalizer. However, a lot of space is required to set up compost plants or unit as space is scarce in cities. Composting takes around one to two months or longer to complete depending upon the waste being biodegraded. Anaerobic degradation of waste to form biogas is a beneficial technology for waste valorization. With the development of technology, various other methods of valorization like biofuel, syngas, bio-oil production from waste are promising alternatives with high economic benefits. However, as market waste in Indian cities and towns contains more than 50% biodegradable material with high moisture content, composting seems the most likely method of valorisation. This mini-review paper is an attempt to comprehensively examine composting as a valorization method of biodegradable municipal solid waste (MSW) for economic viability in India. The current paper concludes with the fact that quality controlling and costing of the composting products, awareness to the users are the most lagging compartments against market waste valorisation processes in Indian context.

Keywords: Municipal Solid Waste, Waste valorization, Market waste, Composting, Economic benefits.



Moving from Waste to Resource Management: A Case Study of Lake Toba, Indonesia

Miwa Tatsuno*, Premakumara Jagath Dickella Gamaralalage, Kazunobu Onogawa

Institute for Global Environmental Strategies (IGES), Kamiyamaguchi, Hayama, Kanagawa, Japan

ABSTRACT: *This paper presents the experience of developing the local waste management plans called Kebijakan Strategi Daerah (Jakstrada) in the Lake Toba region. It examines the current waste management status and discusses key priorities and actions identified in the Jakstradas to improve the waste management based on sustainable and 3R (reduce, reuse and recycle) principles in the Lake Toba region that is a high priority tourist destination in Indonesia. In partnership with public, private, academic and citizen groups, the project activities supported the establishment of Jakstradas in all seven regencies and a resource recovery centre (RRC) as a model in the region. The key lessons learned from these projects are discussed and some practical recommendations are identified based on a literature review, interviews and workshops with local government officials and residents. Through those opportunities, it was found that the regencies in Lake Toba do not have environmentally sound final disposal sites, and do not have the financial as well as technical capacity to provide waste collection and handling services to residents, which often results in illegal dumping and open burning. It was also revealed that no market of recycling chains in the region and citizens do not conduct waste separation at source. The development of Jakstrada and the RRC is expected to drive the improvement of proper waste management moving from waste to resource management in the region including both institutional/organisational system and technical aspects.*

Keywords: *Waste management, 3R (reduce, reuse and recycle), plastic waste, Lake Toba, Indonesia.*



MSW as an IoT enabled service – A Case of Ekamra-Kshetra

Sukanya Dasgupta^{1*}, Avik Roy¹

¹ KIIT (DU), Bhubaneswar, Odisha, India

ABSTRACT: Development in the field of Information technology has open avenues for diverse opportunities in the field of Municipal Waste management. Smart Waste management, employing IoT is one of the latest trends that most smart cities of India have been following. Owing to the growing urbanisation, municipal solid waste is an essential task of any urban local body and a major point of concern as well. However, since the littering still happens in small bins with collection strategies that are bound by time and availability of labour, it is almost impossible to achieve a solution to the threats that the waste in public areas pose to the well being of the humans. Bhubaneswar being the first smart city is an emerging tourism destination that has implemented smart city platform to engage various stakeholders. It is also the temple city and these precincts attract a substantial percentage of these tourists. This transition from temple city to smart city has witnessed a lot being ignored in terms of infrastructure in the Old town which houses all the temples. The objective of this paper is to identify smart waste collection methods that when implemented in the old town of Bhubaneswar will offer results that are sustainable. This paper uses precedence that is being conceptualised and implemented not only abroad but also in India. The method adopted is to review the literature available in the field of waste collection using smart strategies. In addition to this similar the MSW management of similar precincts like the shore temple at Mahabalipuram and temples at Varanasi, wherein smart technologies are being used have been referred to as a case study. The best practices are then recommended in the analysis section. The study area, the Old town of Bhubaneswar, requires proactive implementation in the said field to avoid any irreversible alarming situation in terms of cleanliness and hygiene.

Keywords: Municipal Solid Waste, Smart City, IoT, urbanisation, pilgrimage tourism, garbage collection, sustainable.



Home Composter A Review

Satya Ranjan Panda¹; Kalpana Sahoo²; Basudeb Munshi³; Madhusree Kundu⁴

¹ Energy and Environmental Engineering, NIT Rourkela, Odisha, India

² Department of Civil Engineering, KIIT Bhubaneswar, Odisha, India

^{3,4} Department of Chemical Engineering, NIT Rourkela, Odisha, India

ABSTRACT: *The very existence of Biotic creatures directly depends on the type of food they eat. Generally, when the required quantity of food exceeds our limit it is wasted or it is dumped somewhere. So we can say that food wastage is done in all stages of our Food Pyramid. We, Homo-Sapiens, can at least utilise this waste generated at our kitchen by a Compost pit where in the output we get enhanced bio fertiliser as a resources. This is what the research paper talks about the development of Domestic Composter for organic wastes of houses as input and Bio Fertiliser as output. This composter is mainly an aerobic composter and that's the reason why it can act eco-friendly for treating the waste food generated and also the reduction in methane gas is reduced easily and efficiently. So, composting is in this day and age getting more and more attention in treating kitchen waste. Depending on the type of organic waste the nutrient content too varies as break down of this complex organic contents has to be done as a result emission of CH₄, CO₂ is minimised. The microorganism, pH, temperature, moisture are all other factors affecting the composting.*

Keywords: *Biotic, Food Pyramid, Compost pit, Bio Fertiliser, Parameters.*



Integrated Solid Waste Management in Smart Cities: A Case Study of Lagos State in Southwestern Nigeria

Oluwadare Joshua OYEBODE*

Civil and Environmental Engineering Department, Afe Babalola University, Ado-Ekiti (ABUAD), Ekiti State, Nigeria

ABSTRACT: *Integrated solid waste management is gaining substantial ground in smart cities. The paper x-rays solid waste management in Lagos state. Challenges linked with improper management of wastes, lack of adequate attention to circular economy and financial issues were identified. Flooding, unsanitary conditions, and other conditions that enhance pollution of the environment and outbreaks of diseases were checked. It has been concluded that integrated solid waste management is the way forward for hygienic environment, smart cities, circular economy and sustainable development in developing countries. The tasks of solid waste management are essential as it can lead to administrative, economic, and social problems. Recommendations include enacting of law that can enhance recycling, Zero Waste Management, employment generation, community Involvement for environment protection and circular economy.*



Knowledge, Attitude and Practices on Solid Waste Management of Communities Living Near Close Vicinity to Okhla Landfill Site in Delhi

Bini Samal^{1,*}, Paras Utkarsh², Shyamala Krishna Mani³, MD Omprakash⁴

¹ Forest Research Institute, Dehradun, India

² Indian Institute of Management, Shillong, India

³ National Institute of Urban Affairs, New Delhi, India

⁴ Indian Institute of Forest Management, Bhopal, Madhya Pradesh, India

ABSTRACT: Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. It may be categorized according to its origin (domestic, industrial, commercial, construction or institutional); according to its contents (organic material, glass, metal, plastic paper etc.); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc.). Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal.

Methods of waste reduction, waste reuse and recycling are the preferred options when managing waste. An important problem faced by many societies across the world is unhealthy disposal of solid wastes. Knowledge, attitude, practices of people plays a crucial role as their view point is extremely vital in providing solutions to future environmental problems. A cross sectional study was conducted among the households near Okhla, Delhi and a sample of 240 households were studied.

Strict surveillance, operationalizing and incentivizing segregation at source, organizing awareness campaigns, implementation of bye-laws shall ensure that generator pays user-fee, processes the waste in a decentralized manner, ensuring timely removal for disposal of solid waste by management are the key factors in reducing environmental hazards.

Keywords: Knowledge, attitude, practice, solid waste management.



Environmentally Sustainable Municipal Solid Waste Management - A Case Study of Thiruvananthapuram, India

Megha T. S¹, Dr. Akshey Bhargava², Sheetal Kamble³, Purvi Patil⁴

¹ Civil Engineering (Translational Engineering), Government Engineering College Barton Hill, Kerala, India

² Ex. Rajasthan Pollution Control Board, CEPT University, India

³ Assistant Professor, Environmental Science, P P Savani University, Gujarat, India

⁴ Environmental Science, P P Savani University, Gujarat, India

ABSTRACT: *Municipal Solid Waste Management (MSWM) plays an important role in sustainable development. The motivation for the present study includes the abysmal state and challenges in MSWM in urban India. The concept of zero waste is a latest one for confounding waste problems of our society. Urbanization contributes to enhanced municipal solid waste (MSW) generation along with unscientific handling degrades the urban environment and causes health hazards. The expansion of urban areas, industrialization and changing patterns of consumption results in increased municipal waste generation which deteriorate the quality of environment, posing risk to the sustainable development. The seriousness of the problem increases in a scenario where natural resources are decreasing and the traditional system of landfill is still being practiced extensively for solid waste disposal. This paper addresses the issue of MSW by taking the case of Thiruvananthapuram. It discusses the present municipal waste management system, new technologies, projected population and solid waste generation. In an evolutionary approach, it points out the challenges that the sector is facing and makes an attempt to suggest a way forward through new technologies and estimation of value added products that can be produced from the solid waste.*

Keywords: *Environment, sustainability, municipal sewage, management, generation trend, treatment options, economic viability.*



Potential of Earthworm for Solid Waste Management

Komal Duhan, Rachna Gulati¹, Mukhan Wati^{1*}

¹ Department of Zoology & Chemistry, Chaudhary Charan Singh Haryana Agricultural University (Hisar), India

ABSTRACT: Scientific investigations have established the viability of using earthworms as a treatment technique for numerous waste streams besides producing organic fertilizers. Vermicomposting method is fully utilized to manage the wastes towards a more sustainable approach and results in the bioconversion of the waste stream into two useful products, earthworm biomass and vermicompost. The worms that are used in the vermicomposting are *Eisenia foetida* and *Eudrillus euginae*. With the help of earthworms, organic waste is subjected to decomposition and compost is formed and it is good manure for growth of plant with a permissible NPK values. Earthworm while ingest organic waste and soil, consume heavy metals through their intestine as well as through their skin, wherefore concentrating heavy metals in their body. The present paper review the current state of knowledge on biology and species of earthworm, the use of earthworms for waste stabilization, vermicompost production for plant growth and heavy metal accumulation. Vermicompost retains nutrients for long time and while the conventional compost fails to deliver the required amount of macro and micronutrients including the vital NPK to plants in shorter time, the vermicompost does.

Keywords: Concentration, Manure, Sustainable, NPK, Worms.



A Review: Municipal Solid Waste Management in India

Komal Duhan¹, Rachna Gulati¹, Mukhan Wati^{1*}

¹ Department of Zoology & Chemistry, Chaudhary Charan Singh Haryana Agricultural University (Hisar), India

ABSTRACT: *Municipal solid waste management (MSWM) is one of the major environmental problems of Indian cities. Improper management of municipal solid waste (MSW) causes hazards to inhabitants. Various studies reveal that about 90% of MSW is disposed of unscientifically in open dumps and landfills, creating problems to public health and the environment. In the present study, an attempt has been made to provide a comprehensive review of the characteristics, generation, collection and transportation, disposal and treatment technologies of MSW practiced in India. The study pertaining to MSWM for Indian cities has been carried out to evaluate the current status and identify the major problems. Various adopted treatment technologies for MSW are critically reviewed, along with their advantages and limitations. The study is concluded with a few fruitful suggestions, which may be beneficial to encourage the competent authorities/researchers to work towards further improvement of the present system.*

Keywords: *Characteristics, Hazards, Municipal, Unscientifically.*



Strategy for Electronic Waste Management for Sustainable and Green Environment in Nigeria

Oluwadare Joshua OYEBODE*

Civil and Environmental Engineering Department, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria

ABSTRACT: Sustainable environment and green societies can be attained through adequate management of electrical and electronic wastes. Electrical and equipment (EEE) become technologically obsolete during a matter of months as a result of continuous development of latest models. This paper examined handling, disposal and management of electronic waste in Nigerian environment. Methodology adopted includes literature reviews of issues on this subject matter, specific site inspection, surveys and secondary data from users and industries with massive electronic waste. It has been discovered that these wastes have not been management effectively for greener society. Most of the obsolete equipment finds their way into developing countries such as Nigeria that are eager for information technology access. It has been concluded that most health issues and industrial pollution can be traced to the inadequate management electronic wastes. Electronic wastes eventually find their way into landfills because of arrival of latest electronics, hence electronic Waste (E-Waste or Waste EEE) pose health challenges and environmental hazards to humans, livestock and ecology due to poor management. Facilities, legal framework, and alternative initiatives and means of managing E-Waste both nationally and internationally are essential in developing countries. Electronic wastes issues could be turned into a useful tool for capacity building of various sectors with employment generation, wealth creation, opportunities and poverty alleviation. Recommendations are made for better policy, appropriate technology and treatment of Electronic waste for environmental sustainability, socio-economic development and pollution reduction in Nigeria.

Keywords: Electronic Waste, Environmental Sustainability, Pollution Reduction, Green Societies.



Construction Wastes Management Towards Innovation and Circular Economy in Nigeria: Challenges and Way Forward

Oluwadare Joshua OYEBODE*

Civil and Environmental Engineering Department, Afe Babalola University, Ado-Ekiti, ABUAD), Ekiti State, Nigeria

ABSTRACT: *There are hidden treasures that can be harnessed from construction wastes, demolitions on building sites and civil engineering construction works. This paper examined various construction wastes in Nigeria and viability of innovation and circular economy from it. The methodology adopted includes reconnaissance surveys, site inspection and secondary data from literatures. Various challenges that can affect construction waste recycling and overall site management were identified. Findings revealed that constructions wastes can be recycled and reused for other construction works. Resource recovery, business opportunities and reduction of environmental pollutions are part of tremendous benefits that can be derived from this. Construction waste management has not gained maximum attention among clients, project managers, contractors, civil engineers and other professionals in Nigeria. It was concluded that adequate framework and professional advice need to be put in place by civil engineers, safety officers, environmental experts, government and other professionals for the realization of circular economy and innovation in construction sector. Innovation and circular economy is major driver of sustainable development and cleaner environment. Nigeria has great potentials to become a zero waste society and environmentally friendly nation. All recommendations towards this should be thoroughly checked before implementation.*

Keywords: *Construction Waste Management, Circular Economy, Civil Engineering Environmental Pollutions, Demolitions.*



Swachha Sundara, Namma Bidar; Waste Management project in the Karez of Naubad

Naveen YS *

Saahas NGO, 21, First Floor, MCHS Colony, 5th C Cross, 16th Main, BTM Layout 2nd Stage, Bangalore

ABSTRACT: The Karez of Naubad are more than 7 century old historical underground water channel system in the Bidar district of Karnataka, India. This project started in January 2018, was to restore the Karez of Naubad, to facilitate a cleaner environment and to enable energy recovery from non-recyclable dry waste.

The project is nearly 3 years old, and nearly 286 MT of waste has been handled, out of which nearly 70 MT of non-recyclable dry waste has been sent to cement industry for co-processing, where dry waste is used as a source of energy in the cement kilns and it partially replaces coal, which is still commonly used in India.

Therefore the waste management project at the historical Karez area is both environment friendly, by preventing open burning and dumping of waste, and energy friendly by making optimal use of alternative energy sources for the cement industry. Thereby it is helping preserve the heritage site for the future generations. The project also helped in creating local entrepreneurs who now handle waste on their own, generate revenue by the sale of compost and recyclable materials, and facilitate transport of non-recyclable part of dry waste to cement industries, thus helping in energy recovery from waste. Circular economy of waste is thus achieved through the implementation of this project.



E-Waste as an emerging Public Health Challenge- Indian Perspective

Prof.P.Vijaya Lakshmi ^{1*} and Y.Sathvik ¹,

¹ Sri Padmavati Mahila Visvavidyalaya,(Women's University),Tirupati, Andhra Pradesh

ABSTRACT: *E-waste is one of the fastest growing problems in the world. India is the 3rd largest producer of electronics waste, or e-waste, in the world after China and the United States. India generates 3230 (KT) of e-waste in 2019. Following the current growth rate of e-waste, it is estimated that India generates 5 million tonnes by 2021. E- Waste in India has emerged as a public health challenge due to India's lack of appropriate infrastructure and procedures for its disposal and recycling though regulations are in vogue. Although the Indian Government introduced its dedicated e-waste management policy, less than 5% of e-waste in India is recycled through formally regulated units. The informal sector handles the rest with rudimentary methods without considering the environmental and health implications either for workers or public. There is a body of research that shows a significant risk to workers involved including women and children and public residing near the sites of recycling. Studies indicate that chemicals in e-waste such as lead, mercury, cadmium, chromium have serious impacts on nearly every organ system. It creates a massive threat to the environment and health in India. This paper reviews studies that provide evidence for the association between exposure to e-waste and adverse health outcomes and discusses the existing regulations and e-waste management methods to address this rapidly growing problem.*



Public Policy Toward Municipal Plastic Waste in Bandung City, Indonesia

Arisman^{1,*}, Suyud Warno Utomo²

¹ Senior Lecturer, Department of Development Economics, Faculty of Economics and Business, UIN Syarif Hidayatullah Jakarta & School of Environment, University of Indonesia

² Associate Professor, School of Environment, University of Indonesia

ABSTRACT: Plastic Waste is one of the most critical global challenges nowadays. In the particular case of Indonesia, the problem has become a major challenge, and the need to find sustainable solutions is overwhelming. However, the country faces several challenges that hinder the development of an effective and efficient Solid Waste Management (SWM) system. The aim of this paper is to investigate the escalating problem of plastic waste in Indonesia, while focusing on Bandung city in Indonesia. The main challenges towards effective and efficient policy to reduce plastic waste and recommendations for improvement are gathered in this study based on the explored literature and to analyze the situation in order to propose suitable plastic waste policy for Bandung City based on data/information analysis. To reach the milestone, the interviewing of local administrators and experts in field of solid waste management as well as reviewing of relevant documents are needed. The Analytic Hierarchy Process (AHP) method is implemented to evaluate a sustainable plastic waste management for Bandung City by considering a sustainability model that is associated with environmental, social and economic aspects. The result using Expert Choice software shows the values of the policy preference on plastic waste policy in Bandung City i.e. Reducing single-use plastic products = 0.520, and Ban singles use plastic products = 0.480. Findings from this study are expected to be beneficial to local governments, academics, and policymakers contending with the problems of plastic waste in Indonesia.

Keywords: Plastic waste, analytic hierarchy process (AHP), sustainable municipal solid waste, multi-criteria decision making, Public Policy..



Assessment of the Performance of Different Animal Manure and Feecal Sludge Composting to Optimize the Mix Proportion – A Review

Balaganesh Pandiyana^{1*}, Vasudevan Mangottiria², Natarajan Narayanan³

^{1,2}Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu

³Dr. Mahalingam College of Engineering and Technology, Pollachi Tamil Nadu

ABSTRACT: Proper management of the livestock using suitable methods/technique is one of the feasible ways to achieve the target of sustainable development goals. Developing countries like India generates around thousand million tonnes of animal wastes annually. Composting is a sound technology to manage different types of organic wastes in efficient manner and it reduces the risk of runoff and leaching contaminations. However, the successful production of stable and matured compost is challenging due to varying amendment proportions and other ambient conditions such as C/N ratio, temperature, pH, moisture content, sufficient aeration, etc. The present study aims to review the impact of selecting proper mix proportioning of different animal manure with and without feecal sludge during co-composting. The study highlights the state of the art in terms of (i) carbon and nitrogen transformation after composting, (ii) challenges in preparing ambient conditions, and (iii) feedstock selection to optimize the mix proportions. The results of the study would impart sound technological interventions required to make the best use of animal manure and feecal sludge compost in low fertile soils..

Keywords: Animal manure, Feecal sludge, Compost, C/N ratio, Low fertile soil



Adaptation of Recycling Policy for Solid Waste Management for Kolkata Metropolitan City

Udita Mukherjee¹, Kaniska Sarkar^{2,*}

¹ Research Fellow, Department of Geography, Jadavpur University, Kolkata, India

² Assistant Registrar, Jadavpur University, Kolkata, India

ABSTRACT: Solid wastes belong to garbage, plastics, rubbish, semi-liquid discarded etc. Problems for proper decomposition of solid wastes in Kolkata Metropolitan City are very crucial. The main reasons for the mismanagement are lacking of proper segregation of wastes materials, improper disposal system, in sufficient transportation for dumping, lack of awareness of motivation in human society. As a result different types of pollution created by the solid waste dumping ground invites socio economic and cultural hazard day by day. Adaptation of proper techniques for recycling system in solid waste materials derivatives the same product in a fresh state from the waste. So specific technical management need to be introduced to look after the different types of recycling among the articles of plastic, metal, wood, glass, textile, bricks, paper, semi-liquid etc. This paper will mainly highlight the methodology of recycling process for different types of waste materials to minimize the waste amount and avoid pollutants contamination in air, land and water.

Keywords: Solid waste, problems, recycling methods, policy.



Bioaccumulation of cobalt by two identified bacteria isolated from galvanizing industrial sludge

Dipankar Roy^{1,*}, Arup Kumar Mitra²

¹ Research Scholar, St. Xavier's Collage, Calcutta University, India

² Associate Professor, St. Xavier's College, India

ABSTRACT: Cobalt is considered as a heavy metal which is one of a trace metal required for activation of enzymes and coenzymes needed in metabolic pathways. This is an important component of Vitamin B12. But excess amount of cobalt is hazardous for living being. There are several health problems occurred for deposition of excess cobalt in the body. Recently industrialization and urbanization makes human life easier but as a result of this more amount of heavy metals like cobalt contaminate the environment and as animals get in touch with this so no. of different types of diseases are increasing day by day. Our recent aim is to find out bacteria which can help to detoxify this hazardous cobalt in the environment by the process of bioremediation. We have selected galvanizing industries in Howrah district, West Bengal. From these galvanizing industrial sludge two bacteria have isolated from eight different types of bacteria (Ga1, Ga2, Ga3, Ga4, Ga5, Ga6, Ga8, and Ga9) on the basis of their highest cobalt tolerance ability and later identified by 16s rRNA analysis. Now they were grown in several different environment with different concentration of cobalt to identify what percentage they are able to accumulate themselves. It is revealed that they accumulate this metal near about 70-80% from the growth media enriched with cobalt. They are also not antagonistic to each other. For that we can use both as consortium to cobalt radiation. So, these bacteria should be an important tool for cleaning the cobalt from environment which is our utmost priority now. So this study is most relevant and important in recent context.

Keywords: Industrialization, Urbanization Cobalt, bacteria, Sludge, Antagonistic, Bioremediation, 16srRNA, Consortium.



Sustainable municipal solid waste management: A GHG reduction study of Kolkata

Samran Banerjee¹, Amit Dutta²

¹ Dept. of Civil Engineering, Jadavpur University, Kolkata, India

² Professor, Dept. of Civil Engineering, Jadavpur University, Kolkata, India

ABSTRACT: Increasing inefficiency of Solid Waste Management (SWM) system in developing countries like India is not only diminishing the environmental standards of sustainability but also generating greenhouse gases (GHGs) causing global warming effects. With a per capita average municipal solid waste generation rate of 450-500 g/day under Kolkata Municipal Corporation (KMC), the Kolkata city does not have an efficient waste management system. A mathematical linear programming model for integrated municipal solid waste management system has been developed by considering rate of waste generation, their composition, reuse and recycling, mode of transportation, revenues generating from waste processing, waste disposal to engineered landfills along with transfer station in this case study to meet the needs of sustainable development. The mathematical model was solved by LINGO optimisation software. In the existing scenario, the estimated major potential GHGs are contributed by around 71% CO₂ by wt. and 27% CH₄ by wt. from Dhapa landfill and about 2% by wt. CO₂ from transport sector. In the proposed integrated system, around 97.9% of CO₂ by wt. from vehicular emission, incineration and composting and rest of methane emission leads to GHG pollution. Minimization of methane is the sole objective due to its higher GHG potential than CO₂. As a result, however, CO₂ emission in proposed system is increased especially due to incineration plant but the CH₄ emission is reduced drastically due to high inert content in proposed landfill sites. So, possible GHG reduction is around 67.1% as CO₂ equivalent by proposing an Integrated Solid Waste Management (ISWM) system to meet the environmental sustainability.

Keywords: Integrated Solid Waste Management, GHG reduction, Linear Programming, LP model, Kolkata.



E-waste in Mexico's northern border cities: challenges and prospects

María Eugenia González Ávila*

El Colegio de la Frontera Norte, sede Monterrey Nuevo León, México. Técnicos 277, Tecnológico, 64700 Monterrey, N.L

ABSTRACT: *Recently, Mexico is reported in second place as a generator of electronic waste (e-waste) in Latin America, this even though it has three international agreements and a legal framework for its collection, management and final disposal of e-waste; where state and municipal governments participate, and even private companies. However, the problem of the e-waste remains dormant, especially in the border cities of northern Mexico.*

The problems of said waste and its socio-environmental impact are given, among other things, due to the high flow of e-was due to access to purchase and price; illegal donation, disposal and even importation of electronic devices from the United States of America to the border. To which is added, the short life cycle of the devices, an uneven selective separation and a different number of recycling companies and management actions of border governments.

Under the aforementioned answer, there are great challenges to be faced by border entities such as clear regulations for collection and recycling, including regional management actions, the issue of the extended responsibility of the formal, informal and government sectors and pushing it into national policy As well as the I develop forms of professional recycling for the recovery of valuable materials, in addition to promoting campaigns on the potential risk to health and the environment, and generates environmental awareness among consumers under the comprehensive management of e-waste..

Keywords: *Waste, electronics, management, electrical, border.*



Strategies to Reduce Marine Plastic Pollution from Land-based Sources in Low and Middle-Income Countries

Kazunobu Onogawa*

IGES/CCET

ABSTRACT: *Plastic waste management in relation to marine plastic debris control is being discussed in the world and getting an interest of many Asian countries as well. Many countries and cities are starting to take actions through the development of their strategies or action plans.*

IGES/CCET has published a report to discuss how to promote developments of such action plans with examples of possible policies and activities based on the holistic discussion on this subject. Streamlined discussions are made in the report with proposals of actions from different perspectives including regulations, economic instruments, technologies, EPR, use of data and information. Such possible actions are also discussed in accordance with categorizations for short term, mid-term, and long term actions.

The initial action expected to cities and countries is the development of their own strategies/action plan as the first step for this endeavor. Cities can develop such a plan based on the ideas prepared in the lists of this report. This report targets officials of governments and municipal authorities as the first beneficiaries, but it is also for academicians and professionals for their work to support cities and countries. At the same time, they are invited to make contributions for further development of this report by providing practical ideas and options for plastic waste management in cities and countries.

Activities of IGES/CCET work on plastic waste management would be also discussed in relation to this report.



Nanowaste Management and the Fate of Nanomaterials in Bioreactor Landfills

Mehmet Sinan Bilgili*

Professor, Yildiz Technical University, Istanbul, 34220, Turkey

ABSTRACT: *Nanomaterials are being used in a wide variety of applications and consumer products such as personal care products, electronics, textiles, pharmaceuticals, energy, and environmental applications because of their unique properties in the last two decades. As a result of the increased production of consumer products containing nanoparticles, the concentrations of these materials are expected to increase in the waste streams in the near future. Although engineered nanoparticles paved the way for major innovations in the fields of modern science and engineering, there is a great concern about the potential unexpected health and environmental impacts. In addition, these newly developed materials may lead to new problems by revealing the inadequacy of existing waste management systems.*

Nanotechnology has launched a new era of miniaturization of industrial scale production. However, this has triggered the emergence of a new waste group (wastes containing nanomaterials) that could create difficulties in existing waste management practices. This new waste group is called “nano waste”. Nano wastes include waste groups containing nano materials; nano-scale synthetic by-products produced during production, storage or distribution; end-of-life nanotechnological materials or products; and materials contaminated with nano materials such as pipes, and protective clothing.

The aim of this study is the determination of nanomaterial behavior in sanitary landfills, their effects on decomposition process, determination of potential changes in leachate properties, their effects on the microorganism species in landfills and examination of their transport from landfill bottom liner to groundwater.

Keywords: *Nanotechnology, nanowaste, waste management, bioreactor landfills.*



Parametric optimization for regeneration of waste lubricating oil by CCD approach

Sayantana Sarkar¹, Deepshikha Datta², Bikash Kumar Mondal¹, Bimal Das^{1,*}

¹ Department of Chemical Engineering, National Institute of Technology Durgapur, India

² Department of Chemical Engineering, GMR Institute of Technology, GMR Nagar, Srikakulam, Rajam, Andhra Pradesh, India

ABSTRACT: Due to enormous growth of population, increasing comfortness and modernization of industry, there is continuous replenishment of natural resources that leads to prodigious crisis of conventional petro-fuel. Lubricating oil is an important constituents that comes from crude petroleum oil, which paves away the heat from an engine, protecting against rust, reducing the friction and wear by interposing the film, between rubbing surfaces to reduce the friction. The waste oil produced after prolonged use of lube oil poses a serious threat to the environment, human health, technology and the economy and needs its appropriate management. Re-refining is the embryonic technology that helps to eliminate all the contaminant present in waste automotive lubricating oil which could results in a reduction in the export of lube oils, reduction of transportation cost besides conversion of waste to energy. During last two decades, Extraction-Flocculation technology emerges as the most promising technology in re-refining of waste lube oil. In the present study, CCD approach of Response surface methodology was employed to optimize the set of operating parameters in Extraction-Flocculation technique such as (i) extraction temperature: 50.17°C, (ii) extraction time: 80 minute, (iii) solvent: waste oil: 7 g/g, (iv) flocculant concentration: 3 g/kg of solvent. Finally 86% recovered oil yield is obtained with CCD approach. Determination of the physico-chemical properties like Kinematic viscosity @ 40°C (141), specific gravity (0.85), flash point (230°C) and pour point (-25°C) of the recovered oil justifies that the quality of the recovered oil is similar to the fresh oil and thus can be very effectively used considering the environmental and economic aspect.

Keywords: Waste lubricating oil, Response Surface Methodology, Central Composite Design, Extraction-Flocculation, Optimization, Percentage of yield.



Waste Management in Belegkata Deshbandhu Girls' High School (H.S.)

Dr. Mandira Ghosh*

Belegkata Deshbandhu Girls' High School (H.S.), India

ABSTRACT: *The aim of our project is collection of waste that is generated throughout the day in our school and how to recycle it and make the waste more productive. We have constructed a waste segregation game making waste item cards, electronic waste, dry recyclable waste, construction/demolition waste, biomedical waste, wet compostable waste and hazardous waste are kept in separate box. We want to make a zero waste school and tried to identify a zero waste student from our school. To make a zero waste school by playing game cards, segregating waste is not enough. We have to recycle the products. We have compared different waste product created in different generation during marriage, puja occasion, and thread ceremony. There are some limitation in this work like managing the waste thrown by students, chemical waste created in laboratory and the e waste generated in computer and smart laboratory are posing hazards to the human and domestic animals in the society.*

The practical activity are the recyclable products like paper, plastic, bottle, calendar, bags, towel are used for making handicrafts, flowers, vegetable peels are used as colour dye. Egg shells, tea leaves, used as fertilizers and fruit peels used for facial products, bottles used in hanging garden in window pane. Social effects are plastic which is creating hindrance in the society, eco bricks has been prepared by taking bottles and keeping plastic inside the bottle, for which plastic incineration is not required. This helps in protecting the society from pollution.

All this recyclable waste products helps the society to earn their own living, getting employment..

Keywords: *Segregation, zero waste, limitation, eco brick, own living.*



Critics on Solid Waste Management Policies: Advancement towards a zero-waste goal

Monjit Roy¹, Srimanta Ray^{2,*}

¹ Civil Engineering Department, National Institute of Technology, Agartala, Tripura, India.

² Chemical Engineering Department, National Institute of Technology, Agartala, Tripura, India

ABSTRACT: *The growth of science and technology, expansion of the urban areas and the multiple development of the industries is wide spreading the fire towards environmental degradation. Municipal solid waste management plays an important role for sustainable development of the developing countries. In the age where the management of resources, particularly natural resources, is a priority the orthodox waste management policies are obsolete. A decision making framework and standard or advanced policies for improved waste management are to be implemented on a priority. The world needs to have parity among the policies of the nations in order to balance and maintain a rightful march towards sustainable waste management practices. The concept of zero waste, and sustainable environmental consumption is the need of the hour. A meaningful transition of municipal solid waste management requires the ideas of historical developments and achievements. The role of government and institutions is of prime importance to facilitate adoption of technology in the countries lacking in effective waste management. This paper reviews the common themes towards waste managing concept along with the zero waste techniques and value addition of waste as a way towards nourishing the waste management practice. Policy makers having conjugate ideas about fundamental and advanced measures for managing municipal solid waste deals with a major impact regarding failures towards the previous implications. The objective of this paper is to critic the management schedules made by various countries through different interacting factors of policy, environmental, socio-economic and technology for sustainable development.*

Keywords: *Critics, Policies, Municipal solid waste, Management, Technology, Socio-economic, Zero-waste.*



Analysis of the technical and financial approaches to solid waste management in a medium-sized city: case of Sokodé in Togo

Nitale M'Balikine KROU^{1*}, Gnon BABA¹

¹ Laboratory of Sanitation, Water Science and Environment (LSWSE), University of Kara, Togo

ABSTRACT: *The rapid growth of the population of Sokodé city has generated during these recent decades the production of enormous quantities of solid waste in the city.*

The daily production of solid waste generated in the city of Sokodé is estimated at more than 61 tons. It was then interesting to know how this waste stream is managed from production to landfill. The objective of this study is to carry out an analysis of the technical and financial implications in the modes of solid waste management in the city of Sokodé in order to provide the municipality with indicators to further convince households and other sectors of 'socio-economic activities to abandon the bad practices of traditional management and get them to join the paid collection service.

The establishment of a sanitation master plan in the city of Sokodé will make it possible to increase the rate of pre-collection of solid waste by 2035. Thus, an average amount of around 71700 euros will have to be mobilized each year to ensure complete pre-collection of solid waste in the city of Sokodé. This expense includes the purchase of small pre-collection equipment and bonuses for pre-collection staff. Based on the evolution of the number of households and other sectors of socio-economic activity in the city of Sokodé between 2020 and 2035, revenues could reach 22900 euros in 2035. The characterization campaigns showed that an inhabitant of the city of Sokodé in 2020 produces on average 0.51kg of waste per day.

Keywords: *Waste, management, traditional, associative, costs.*



Using Steel Ladle Furnace Slag in Cementitious Media

Iffat SULTANA, G. M. Sadiqul ISLAM*

Chittagong University of Engineering and Technology, Bangladesh

ABSTRACT: Ladle furnace slag (LFS) is a by-product in the steel production process, generally used for landfill. The cement production process is generally unsustainable and requires to search for alternative materials. Both landfilling with slag and cement production have a high impact on the environment. To reduce these impacts, this study aims to evaluate the cementitious properties of ladle furnace slag as a substitute for cement. LFS is used as the partial replacement (5%, 10%, 15%, 20%, 25% and 50%) of cement in the concrete of two different strength classes (35 MPa and 41 MPa). Both raw slag and its finer part (passing through #200 sieve) were used to compare their performance. The compressive strength of both mortar and concrete was evaluated. The tensile strength of concrete was also examined. It was observed that using finer slag, increases the strength up to a certain cement replacement level. The strength improvement was in the range of 20 to 30% compared to the control concrete without slag. However, beyond a certain replacement level, the strength was reducing. Therefore, recycling LFS as cement replacement up to a certain ratio in concrete construction can be a construction solution leading towards saving cost and environment.

Keywords: Ladle Furnace Slag (LFS), industrial by-product, Cement replacement; Compressive strength.



Quantification and Characterisation of microplastics in freshwater kaveri river sediments collected at Tiruchirappalli, India

Selvakumar Muniraj¹, Praveenkumar Dharmaraj¹, Tamilselvi Duraisamy¹, Sivasankar Venkatraman², Vasanthi Muthunarayanan^{1,*}

¹ Water and Solid Waste Processing Lab, Department of Environmental Biotechnology, Bharathidasan University, Tiruchirappalli, Tamil Nadu, India.

² Department of Chemistry, Pachaiyappa's College, Chennai, Tamil Nadu, India

ABSTRACT: Plastic debris is one of the most significant organic pollutants in the aquatic environment. Synthetic polymers are found in rivers, lakes, and oceans, and get collected in sediments all over the world, due to properties such as buoyancy and extreme resilience. However, freshwater kaveri river sediments have attracted less attention than the investigation of sediments in marine environment. Under the light microscope, four types of microplastics were observed, such as foams, fibres, films and fragments. In sediments, fragments were commonly presented. The surface topography of microplastics is complex, usually including porous structures, extensive damage, rough surfaces and cracks. Scanning electron microscopy with energy dispersive X-ray analysis showed that Si, Na, Ca, Cl and Al were present in most microplastics. Overall, the findings show clear evidence of large amounts of microplastics in freshwater kaveri river sediment in Tiruchirappalli, indicating that the condition of microplastics contamination in the kaveri river should continue to be controlled.

Keywords: Microplastics, Microplastic quantification, Kaveri river, FT-IR, SEM-EDX.



Green synthesis of gold nanoparticles using *Oldenlandia corymbosa* plant extract

K S Deepak¹, Deepshikha Dutta², Bimal Das^{1,*}

¹ Department of Chemical Engineering, National Institute of Technology, Durgapur, India

² Department of Chemical Engineering, GMR Institute of Technology, GMR Nagar Razam, India

ABSTRACT: Nanoparticle technology plays a key role in providing opportunities and possibilities for the development of a new generation of sensing tools. In today's world, using the available and field-proven polluting methods cannot be the *Casus belli* for the damage incurred to nature. Green synthesis is an innovative method to approach the synthesis of metallic nanoparticles employing eco-friendly substances acting as reducing agents. The present study elaborates on the green method of extraction and synthesis of gold nanoparticles (GNPs) by reducing chloroauric acid (HAuCl₄) with the plant extracts of *Oldenlandia corymbosa*. For the preparation of plant extract, the roots of the plant were pruned before washing so to remove any dirt. This was followed by drying for 2 consecutive days. The dried plant was then powdered and mixed with distilled water. This solution was then subjected to 3 stages of filtration: first by a normal filter, then by filter paper of 40 of 110 mm diameter and finally through a syringe filter of pore size 0.22 μm. The final product was the ready-to-use plant extract which was then added with gold chloride solution followed by heating and stirring till the wine-red color appeared thus confirming the formation of gold nanoparticles. Formations of gold nanoparticles were then approved from the surface plasmon resonance band in the Ultraviolet-visible (UV/Vis) spectrum, maxima at 542nm and from the SEM images.

Keywords: *Oldenlandia corymbosa*, Gold nanoparticles, Green synthesis, Surface plasmon resonance.



Assessment of Solid Waste Management Options in the Slums of Khulna City

Tusar Kanti Roy^{1,*}, Azmeri Ferdous², Sadika Maheruma Khan³

¹ Associate Professor, Department of Urban and Regional Planning, Khulna University of Engineering & Technology (KUET), Khulna, Bangladesh,

² Lecturer, Department of Urban and Regional Planning, Khulna University of Engineering & Technology (KUET), Khulna, Bangladesh,

³ Research Assistant, Department of Urban and Regional Planning, Khulna University of Engineering & Technology (KUET), Khulna, Bangladesh

ABSTRACT: The gradual increasing production rate and amount of wastes globally is supposed to explore such a solid waste management (SWM) system that not only brings the least negative impact on the environment but also makes people earn from it. Among the 520 slums of Khulna City, Rupsha, Montu Colony and Kulibagan slums are selected as study slums to assess their SWM options using Multinomial Logistic Regression. While investigating the existing SWM, wastes having potential for recycling or reuse are considered. In the slums, several NGOs namely Caritas, BRAC, World Vision, Prodipan are working to promote recycling and reuse of wastes by providing orientation, training and logistic supports. They even provide monetary support to slum dwellers for organic bag gardening and running small waste based business. To perform the regression test, year of schooling of the slum dwellers, ownership of bag garden, enrolment in training programs on SWM etc. are taken as variables. The value of variance inflation factors (VIFs) for each of the variables is less than 10 and the developed model shows a good fit. Three models developed separately for each slum show that year of schooling, keeping livestock, training, ownership of bag garden etc. variables are common determining factors of selecting SWM options. Kulibagan slum is deprived of training programs resulting in higher tendency of indiscriminate waste dumping by the slum dwellers. Among the three slums, Kulibagan slum needs attention from NGOs. Raising awareness and training are the two better approaches towards sustainable SWM in the slums.

Keywords: Khulna City, slum, waste composition, SWM options, NGO, Multinomial Logit Regression.



Perspective on Glass Waste Management

Abhigyan Chakraborty¹, Srimanta Ray^{2,*}

¹ Civil Engineering Department, National Institute of Technology, Agartala, Tripura, India.

² Chemical Engineering Department, National Institute of Technology, Agartala, Tripura, India

ABSTRACT: Glass is common in our daily life. Glass waste are generated from disposed glass materials. Glass is one of many materials that can be completely recycled. Glass can be re-melted and re-fabricated without any deterioration of the material properties. The recycling glass consumes 40% less energy than manufacturing. The recycling of glass creates less pollution, saves enough energy, minimizes landfill consumption, reduces greenhouse gas emissions, and creates employment. The challenges for recycling of glass involve the presence of contaminants from additives, like tinting agents, and other non-glass materials. The other challenges include low availability of glass waste and requirement of manual labour for sorting and recycling. Further, waste glass is often contaminated with hazardous and corrosive substance due to improper disposal. Therefore, the choice of proper technological means is important for management of the valuable glass waste. However, the scopes of applications of glass waste is on the rise. A promising application is to reuse glass waste as crushed glass aggregates as replacement of siliceous raw materials in the making of house hold glass items, construction materials and variety of other applications. Also, many new applications and manufacturing processes involve combination of glass with other materials. Recently, there has been a huge demand in the use of glass materials in biological and medical industries. Thus, the recycling of glass waste has a promising future. This paper presents an overview on the various technological means for recycling glass waste and discusses various application scope for utilization of waste glass.

Keywords: Glass waste, recycling, applications, technology, management.



From Urban Waste to Urban Farmers: Can we close the agriculture loop within the city bounds?

Rafael Carvalho Machado^{1,*}, Sieglinde Kindl Da Cunha²

¹ Universidade Positivo, R. Prof. Pedro Viriato Parigot de Souza - Cidade Industrial De Curitiba, Curitiba - PR, 80740-050

² Universidade Tecnológica Federal Do Paraná, R. Dep. Heitor Alencar Furtado, 5000 - Cidade Industrial De Curitiba, Curitiba - PR, 81280-340T

ABSTRACT: As urbanization intensifies in Brazilian cities (UNITED NATIONS, 2018), life quality in urban centers becomes a greater challenge for policymakers. Innovative solutions and transitioning urban systems to sustainability are required to solve modern urban problems. Circular economy-based alternatives may contribute to face challenges, especially those owing to municipal solid waste (MSW) management. Curitiba is a southern Brazilian municipality which is known for its innovative initiatives towards sustainability: the city's holistic sustainability plan was recognized by the Globe Award (GLOBE AWARD, 2010); also, the city's Urban Agriculture Program was awarded the C40 Awards (C40, 2016). This program promotes urban vegetable gardens in schools, public buildings and areas that are, otherwise, urban wasteland. Community gardens assisted by the program receive material support - such as seedlings, fertilizers, and equipment - and technical training (CURITIBA, 2017); Recyclable waste has been collected separately since 1989, when the city was awarded a United Nations award.

Despite this great performance, roughly 800 thousand tons of MSW are still transported to a landfill located 50km from Curitiba every year. Handling, transporting and disposing this material is of great environmental impact. To reduce this impact, the municipality bets on composting 35-50% of the MSW that is compostable. Although composting can be carried out in specialized treatment units as recyclables are, this would not eliminate collect and transportation impacts (MOREIRA, NETO, 2009).

This bet faces difficulties due from factors identified in previous studies, such as the stigma of waste handling (PUZZOLO et al, 2016), organizing new processes for selecting and reusing waste, learning to handle new equipment (KELEBE et al, 2017) such as domestic composters, the insufficient organic material flow (BECKCHANOV et al, 2018) needed for efficient composting and incompatibility between consumption and production (BÖSSNER et al, 2019). In this sense, urban agriculture facilities seem to be a likely context where composting practice can be promoted, closing the agricultural loop within the city bounds. Urban agriculture's role goes beyond food security and sovereignty (ODS, ENAP, IPEA, 2019) as it can change people's relationship with food and household waste. These facilities use fertilizer, generate organic material, and already handle the tools needed for composting.

At the end of 2019, 24 communities of urban farmers were trained in composting techniques. That was not enough, however, to convince them to adopt composting. It has been studied how government-imposed technologies can be quickly abandoned if they don't make sense to practitioners, as shows cases with efficient domestic stoves (DICKINSON et al., 2018) and waste biodigesters (TIGABU et al., 2015). This study intends to understand how cultural perspectives influence the adoption of domestic composting.

To achieve this goal, urban farmers, neighborhood members and city officials were interviewed in a narrative method capable of understanding the subjects' point of view regarding domestic composting. Participant observations were carried out to complement a cultural description of each group point of view. From the analysis, cultural barriers to domestic composting adoption in the urban farming facilities were pointed out, which can support innovative actions from policymakers.



Effect of solids concentration for the solubilization of waste activated sludge in microwave pre-treatment

Ragashree Srinivas¹, Sabumon P. C.^{1*}

¹ School of Civil Engineering, Vellore Institute of Technology (VIT), Chennai Campus, Chennai, TN, India

ABSTRACT: *The anaerobic digestion process of activated sludge is very slow because of the slow degradation of the biosolids which leads to long residence time resulting the entire economy of sludge treatment process. This study aims for examining the effect of solids concentration for solubilization of activated sludge using microwave pre-treatment which can reduce the treatment time in anaerobic digestion significantly. The solids concentrations selected for the study was similar to aeration tank or secondary clarifier underflow mixed liquor suspended solids concentrations and such studies are not reported and can have alternate treatment options. Waste activated sludge concentrations (1.75, 3.13, 6.56, and 7.57 g/L) were studied in microwave irradiation (1270 W power, 2450 MHz frequency, and 12.24 cm wavelength) at varied time intervals (10 to 120 s with an increment interval of 10 s). After microwave treatment, the temperature, soluble COD, NH₄-N, and pH of the treated samples were analysed and reported. The results showed that temperature increases with increase in treatment time and solids concentration and time required to attain a higher temperature decreases with increase in solids concentration. The degree of solids solubilization increases with solids concentration at less treatment time without an effective breaking down of proteins whereas at low solids concentration protein breaking was more at increased treatment time and temperature. The results of this study are helpful to advance further research in microwave treatment of waste activated sludge in a compact reactor bypassing sludge thickener and may contribute to improve the economy of sludge treatment.*

Keywords: *Waste activated sludge, sludge solubilisation, anaerobic digestion, microwave pre-treatment, wastewater treatment plant.*



A Call for a Value Rearrangement to Achieve Sustainability – Example of Single use Plastics

Lavtizar Vesna*

Institute for Global Environmental Strategies, Kitakyushu Urban Centre, Kitakyushu, Japan

ABSTRACT: *Single use plastic (SUP) is getting a world-wide attention due to the increasing environmental issues associated with its mismanaged disposal (leading for example to marine plastic debris), microplastics, and enormous amounts of generated plastic waste, that are not economically feasible to recycle and are, including in developed countries, landfilled or incinerated.*

The hierarchy of the solid waste management prioritizes the 3Rs as the most acceptable waste management methods - among them, waste reduction is the most preferred option, followed by reuse and recycle. However, in the process of searching and applying solutions for increasingly growing amount of plastic waste, the main focus is clearly fixed on plastic recycling while SUP reduction and reuse remain overlooked. The need for packaging is in various cases necessary and understandable. However, the excessive packaging and the reluctance of implementing known solutions for SUP reduction suggest i) the lack of awareness of the negative impacts associated with the unsustainable use of resources; ii) not sufficiently explored potentials of SUP reduction, or iii) the presence of other motives, which are believed to outweigh the reasons for SUP reduction. In the latter, however, those motives are not necessarily rationalized to be compulsory and to serve a vital purpose. Reconsideration and rearrangement of values would bring permanent and most profound solutions to a plastic waste-related issues and support sustainable use of resources in general.

This paper explores the opportunities for SUP reduction and provides recommendations for an easy to apply short term, as well as mid and long term plastic reduction and reuse strategies and recommendations for sustainable plastic alternatives in cases, where packaging is imperative.

Keywords: 3R, reduce, circular economy, waste management, marine plastic pollution, awareness.



Construction waste management in public housing projects through application of ranking and principal component analysis

Adil Masood^{1,*}, Akash Prakash², Kafeel Ahmad¹, Abdul Hameed Siddiqui¹, Quoc Bao Pham^{3,4}

¹ Faculty of Engineering and Technology, Jamia Millia Islamia University, New Delhi, India

² Vivekananda College of Engineering and Management, Aligarh, Uttar Pradesh, India

³ Institute of Research and Development, Duy Tan University, Danang 550000, Vietnam

⁴ Faculty of Environmental and Chemical Engineering, Duy Tan University, Danang 550000, Vietnam

ABSTRACT: A Prodigious amount of construction activity in Aligarh has led to the generation of high volumes of construction waste. Particular concern is the added pressure exerted on the environmental quality of this region. Currently, data and research of quality standard are lacking in this domain of construction waste management (CWM). First, this paper provides an overview of the waste which was generated at eight different public housing project sites in the Aligarh district. Second, this paper analyzes the state of CWM at these sites through statistical approaches. Moreover, the results of our work also establish the connection between the extracted components and their effect on waste generation at these sites. The study provides statistical evidence on the factors that contribute significantly to waste generation by implementing Ranking and Principal Component Analysis. The findings of our study will assist site managers and other site operatives in developing waste management awareness and also helps them to track potential waste generating factors at the construction sites.

Keywords: Construction waste · Principal Component Analysis · Cronbach alpha · Index of factor.



Detecting cadmium(II) by using coal extracted from organic waste as modifier of carbon paste electrode

Khaoula ABBI¹, Lina HERMOUCH², Youssra EL HAMDOUNI², Abdelmajid SKALLI¹, Mohammed DALIMI¹, Mohammed EL MAHI¹, El Mostapha LOTFI¹, Souad EL HAJJAJI², Najoua LABJAR^{1*}

^{1,2} Mohamed V University, Rabat, Morocco.

ABSTRACT: Prolonged exposure to cadmium by humans, can cause kidney damage, bone fragility, of the effects on the respiratory system, disorders of reproduction as well as an increased risk of cancer. It is also suspected to result in effects on the liver, the blood and the immune system.

Accordingly, our work is oriented towards the development of electrochemical sensor able to detect cadmium ions, in several matrices. These sensors are characterized by their sensitivity to the Cd²⁺ ions even at low concentrations.

Recognition system used is carbon paste electrodes modified by a natural compound. The analyses were conducted by cyclic voltammetry, SWV. Optimum conditions are obtained compared to the variation of the maximum current intensity based on electrochemical and chemical parameters. The results of these analyses showed that our electrode represent a good sensitivity of detection of cadmium ions, with a very low detection limit.

Keywords: Cadmium (II), coal, square wave voltammetry, Tap water



Landfill leachate treatment using electrocoagulation: Case the Controlled Discharge of the City of Mohammedia-Morocco

Jamal Mabrouki^{1,*}, Souad El Hajjaji¹, Driss Dhiba²

¹Mohammed V University in Rabat, Faculty of Science, AV IbnBattouta, Agdal, Rabat, Morocco,

²University Mohammed VI Polytechnic (UM6P), Benguerir, Morocco

ABSTRACT: *The electrocoagulation process allows the treatment of soluble metals found in the rinsing water of surface treatment baths. Electrocoagulation is a process that coagulates pollutants through electrolysis with a consumable anode (aluminum or iron). The release of aluminium and iron ions by electrolysis and their reaction with water allows the formation of clusters of pollution particles: flocs. The electrolysis of water generates micro-bubbles that attach themselves to the flocs. The electroflocculation reactor must be followed by an additional process to separate the treated effluent from the flocs. To recover the sludge formed, one must either take advantage of the fixed micro-bubbles to perform a separation by flotation, or recover them by decantation, as the micro-bubbles can be disturbing and promote foaming on the surface. This technique can only be used if the effluent is a sufficiently good electrical conductor. This work presents electrocoagulation (EC) controlled waste leachate treatment using aluminum electrodes. The sample leachate was collected at the Mohammedia municipal solid waste site. Effects of process variables such as pH, cell applied the voltage and the operating time were studied on the COD and the elimination of the turbidity. The EC process was carried out in a batch reactor of 1/2 liter capacity and 500 ml samples were taken in batches at 05 until 60 minutes of operation. Results obtained from the experiments showed that the removal of COD and turbidity was strongly influenced by the initial pH. The highest COD and the turbidity removal efficiency of 75% and the miler result was obtained at an applied cell voltage of 3V, 60 minutes of operation.*

Keywords: leachate, landfills, electrocoagulation, aluminum electrode, treatment



Remedial Strategy for the Ghazipur Dumpsite in Delhi, India

Gagan Nigam^{1*}, Leju Valsan¹, Palash Kumar Saha², Kåre Helge Karstensen²,
Christian J Engelsen², Mahesh Babu¹

¹IL&FS Environmental and Infrastructure Services Limited (IEISL), India;

² SINTEF AS, Norway

ABSTRACT: *Ghazipur Dumpsite is one of the oldest and largest dumpsites of India. It outlived its planned life of 25 years in the year 2009 but continues to receive 2200 tonnes of municipal solid waste daily from East Delhi and has accumulated 14 million tonnes of wastes over the years (legacy wastes). At least three million people live within the 10 km radius of Ghazipur and the nearest residential settlement is only 200 metres away. The dumpsite is cause of serious environmental problems, ranging from local pollution concerns (health, soil, and water) and land-use restrictions to global impacts in terms of greenhouse-gas emissions. For the Ghazipur dumpsite remediation pilot demonstration project, the consortium of IEISL, SINTEF, Central Road Research Institute and Gulmeher Green Producers Company (a rag picker turned artisans based Self-help group) has been shortlisted by the office of India's Principal Scientific Advisor (PSA), after careful examinations of 24 proposals submitted against a global request for proposal. The mixed nature and age of the legacy waste on the dumpsite, combined with the onsite operational issues, are some of the perceived challenges. The 18-month long unique pilot project (expected to begin in 2021) will investigate into mining, screening, and integrated waste management options with the objective of maximum valorization and reclamation of land. The paper has discussed the integrated solutions offered by the consortium, for example, technical feasibility and cost-efficiency of utilising non-recyclable plastic wastes in cement kilns, thermal power plant and waste-to-energy plants; utilising plastic waste in road construction, utilising recycled aggregates as road base and sub-base, utilising soil fraction for capping of ash pond and construction of road embankment. The underlying environmental and social implications of the proposed solutions are also discussed. The findings of the pilot project will provide valuable inputs to decision makers to support policy changes and increase treatment of plastic and other wastes from large dumpsites across India.*

Keywords: *Ghazipur dumpsite, plastic waste, resource recovery, energy intensive industries, recycled aggregates, road construction.*



Road towards sustainable urban solid waste management: Review of diversion practices of Baguio City, Philippines

Jeffrey Z. Duran^{1*}, Marcelino N. Lunag, Jr ¹, Eugene D. Buyucan², Jessie C. Elauria³

¹Saint Louis University, Baguio City, Philippines.

²General Services Office, Baguio City Hall, Baguio City, Philippines

³Institute of Agricultural Engineering, College of Engineering and Agro-industrial Technology, University of the Philippines Los Baños, Laguna, Philippines

ABSTRACT: *Rapid urbanization in developing countries such as the Philippines has brought about several environmental concerns. In perspective, Baguio City's solid waste problem has grown intense throughout the years, with the present solid waste management considered as insufficient in dealing with the overwhelming amount of waste generated. Among the classification of solid waste, biodegradable wastes (bio-waste) has the largest composition in weight percentage. With this, the study intends to highlight the current bio-waste management in the city, alongside reporting feasible treatment methods that could potentially augment to the present system. On a projection perspective and considering the limited space in the city, decentralized composting gives promising outcomes that may be beneficial to Baguio's sustainability. Furthermore, the proposed waste-to-energy facility offers a viable option that could accommodate the wastes not only of Baguio, but also from nearby towns within the Benguet Province. It is found that the enforcement of the law and the cooperation of private and public sectors play a vital role in developing a sustainable solid waste management system.*

Keywords: *bio-waste management; composting; hill station; sustainable development; waste diversion*



Potential Drivers for Municipal Solid Waste Management Problems in Bhutan

Krishna Lal Chhetri*

Country Head, South Asian Forum for Environment

ABSTRACT: Bhutan's economic development began in 1961 aiming to create basic infrastructure in transport, communication system, power, agriculture and animal husbandry. Since then, enormous development has been achieved in each economic program taking into account the government's desire to protect the environment. Alongside the growth of population and urban centers, waste generation in huge amounts has led to unmanageable problem recently. In order to subside the evolving waste management issues, the Royal Government of Bhutan has established policies that could easily deal with the proportionate amount of waste generated by its population. This study investigates the causes of ineffective policy implementation, analyses the ground reality of waste management problems from government of Bhutan's publications, national newspaper Kuensel, international agencies' reports, as well as peer reviewed journal articles and identifies the principal drivers for Municipal Solid Waste management problems for Bhutan. Bhutan's landscape, culture, lack of financial power, expertise and technology, and the lack of awareness on waste management among its population have obstructed the implementation of these waste management laws. Massive amount of waste containing recyclables are landfilled every day. These recyclables can be processed in simple waste recycling facilities (existing few are failing due to lack of financial support) such as composting plant, bottle crusher, PET bottle shredder, paper recycler etc. with the support from government and NGOs. By 2030, more than 88,000 tonnes of organic waste will end up in landfills that will eventually generate substantial amount of methane, a greenhouse gas to the atmosphere. The least occurring component, metal (1%) if not recycled properly, about 1800 tonnes will end up in landfills by 2030. In order to divert from such consequences, cheap and effective measures practiced by some developed countries can be adopted in MSW management policies. Bhutan is in the initial phase of waste management problems, more studies are required to validate the facts so that future researchers can study in depth, the problems faced by a small Himalayan kingdom and suggest effective measures to curb its mounting waste problems.



Thermal decomposition in waste management - legal obstacles to practical implementation in EU practice

Jozsef Kovacs ^{1*}

¹ Felso-Bacska Storage Windpark Limited Liability Company; Hungary

ABSTRACT: Reducing the exponentially growing amount of waste in the world and the practical application of the Circular Economy was essential to rethink waste management on a global scale. One of the elements of this is to reduce the generation of waste, as well as to reuse and recycle as much waste as possible.

As a result of researches and the application of the Best Available Technologies, waste disposal and recovery can now be carried out using methods that ensure the practical application of the Circular Economy. One such process is the thermal decomposition of wastes in the absence of oxygen, i.e. the pyrolysis.

This process, which has been much criticized on many aspects, as a technologically advanced disposal and recovery procedure, has a serious impact on regional development. We know the green-economic development effects and other possibilities of the application of pyrolysis as plants used in practice. However, in the field of the establishment and operation of these plants, we encounter many issues, mainly concerning rules and regulations, which hinder this kind of practical application of the practical application of the Circular Economy.

In my presentation, I would like to emphasize that, at present, the legal assessment of thermal decomposition complies with the rules for waste incinerators. Based on the applied technology and practical experience, the thermal decomposition technology must ensure that it is considered a product or material after the treatment of the waste, in accordance with the principles of the Circular Economy.

Thermal decomposition ensures that the material that has undergone the recovery process becomes a product, but it is only accepted if the materials generated during the pyrolysis can be used for a specific intended purpose in a general way, they are marketable and are in demand.

It is known that during the installation of plants using thermal decomposition technology, it is essential to comply with the technological and technical requirements in accordance with the relevant legal regulations and standards. In addition to complying with the rules on waste incinerators, it is also necessary to demonstrate that there is no overall adverse effect on the environment or human health. There is currently no suitable quality assurance system.

In my presentation, based on practical experience, I propose the transformation of energy-recoverable waste into a marketable product and the rules of use. I will cover such areas as the possibility of justifying the cessation of waste status, setting up a suitable quality assurance system in accordance with the current EU legislation.

Keywords: pyrolysis, circular economy, legal obstacles.



Exploring Synergistic Integration of ZED and Waste Management

R. Dasgupta¹, S.K Ghosh^{2*}, A.R.Mukhopadhyay³

^{1,2} Jadavpur University, Department of Mechanical Engineering, Kolkata

³ Indian Statistical Institute, SQC & OR Division, Kolkata

ABSTRACT: Environmental pollution is the serious problem associated with rapid industrialization, urbanization and rise in the standard of living of people in any nation. For developing countries, industrialization is of utmost priority to build self-reliant buoyant economy. However, industrialization has also yielded unintended wastes along with the intended products which, in turn, have caused serious problems relating to environmental pollution. Wastes seem to be a natural by-product of growth. Quite naturally, to control pollution, efforts need to be put to create value from wastes. One of the ways for controlling pollution arising out of the disposal of wastes is by conversion of these unwanted wastes into utilizable raw materials. The problems relating to the disposal of industrial solid waste are associated with lack of infrastructural facilities and negligence on the part of industries to take proper safeguards. Although the large and medium scale industries located in identified (conforming) industrial areas have some arrangements to dispose of solid waste, the condition of most of the small-scale industries is not at all good in this respect. Therefore, it becomes necessary to extensively pursue the problem particularly in the context of small-scale industries to work out requisite strategy for organizing proper collection and disposal of industrial solid waste. ZED (Zero effect zero defect) is the effective and efficient operating system equipped with capable processes and people to attain world-class manufacturing to produce and deliver quality products and services without making any adverse impact on the environment. ZED aims to bring together two important, but often studied separately, fields in operations management: supply chain management and environmental management. This article demonstrates a theoretical basis with a case example for the synergy for bringing together environmental initiatives in the supply chain and organizational performance to enhance the efficiency of production process and side by side minimize the industrial solid waste.

Keywords: ZED, Environmental Management, Industrial Waste Management, Collection and Disposal of Industrial Waste.

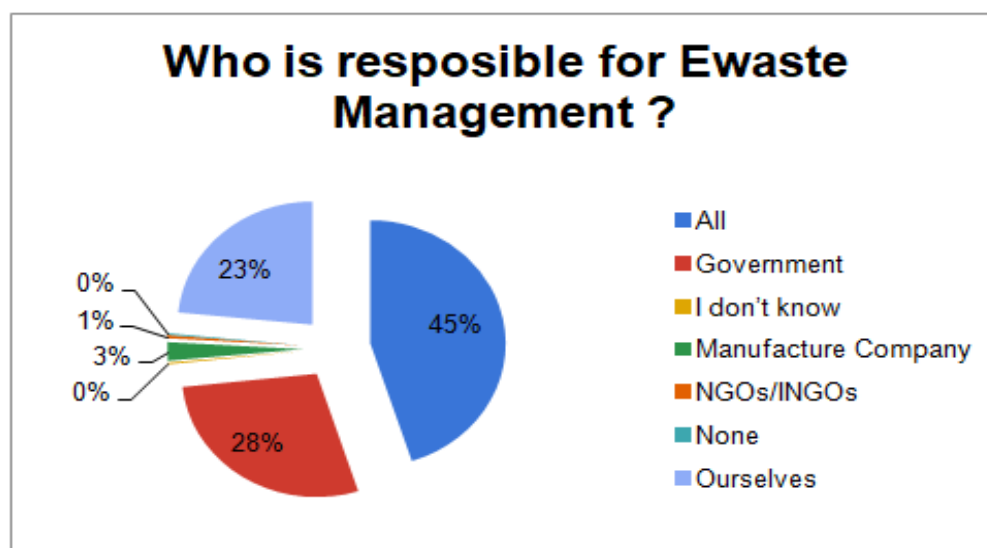
The E-Waste Management Novel Social Challenges for Nepal: Post Covid-19 Issue

J. Giri^{1*}, H. R. Joshi¹, S. Aryal¹, R. Gautam¹, A. Neupane¹, R. Bhattarai¹

¹Tri-Chandra Multiple Campus, Tribhuvan University, Ghantaghar, Kathmandu, Nepal

ABSTRACT: Form the beginning of life, human nature always move towards developments and advancements for sophisticated life. The modern era adds application of electrical and electronic gadgets in day to day life, producing E-waste in huge amount. Therefore, E-waste management has become challenge globally. Moreover, pandemic COVID-19 added more woes in it by enormous use of electronic gadgets especially, laptops, smartphones etc., in virtual platforms for studies, meetings, official-works, conferences, symposiums and building networks to work in this critical state. Developing country like Nepal lacks basic infrastructure for E-waste management. Due to COVID-19, whole cycle of waste management gets disrupted starting from collection, segregation, recycling and disposal. The restriction in movement of people and vehicles, impact on E-waste collection system. Nepal's collection system depends on informal sectors mainly from India without use of PPE and basic safety guidelines. The restriction in movement had brought the E-waste collection system stand still and there is no sign of complete removal of COVID-19 from world in near future. E-waste is among hazardous waste category, and are holding in homes and offices will add toxic in living environment while disposal and the management is practiced in very unsafe manner for fraction of E-waste collected. Bio-medical instruments and other equipment are being used in treatment of COVID-19 patients which further added E-waste fraction. Handling of these medical devices is another level of challenge.

There are some good changes coming up due to COVID-19 where people are becoming more aware about keeping environment clean and waste management. This is the perfect time to induce E-waste management in general public practice.



Keywords: E-waste, hazardous waste, E-waste management.



Life Cycle Assessment Of Solid Waste Management Options For Dhulikhel Municipality, Nepal

S. Bajracharya^{1*}, A. Adhikari¹, A. Ghimire¹

¹ Kathmandu University, Dhulikhel, Nepal

ABSTRACT: As of little research on the waste management sector in Nepal, the decision support system is not well established. This has resulted in poor planning and execution of engineered facilities related to waste collection, treatment and disposal methods. In this study, Life Cycle Assessment (LCA) is used to investigate the waste management treatment options in Dhulikhel municipality. The assessment was based on four different scenarios: Scenario 1 includes landfilling, Scenario 2 includes composting combined with landfilling, Scenario 3 consists of recycling, composting and landfilling and Scenario 4 incorporates recycling, anaerobic digestion and landfilling. The current baseline scenario which includes open dumping is also evaluated in terms of global warming potential. The assessment of solid waste was done from the latest report on Baseline Study of Solid Waste Management of Dhulikhel Municipality 2018. Therefore, LCA methodology was developed, including the benefit and impact potentials of each unit process, considering the energy emissions as well as utilizing the default method of Intergovernmental Panel on Climate Change (IPCC) for the calculation of methane and nitrous oxide gas emission from the disposal site and biological treatment methods. The environmental impacts from the scenarios were compared in terms of Global Warming Potential (GWP), Acidification Potential (AP) and Eutrophication Potential (EP). Among the four scenarios, the anaerobic digestion scenario (scenario 4) had shown the most environmental advantage, whereas scenario with no biological treatment facilities shall be the least preferred option as its impact is considerably higher than other options.

Keywords: Life Cycle Assessment, Solid Waste, Global Warming Potential, Biological waste treatment



The Role of Automation in Eco-Industrial Parks Development in Russia

Yaroslavtsev D.A.*

Baltic Academy of Tourism and Entrepreneurship, Saint-Petersburg, Russia

ABSTRACT: *In modern conditions, there is a need for the formation of an innovative infrastructure for a modern large cities focused on the integration of industries, science and education with the aim of solving existing problems. An important element of this infrastructure is eco-industrial parks. Eco-industrial parks development become a trend in the most of European countries, United States of America, Japan and China. These parks implement the principles of circular economy, such as industrial symbiosis, waste recycling, energy saving, etc.*

Russia is just at the beginning of the process of elaboration of eco-industrial parks development policy. The mission of the eco-industrial parks in Russia is to fulfill the role of a laboratory for advanced researches on improving energy efficiency, resource saving and obtaining synergies through pooling the assets and intellectual capital of residents in the eco-industrial park and sharing the infrastructural subsystems. For the successful operation of eco-industrial parks, combining industrial, research and educational activities, it is necessary to attract and use resources efficiently. First, we are talking about material, financial and labor resources. Equally important is the creation of an advanced information system in the form of constantly functioning monitoring that provides an eco-industrial park with complete, reliable and up-to-date information on modern innovation processes. Also, at this point, it is important to use consulting and actively involve innovative technologies to enhance the efficiency of the functioning of eco-industrial parks in Russia. The main task of automation is the execution of cyclic processes, or processes running according to a strictly defined algorithm. Automation processes are widely developed all over the world, and South Korea is one of the world leaders. According to the latest data, there are 476 robots per 10,000 workers in Korean enterprises.

At the initial stage it is very important to establish the process of automating the movement of secondary resources between temporary storage and processing zones. The development of services for automating the management of material and information flows in eco-industrial parks will improve the efficiency of their warehouse and logistics infrastructure, as well as create the basis for sound management decisions.

In addition to the introduction of automation systems, the author suggests the active use of consulting services. For this purpose, the world's leading companies are identified, cases in similar areas are analyzed, and the attractiveness of implementing consulting services in the activities of eco-industrial parks is assessed.

Keywords: *circular economy, eco-industrial parks, solid waste, automation, consulting*



Phytotoxicity assessment of landfill leachate emanating from young and legacy landfills using *Lepidium sativum* var.

N. Anand¹, Gireesha T Mohannath¹, P. Sankar Ganesh^{1*}

¹Environmental Biotechnology Laboratory, Department of Biological Sciences, BITS Pilani, Hyderabad

ABSTRACT: In this study, Landfill Leachate (LL) emanating from young and legacy landfills from Hyderabad Integrated Municipal Solid Waste Pvt. Hyderabad was evaluated for its toxicological effects on seed germination and root elongation of garden cress plants (*Lepidium sativum* var.). Leachate from these landfills was diluted with distilled water (DW) in 10 different ratios (LL: DW:: 100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, 20:80, 10:90) for the treatment of seeds and distilled water was used as a control. The experiment was performed in triplicates with 10 seeds in each Petri dish, incubated in the dark at room temperature for three days. The seed germination percentage, mean root length, and germination index were analyzed to assess the toxicity of LL. In young LL, seed germination was observed in 40:60, 30:70, 20:80, 10:90 (LL: DW) ratios, whereas in legacy LL, seed germination was observed only in 10:90 (LL: DW) ratio and not in others. In control, 100% germination was observed with a mean root length of 4.2cm. In young LL, 100% germination was observed in 10:90 and 20:80 (LL: DW) ratios, with a mean root length of 1.34cm and 0.61cm, respectively. 30% and 13% germination were observed in 30:70 and 40:60 (LL: DW) ratios with a mean root length of 0.12cm and 0.06cm, respectively. In legacy, LL 10:90 ratio has 100% germination with a root length of 0.75cm. The germination index in all the experiments was less than 35% in all ratios, which indicates that diluting landfill leachate is inducing toxicity to the seeds. From our earlier study on characterization of LL, it was found that legacy LL had high ammonia and heavy metal content (phytotoxic compounds) than young LL, indicating that legacy LL is more toxic than young LL.

Keywords: Landfill leachate, *Lepidium sativum*, Phytotoxicity, Germination Index, root length.



Assessment of the Impact of Bio-solids Application in Okra Cultivation Derived from Stabilized Fecal Sludge

Atun Roy Choudhury*¹, L K Mahalakshmi¹, Jheelam Sarkar¹, Namita Banka¹, Rajarshi Banerjee^{1*}

¹Chadwick's FSM Laboratory, Banka BioLoo Limited, 56. Nagarjuna Hills Road, Punjagutta, Hyderabad

ABSTRACT: Stabilized bio-solids, primarily sourced from the treated fecal sludge (FS) is a never-ending source of plant nutrients. Fecal sludge being the preliminary source of derivation, the mass is highly enriched in nutrient content. C/N ratio, total nitrogen, and total phosphates (P₂O₅) content in the bio-solid are assessed as 9.57, 0.93%, and 1.95% respectively. The present study incorporates the formation of two experimental beds of dimensions as follows 10 ft. x 2 ft. x 1 ft. Primary bed soil was excavated up to 1 ft. depth and replaced with red soil as control and an equivalent mixture of 1:1 for red soil and bio-solid for the other. The bed depth was so selected, not to interfere with the root depth of Okra. Okra seeds were procured from PHS seeds and distributed 16 gm or 247 nos. on each of the beds. Both the beds were initially flooded with 80 litres of water and seeds were spreader. Primarily, biosolid discovered to positively influence the rate of germination. Post seeding (on the 7th day), total of 92 sapling germination was counted on the control bed (CB). While the experimental bed (EB) recorded a count of 98. Further, a substantial difference in the growth and biomass content of the mature plants also have been recorded. Over 60 days plants rooted in EB have grown to an average height of 1-1.2 m. Whereas, the mean height of the specimens rooted in CB was restricted between 0.6 - 0.7 m. The first yield was harvested on the 55th day and later the harvesting frequency for the other yields was 10 days. The total pod weight from CB for the first and second yield was 519 gm and 830 gm respectively. Positively, the first and second yield from EB was recorded as 1176 gm and 1713 gm respectively. While a similar trend was followed for the average, maximum, and minimum pod lengths. The encouraging results quite effectively authenticate the quality of the bio-solids obtained from the stabilization of FS and establishes it as one of the most promising alternates to chemical fertilizers.

Keywords: Fecal Sludge, Bio-solids, Okra, Plant growth, Yield



Integrated Waste Utilization on Induction Furnace Slag

Lekhar Nath Sharma^{1*}, Anoop Ghalley² Ugyen Tshomo³, Krishna Lal Chettri⁴, Sunil Herat⁵

¹ Lhaki Cement Pvt. Ltd, Bhutan.

² Lhaki Steels and Rolling Pvt.Ltd, Bhutan.

³ Waste Management Division, National Environment Commission, Bhutan.

⁴Country Head, South Asian Forum for Environment

ABSTRACT: *With ever increasing demand of raw materials for roads and construction, and rampant reclamation of natural resources, the environmental eco-balance is getting disturbed. Hence, there is an urgent need to preserve the precious natural resources and find newer materials.*

Some of the feasible and economical solutions that have emerged in recent years are to reuse the industrial process wastes through recycling or reprocessing. Steel slag is an industrial by-product that is manufactured under extensive quality control and can be used as aggregates in civil construction. These contain no organic impurities, clay, shells, or similar materials and have uniform chemical composition. Slag can be used as both coarse and fine aggregates in mortar and concrete. Slag aggregates are comparable to natural aggregates in terms of strength and other property requirements and are extensively utilized in developed countries.

The present paper highlights the processing techniques developed for converting slag into aggregates and its usage in road and civil construction. Amendment requirement in the existing standards and development of specifications for widespread use of slag as aggregates is also discussed. Use of slag aggregates will reduce environmental impacts, preserves precious natural resources and reduces the energy consumption in mining, stone crushing, and other activities.



Vegetable oils for the modification of polylactic acid: opportunities and challenges

Bianka Nagy¹, Norbert Miskolczi^{1*}

¹University of Pannonia, Research Centre for Biochemical, Environmental and Chemical Engineering, Veszprém, Hungary

ABSTRACT: *Polylactic acid (PLA) is one of the widely used bioplastics. In one hand both the consumption and production of bioplastics is significantly lower than that of traditional petroleum-based plastics. On the other hand the volume of production and consumption is increasing to a significant extent. The main advantage of bioplastics is that their use can significantly reduce the environmental problems caused by plastic waste and their use can greatly contribute to sustainable development and support the concept of circular economy. However, the structure of bioplastics often needs to be modified for the intended use. Polylactic acid can be also used in the form of blends and composites. Of these, its use with starch and natural fibers is significant. In order to achieve more favorable properties, in addition to the cellulose-containing components, additional additives are used in most cases. Recently, more effort is found to the possibility of vegetable oils application to modify the structure and properties of neat PLA. The use of vegetable oils significantly modifies the properties of the mixtures, but also should improves the compatibility of the components. In our work, the structure of neat PLA was modified with different vegetable oils (e.g. sunflower oil, castor oil, rapeseed oil, coconut oil, olive oil). It was found that the use of vegetable oils significantly changed the elastic properties of PLA. However, the concentration and the hydrocarbon composition of vegetable oils had a key role regarding the property modification.*

Keywords: *polylactic acid, vegetable oil, sustainable, properties*



Waste polymer recycling by high temperature process: opportunity for hydrogen production and for less CO₂ emission

Norbert Miskolczi^{1*}

¹ University of Pannonia, Research Centre for Biochemical, Environmental and Chemical Engineering, Veszprém, Hungary

ABSTRACT: The recycling of various polymer wastes (e.g. plastics, biomass, municipal solid waste, etc.) is a key issue not only from environmental, but also from energy point of view. The most difficulty is that the plastic waste generated from the yearly consumed 350Mt plastics is not able to decompose, thus significantly loading the environment. At the same time, significant amounts of energy consumption and CO₂ emissions can be saved by sustainable utilization of the energy content of plastic waste. Cracking and pyrolysis of polymer waste should be the solutions that can significantly reduce the environmental problems caused by them. The processes typically take place at temperatures between 400 and 1000°C in inert atmosphere. The products of the process can be predominantly liquid and gaseous products, depending on the operating parameters to be used. Both products show many similarities with refinery and petrochemical feedstocks. At high temperatures and using catalysts, the gas products contain significant amounts of hydrogen and carbon monoxide. The amount of hydrogen can also be increased by increasing temperature, using catalysts and steam. This process also has great importance for the recycling of biomass waste, because it is possible to obtain products on the basis of biomass, from which, among others, hydrocarbons (Fischer-Tropsch process), hydrogen, methanol, ammonia and other valuable derivatives can be produced. By using appropriate process parameters, the amount of CO₂ generated in the process can also be reduced, which can make a major contribution to reducing the greenhouse gas emissions from waste.

Keywords: waste polymer, pyrolysis, gasification, hydrogen, syngas, CO₂



Assessment of Different Methods of Extraction of Banana Fibre from Banana Pseudostem Waste

Lipsita Saha¹, Samima Razia², Ramalaxmi Dutta², Aniruddha Mukhopaddhayay¹, Debasish Das³

¹ Department of Environmental Science, University of Calcutta, Kolkata

² Vivekananda Institute of Biotechnology, Nimpith, West Bengal

³ Department of Jute and Fibre Technology, University of Calcutta, Kolkata

ABSTRACT: *Agricultural waste gives rise to different environmental problems. Banana is one of the major fruit crops widely grown and generates huge quantity of waste which includes pseudostem waste. Banana fibre extracted from pseudostem waste have favourable physico-chemical properties for textile and other related applications. Extraction of banana fibre retaining its favourable physico-chemical properties for such applications is significant for its subsequent successful use. In this study, suitability of different extraction methods, with or without prior aqueous treatment of banana pseudostem, under acidic, alkaline and neutral condition have been assessed in terms of achievable strength, extensibility, fineness and whiteness of the extracted fibre. A best set of treatment conditions have been identified which are related to balanced improvements of the above properties of the extracted banana fibres. A prior treatment of pseudostem with water at 100°C under neutral condition for a duration of 45 minutes appears to be best to give balanced improvement of the above properties of the fibre.*

Keywords: *Banana fibre, methods of extraction, fibre properties, textile, banana pseudostem waste.*



Prevalence of Anaemia among rural women having Poor sanitation practice: findings from a cross-sectional study in Odisha, India

Kripalini. P¹, Kulumina Dash^{1*}

KIIT Deemed to be University (IOE), Bhubaneswar, India

ABSTRACT: Anaemia is a major public health problem especially among poorer segments of the population in developing countries. Across the globe, 1.62 billion people are anaemic (24.8%), with the highest prevalence among preschool age children (47.4%) and pregnant women (41.8%). Currently 52% of Indian women of reproductive age are anaemic. Globally, 1.1 billion people still practices open defecation, of which 638 million are in India. Poor sanitation, alongside unsafe drinking water and hygiene, are responsible for a considerable proportion of the global burden of disease. Open defecation and poor hygiene practice is prevalent in India. Relationships between sanitation practice and anaemia have not been well characterized in Odisha, Therefore, we conducted the study to know the prevalence of anaemia among women in reproductive age in Khurdha district in Odisha and its association with sanitation practice. A Population-based cross-sectional study was conducted in Balianta Block of Khurdha District. 550 women were selected randomly. In our study the Outcome variable was Anemia (haemoglobin level of ≤ 11 g/dl) [WHO, 2010] and Exposure Measures were Sanitation Practice, Practice to latrine or open field for defecation, type of latrine, water source availability etc. Informed consent was obtained from the participants or parents. Descriptive statistics was used for determining the prevalence of anaemia among women. Logistic regression was used to establish the association between sanitation practice and anemia. The average haemoglobin level was 10.88 g/dl with 1.68 standard deviation (\pm SD). The prevalence was 45.64%. Among 550 women, 116 (21.09%) were using latrine and 434 (78.91%) going for open defecation. Among 434 women going for open defecation, 228 were anaemic. In the multivariate adjusted model for confounders were found to be significant association with anaemia among those who were practicing open defecation AOR 2.18, C.I. (1.35-3.51), P-value 0.001. The odds of open defecation is 2.18 times higher in anaemic women than non anaemic women. Anaemia is the most common problem among women in the study area and this study has highlighted the association between anaemia and open defecation. Health promotion and behavioral changes that impact on defecation practice which can decrease the risk of anemia may be targeted. In future, public health interventions can be needed to reduce the burden of anaemia among women living in rural area where there is limited access to adequate sanitation community level, which can prevent and treat anaemia among women.

Keywords: Anaemia, Prevalence, poor sanitation practice, rural women.



An Investigation on Mechanical Properties of IS Concrete Specimens confined with FRP Composites

Sudheer Ponnada^{1*}, G. Chandramukhi Sai¹

¹Department of Civil Engineering, MVGR College of Engineering (Autonomous), Vizianagaram, A.P., India

ABSTRACT: Fibre-Reinforced Polymer (FRP) composites wrapping is one of the current approaches for retrofitting of many concrete elements. It is considered as a new generation of materials. The main reason for using FRP is their outstanding mechanical and chemical properties as well as quick installation. The main anxiety about the use of FRP is the minimum strength of the base substrate and its number of wrapping effect on the strength and ductility of the concrete. Fibre-Reinforced Polymers (FRP) can be classified as a type of composite material that is increasingly used in the construction industry in recent years. Fibre reinforced polymer (FRP) materials are continuing to show great promise for use in strengthening reinforced concrete structures. These are excellent option for use as external reinforcing materials because of their light weight, resistance to corrosion, and high strength. Due to their properties and easy to implementation makes these material preferred solution for strengthening method of reinforced concrete structural elements.

The main objective of this study is to investigate the mechanical properties of concrete with the applications of FRP (Fibre Reinforced Polymers) composites. In this study M30 grade mix design as per IS:10262-2009 is adopted for investigation. The mechanical characteristics are determined for the designed concrete by casting specimens like cubes, cylinders, and prisms. Three samples with designed cement content were prepared then each sample arranged in three different shapes, cubic with dimensions of 15×15×15cm and cylinders with a diameter of 15 cm and a height of 30 cm and prisms of 10×10×50 cm confirming to IS:516-1959. So, the compressive, split tensile and flexural strength tests were conducted for these specimens. Variations of strengths are reported by having the single, double, and triple wrapping to the above mentioned IS specimens.

Keywords: Coarse aggregate, fine aggregate, cement, concrete, mechanical properties, Glass fibre cloth and polymer.



Reduction of construction and demolition wastes with its reuse in different construction scenarios

E.R. TEIXEIRA*¹, A. FERNANDES¹, J. CAMPOS e MATOS¹

¹ ISISE, Department of Civil Engineering, School of Engineering, University of Minho Campus de Azurém, Guimarães, Portugal

ABSTRACT:

The civil construction sector and the different activities it develops result in a higher intensive use and consumption of raw materials and consequently in the production of high amounts of Construction and Demolition Wastes (CDW). With global urban growth, waste production has dramatically increased, particularly construction and demolition waste, which has led to serious management problems in different cities and countries [1–3]. The residues have different origins, they can result from surpluses during the construction process, being essentially: packaging materials, containers, machinery or parts of equipment that are no longer usable [4]. However, it is estimated that 30 to 50% of the waste results from rehabilitation activities. Finally, during the demolition phase, when buildings have already completed their operational life cycle, the entire building becomes waste and this significantly increases waste production [3,5]. CDWs are usually heavy, with high volume and sometimes toxic, which leads to their final management, the simplest process, the landfill [3,4], with a significant percentage in some countries 80-90% [6]. However, a large portion of these residues can be usable through good planning and their use can be a solution to the problems that societies and the construction sector face in relation to waste management [4,5]. The CDW associated management costs are significant and tend to increase in the future, being extremely important to promote strategies that allow its reuse. With great value for the sector's circularization, CDW has, nowadays, significant legislation to make the regulation and classification, reutilization and final management [1,7]. So, the Circular Economy (CE) principles are of extreme value. CE is an alternative to the linear economy, which depends on production, use and final disposal of goods, encourages the ideal use of resources, extract the maximum value, including the recuperation and regeneration after use. Besides that, allowing the creation of new opportunities, a more circular economy could reduce the production of wastes/residues, increase the resource productivity and offer an economy much more competitive. The present chapter arises precisely in this context, aiming at the development of CDW solutions originating during the demolition and/or rehabilitation of buildings, for application in the rehabilitation or new construction processes, allowing to improve the functional, economic and environmental performance of this sector. For that, will be study the reuse in different construction scenarios, with its use for reinforcement or rehabilitation of: i) land and slope stabilization; (ii) incorporation of materials in structural elements; and (iii) incorporation of waste into the mix for concrete reinforcing.



Plastic Waste Management In Malaysia

Agamuthu, P^{1*} & Jayanthi B²

¹Jeffrey Sachs Center on Sustainable Development, Sunway University, Sunway. Malaysia.

²Faculty of Agro Based Industry, University of Malaysia Kelantan, Kelantan, Malaysia.

ABSTRACT: *Plastics is relatively important in our daily life and it is abundantly available however their end disposal has been an issue. Approximately 13.2-24 % of the municipal solid waste generated in Malaysia is plastic, thus the potential of plastics to contaminate the surrounding environment is very high due to its lightweight in nature, durable and most importantly easily obtained in the market. Some fraction of the generated plastic waste are recycled and reprocessed whereas the bulk are indiscriminately disposed, hence increase in plastic pollution in general and microplastic pollution in particular may happen. This paper reviews the plastic waste management in Malaysia which highlights the type of plastics in Malaysia, Law and regulations related to plastic waste in Malaysia, plastic recycling, plastic flow in Malaysia and also microplastics issue in Malaysia. Hence, the review identified that there is law and policy that related to plastic waste management in Malaysia and Malaysia also expected to completely reduce the usage of single use plastics by year 2030 through Action Plan of MESTECC's roadmap. Malaysia also introduced The Solid Waste Management and Public Cleanliness Corporation by launching the Separation at Source Initiative (SSI) under Solid Waste and Public Cleansing Management Act 2007 (Act 672), that effective in 2015. Furthermore, the current rate of plastic recycling in Malaysia is 28.06% as of data extracted in 2019 whereas the remaining plastic waste is solely disposed to landfills or open dump in Malaysia.*

Keywords: *plastics waste, waste management, MSW, microplastics, Malaysia.*



Effects Of Dried Sludge Types In Biowaste Decay Using Aerobic Composting Barrel

Marcelino N. Lunag Jr^{1,*}, Luis Alphonso C. Aunor², Marvin Clark O. Bartolome², Kristian Matthias A. Luquingan², Prendonn R. Ocon², Carl Bryan P. Pacol², Tyron Clemens B. Palitayan², John Cedrex C. Quimson², Lucky Jemard F. Quintay², John Michael M. Simon², Earl Jonas C. Wagan²

¹ Faculty Member, Mechanical Engineering Department, Saint Louis University, Baguio City 2600, Philippines

² Student, Mechanical Engineering Department, Saint Louis University, Baguio City 2600, Philippines

ABSTRACT: *Biowastes constitute 45 to 70 % of the total waste generation which has become a formidable socio-economic environmental problem for developing countries, particularly in regards to dried sewage sludge which needs further treatment especially for the reduction of potentially toxic elements (PTE's). This study wishes to evaluate the multiple positive effects of composting in the minimization, stabilization, and conversion of this waste into a valuable compost final by-product. For this purpose, the research aims to assess the effects of adding naturally dried sludge (NDS) and polymer-infused dried sludge (PIDS) in the degradation process of biowaste using aerobic composting barrel. Result showed the significance ($p < 0.05$) of adding NDS or PIDS in achieving ideal optimum temperature for the destruction of pathogens during composting process. Moreover, the effect of PIDS has met the standard for compost as a soil conditioner. With the exception of Cd, the detected potentially toxic elements (PTE's) such as Pb, Ni, and Cu were reduced to standard limits. Most macro, micro, and other elements were decreased significantly. The aid of Scanning Electron Microscopy (SEM) confirmed by X-ray fluorescence (XRF) analysis provided alternative proofs of metallic reduction due to higher charge build-ups in the specimen. The study revealed that on top of Nitrogen, Potassium, and Phosphorous, other elements like Ca, S, K, and Mn have reached standard range for plant nutrients which can be essential for ideal plant growth and maximize crop yield.*

Keywords: biowaste; dried sludge types; composting process; toxic elements; plant nutrients



Environmentally Sustainable Municipal Solid Waste Management-A Case Study Of Thiruvananthapuram, India

¹Megha T. S, ^{2*}Sheetal Kamble, ³Akshey Bhargava, ⁴Purvi Patil

¹ Mtech, Civil Engineering (Translational Engineering), Government Engineering College Barton Hill, Kerala

²Assistant Professor, Environmental Science, P P Savani University, Gujarat

³ Ex. Rajasthan Pollution Control Board, CEPT University

⁴BSc (Hons), Environmental Science, P P Savani University, Gujarat

ABSTRACT: *Municipal Solid Waste Management (MSWM) plays an important role in sustainable development. The motivation for the present study includes the abysmal state and challenges in MSWM in urban India. The concept of zero waste is a latest one for confounding waste problems of our society. Urbanization contributes to enhanced municipal solid waste (MSW) generation along with unscientific handling degrades the urban environment and causes health hazards. The expansion of urban areas, industrialization and changing patterns of consumption results in increased municipal waste generation which deteriorate the quality of environment, posing risk to the sustainable development. The seriousness of the problem increases in a scenario where natural resources are decreasing and the traditional system of landfill is still being practiced extensively for solid waste disposal. This paper addresses the issue of MSW by taking the case of Thiruvananthapuram. It discusses the present municipal waste management system, new technologies, projected population and solid waste generation. In an evolutionary approach, it points out the challenges that the sector is facing and makes an attempt to suggest a way forward through new technologies and estimation of value added products that can be produced from the solid waste.*

Keywords: *Environment, sustainability, municipal sewage, management, generation trend, treatment options, economic viability*



Occupational Health Safety of Waste Workers: A Review towards Sustainable Waste Management in Bangladesh

Md. Arif Hossen^{1,*}, Mst. Farzana R Zuthi²

¹ Assistant Professor (Research), Center for Environmental Science and Engineering Research (CESER), CUET, Chattogram-4349, Bangladesh

² Chairman, Center for Environmental Science and Engineering Research (CESER), CUET, Chattogram-4349, Bangladesh

ABSTRACT: *The management of waste and its related environmental and health hazards are of global concern in the era of global climate change. The work of Waste collection and disposal has been considered as one of the most dangerous job which exposes the workers to an occupational hazards. Waste workers carried out collection, sorting, processing, and recycling of waste with little or no safeguards for their health and safety. The issue have been addressed and necessary incentives are being taken to minimize health hazards of the workers in developed countries. However the concern in this area are at rudimentary level in developing countries especially in Bangladesh. In this regard this paper reviews the overall scenario of waste worker in case of waste management in the country to achieve sustainable development goals set for the country. Lack of knowledge, no proper handwashing facilities at the workplace, discomfort in using safety gears etc. are found in literature. Some new biomedical waste has been introduced to the waste sector during the coronavirus pandemic, posing additional risks to waste workers in the health sector. Most of the waste workers experienced COVID-19 symptoms but there is the lack of knowledge regarding symptoms or even the treatment facilities of COVID-19. Therefore the development and implementation of public health policies, awareness building, training of the workers, improved and specialized waste collection vehicles etc. are deemed essential to reduce occupational health hazards and ensure health and safety of the worker.*

Keywords: *Health safety; waste workers; waste management; review; sustainable development.*



Urban Green Space Solid Waste Management for Climate Mitigation of Khulna City

Tusar Kanti Roy^{1*}, Md Mustafa Saroar¹, Md Ashraful Alam¹

¹, Khulna University of Engineering & Technology (KUET), Khulna 9203, Bangladesh,

ABSTRACT: Waste sector generates 5% global greenhouse gas (GHG), which is contributing to global warming and climate change. By 2025, urban population is projected to be 4.3 billion and will generate 2.2 billion tons of municipal solid waste (MSW) per year. Khulna, one of the topmost climate vulnerable cities in the world produces about 520 tons of solid waste per day, of which around 7% is green space waste (GSW). Urban green space (UGS) of Khulna City in the form of parks and playgrounds, road and waterfront greens, urban forestry, institutional landscaping, nurseries, graveyards, cemetery and cremation grounds etc. constitutes about 10% of the total city land use area. Organic wastes of the urban green spaces are tree leaves, flowers, twigs, turf grasses, weeds, trimmings, food discards, and papers etc.; whereas polythene and plastic packets, plastic and glass bottles, plastic and metal cans etc. are inorganic wastes. Khulna City Corporation (KCC), without any sorting, collects GSW with other wastes and haphazardly dumps in unsanitary landfill sites. This causes greenhouse gas emission and significantly contributes to global warming and climate change. Data for the paper are collected mainly from KCC and relevant research and planning documents, where GHG emission standards are derived from USEPA and IPCC. Efficient scientific management of organic GSW through aerobic-anaerobic recycling process can produce compost, biogas, electricity, biofuel etc. Recycling of inorganic recyclables can produce new plastic, metal, and glass products etc. Controlled incineration can produce heat and energy. Thus, sustainable management of GSW can potentially recover resources and mitigate climate change towards better urban environment of Khulna City.

Keywords: Khulna City, Urban green space (UGS), Green space waste (GSW), climate mitigation, aerobic and anaerobic recycling.



Co-processing of Non-Recyclable plastic waste in cement kiln

Sadhan K Ghosh^{1*}, Tejashwi rana²

¹Professor, Jadavpur University, Kolkata 700031, India,

² Research scholar, Jadavpur University, Kolkata 700031, India,

ABSTRACT: Global cement production is expected to grow by 12-23% by 2050 from current level, due to rising global population and urbanization patterns. This increase in production of cement ultimately impacts the CO₂ emission from cement industries and expected to increase by 4% globally (Technology Roadmap, IEA). India is the second largest producer of cement after China. One ton of clinker required approximately 100 kg of coal and share of energy in total cost of production of cement is 30-40% (IEA, Energy Efficiency and CO₂ Emissions from the Global Cement Industry, 2006). In recent year, the quest for increasing energy efficiency and reduction in CO₂ emission has led cement industry to test and use the waste material as alternative fuel. India generates 26000 tons of plastic waste every day. The mismanagement of this plastic waste is the main cause of marine littering. In this paper we have taken non-recyclable plastic waste (NRPW) as waste material for alternative fuel in cement kiln. We have discussed the approach of pre-processing and co-processing of NRPW in cement kiln. The capacity of using NRPW in cement plant is enormous because it can be collected from household as well as industry. The main objectives of the study is to provide statistic data on characteristics and proportion of plastic waste and NRPW generated from some target sectors (household, school, office, hospital, industries, trading and service, and tourism) in Kolkata, India and the co-processing of waste in cement plants in India.

Design/Methodology- The Work is based on literature review and case study.

Findings- Co-processing is the best method we have till now for managing NRPW. The goal is to analyse the mass flow of non-recyclable plastic and optimize the NRPW consumption while maintaining the product quality in kiln. The potential is enormous since today globally 3.8 billion tons of cement produced by cement industries that consumes nearly 380 million tons of fossil fuels and AF. This study has shown the use of RDF(Refuse Derived Fuel) as an alternative fuels and several cement industry in India using RDF as an AF. Now a days coal is the fuel that most widely used and represent 70% of the total thermal energy consumption, oil and natural gas contribute 24% while AF only contribute 5% towards the global thermal energy demand in cement sector. Replacing fossil fuels by AF that are less carbon intensive leads to 12% of the cumulative CO₂ emission saving by 2050 globally (technology roadmap, IEA).

Originality- The practice of co-processing in cement industry for managing NRPW conserve natural resources (fossil fuels) and reduces overall cost of production of cement at the same time. The practice of co-processing is beneficial for society because this technology helps in reducing GHGs and leads to a healthy living. Co-processing have gave an opportunity for stakeholders and entrepreneurs to develop a new business idea to manage the plastic waste. This new business of managing plastic waste will ultimately help us to control marine littering.

Acknowledgement- This study conducted in cooperation with the Norwegian research institute SINTEF under the OPTOCE (Ocean Plastic Turned into an Opportunity in Circular Economy project).

Keywords: Pre-processing, Co-processing, NRPW, AF, RDF.



Survey methodologies to determine the supply chain & inventory of non-recyclable plastic wastes in landfill and other sectors towards closing the loop through co-processing

Sourya Subhra Chakraborty¹, Sadhan K. Ghosh^{2,*}

¹PG Student, Meghnad Saha Institute of Technology, MAKAUT, Kolkata

²Jadavpur University, Kolkata 700032, India

ABSTRACT: Plastic wastes have become an evident threat to environment due to its indestructibility. Plastic waste takes forever to decompose, and are ultimately dumped into landfills, water bodies and a bigger portion lead to the marine environment. Plastics turns into micro and nano-plastics which inturn are consumed by animals on lands and mammals and fish in marine environment and birds. A portion of these micro and nano-plastics ultimately finds its way to the human body through eco-systems through fishes, birds, water bodies and many other paths. Before plastic wastes gradually fills up our oceans and landfill sites, there is an immediate need to address this cause in order to reduce generation of plastic wastes. The objective of this paper is to assess, by quantitative method, the amount of plastic wastes generated by various organizations prevailing in our society, the supply chain and their. The supply chain includes the sources of generation, use and reuse and the amount released to the environment as a waste material causing damage to the environment and living beings. The survey will be carried out both inline and physically for feedback from several sectors, namely, municipalities, educational institutes, health care units, industrial units and residential bodies. The appropriate methodologies will be adopted consulting IS (Indian Standard) and ISO (International Organisation for Standardisation) standards. Quantitative assessment of plastic wastes from landfills sites will also be deduced by different methods including drone mapping, and desktop research. Though the task has limitations like limited data availability, no response from surveyed organisations, inaccurate data sharing, reaching target people etc., the estimation model will be further implicated with the help of statistical analysis. Furthermore, the model will be analyzed and compared with the usage of the plastic waste as AFR (Alternative Fuel & Raw materials) in co-processing in cement kiln. The study identifies right methodologies and analytical tools for inventorisation. The result will help in determining the future course of planning and actions for co-processing in cement plants and other potential use, if any and assessing the amount that leads to marine environment. The study will also help in mapping the behavioural pattern of citizen on use and disposal of non-recyclable plastics.

Keywords: Survey methods, statistical analysis, non-recyclable Plastics, inventorisation, marine littering;



Environmental analytics in the Hungarian waste management practices.

Dr. Csaba Ágoston*

Chemist, Professor in chemical analysis, Hungary

ABSTRACT: In Hungary which is the member of the European Union, the waste management and infrastructure system are operated according to the directives of the European Union. In accordance with the waste management, the circulating economy principle plays important role, so well a growing proportion of waste is recycled.

The analytical investigations related to the waste management are grouped as the concepts below:

- The recognition of the waste properties (e.g. water soluble mineral content, total concentrations), or the aim of disposal with landfill. The investigation of the disposal waste regulated according to a Hungarian legislation which prescribe the analysis of the waste before landfill. Waste treated by incineration, the emission of the incinerator should be investigated.

- Recyclable materials of the waste. In Hungary the structural-degradation (selectively degraded concrete, brick) rubbish analysis started recently. Investigations focus on the determination of the water soluble mineral content. The production of solid reused fuel from domestic waste also started recently which is regulated according to an international standard.

- Investigations of the effects on the environmental elements of the waste management institutions. During the operation of the waste treatment and disposal institutions the analysis of the groundwater, if necessary air and soil, determined inorganic and organic compounds. Special investigations needed when the populace is disturbed by smell caused by odorants during the disposal of sewage sludge or tankage.



Sampling plan and test methodologies of non-recyclables & recyclable plastic wastes from different sources for recirculation through co-processing

Abesh Chatterjee¹, Sadhan K. Ghosh^{2,*}

¹PG Student, University of Calcutta, Kolkata, India

²Jadavpur University, Kolkata 700032, India

ABSTRACT: The paper is dealing with the non recyclable plastic wastes, dumped in various sources, includes Dump yards, Municipalities trash bins and the marine litter. After collecting plastic wastes from different sources, they are to be segregated depending on their size differences as mega, macro, micro and nanoplastics. After sorting out proper amount of micro and nanoplastics, they are to be analysed and characterized accurately. The characterization consists of physical treatment, includes size, shape, colour, aging etc., chemical characterization, containing the identification of Microplastics, type of the polymer used, additives and chemicals associated with macro and Microplastics etc and lastly the biological treatments, which includes identification of microbes and fauna and flora. A potential use of wastes is co-processing in cement plants. The main objective of this study is to identify the appropriate sampling plans and analytical test methodologies of non-recyclables plastics to facilitate segregation and appropriateness for use in co-processing in cement plants. The study focuses on plastic wastes composition which are potential man made sources on lands to produce micro and nano-plastics in marine environment. Plastics and other wastes are being used in the co-processing of cement plants whereas this study will focus on the sampling plans and analytical test methodologies and testing for analysing the composition of non-recyclable plastics within the wastes. This will help in inventosiation of non-recyclable plastics and their potential use in co-processing which will be used as alternative raw materials and fuel (AFR) in the cement kiln for co-processing leading to cement production. This will help reducing the huge amount of non-recyclable and recyclable plastic wastes from different source as well as to cut down the CO₂ emission from cement production plants, reduce GHG emission from dumpsite and reduce marine littering.

Keywords: Sampling, Recyclable Plastics, alternative raw materials and fuel; analytical test methodologies;

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Greening of Solid Waste Management System in Achieving Sustainable Development Goals

Chowdhury S R^{1*}, Ghosh S K²

¹Deputy Director, Bureau of Applied Economics & Statistics, Government of West Bengal

² Jadavpur University

ABSTRACT: “Greening” of the Solid Waste Management (SWM) represents a policy shift from the conventional SWM practices towards management of solid waste in a manner that reduces the waste, promotes re-use, maximises recycling and recovery of waste thereby conserving the natural resources and at the same time meets public health, addresses environmental concerns, creates jobs and contributes positively to the economy. Literature survey shows that it is well established that many of these 17 Sustainable Development Goals (SDGs), with 169 targets, which are to be achieved by 2030 are directly and or indirectly related to solid waste management system. Though there are several papers which separately studies these management processes, however, no such literature is available which binds their findings in a correlated manner and discusses its benefits for achievement of SDGs. This paper focuses on the green management of solid waste for achieving some of the targets of SDGs. This study identifies the processes of configuring businesses and implementation of greening of MSWM system in developing countries like India which have ample potential to reap the benefits and significantly contribute to the attainment of SDGs. The study is beneficial to the researchers as well as the policy makers to design a framework for implementing Greening of Solid Waste Management (GSWM) for attainment of quite a large number of Targets of SDGs.

Keywords: Greening ♦ SWM ♦ GHG ♦ Bio-methanation ♦ Incineration ♦ RDF
♦ SDG ♦ Carbon Emission ♦ Leachate



A Compact System Development for Mitigating the Faecal Sludge Transportation & Emptying Problems

Md Shehab Uddin^{1,*}, Dr. Md Nurul Islam¹, Nazmus Sakib¹, Rafat Safayet¹, Shariar Kabir Shohan¹, Nashid Mumtaz²

¹ Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh

² Assistant Project Officer, Practical Action in Bangladesh

ABSTRACT: *Faecal Sludge Management has become one of the most significant concerns in Bangladesh nowadays. Onsite sanitation systems have been developed throughout Bangladesh at an increasing rate, but the management of faecal sludge is facing some real problems in the transportation and emptying process. In this regard, an efficient vehicle is developed to mitigate the difficulties regarding the transportation and emptying process. The compact vehicle can move through a 3ft road easily and can be recharged from two sources. The system is very cost-effective and can be manufactured with locally available mechanical components. The carrying capacity of the vehicle is about 1800-2000L. Besides this, the system will also help to resist the damage of household fuses.*

Keywords: *Faecal Sludge Management; Compact vehicle; Faecal Sludge Transportation.*



A Comparative Analysis of Different Faecal Sludge Emptying Methods Used in Developing Countries

Hakim Dina Anjum¹, Faria Noor¹, Rezwana Sarwar¹, Md Enamul Haque^{1,*}, Dr. A.R.M. Harunur Rashid¹ and Sonia Shahid²

¹ Islamic University of Technology, Gazipur, Bangladesh

² General Manager, Practical Action Consulting in Bangladesh

ABSTRACT: *Faecal sludge emptying in developing countries is a widespread sector, and several technologies are being used and developed for the emptying processes. In developing countries, faecal sludge is primarily emptied from septic tanks in households, latrine pits in slums, and public toilets. And because of the variation in the composition of sludge and the structural designs of different units, different semi mechanized and mechanized technologies are required for emptying sludge. These technologies have some limitations, providing a lot of scope for further improvement in the field of faecal sludge emptying. It is a great challenge to design a solution that can efficiently and affordably empty the sludge from tanks or pits, as the pits are often filled with plastic wastes, hard trashes, and grits. This paper focuses on the comparative analysis of different emptying technologies used in developing countries and sheds light on some scopes of improvement to further develop the faecal sludge emptying sector.*

Keywords: *Faecal Sludge Emptying, Semi-mechanized, Power-driven, Solid Waste, Sludge Removal Rate, Capital Cost.*



A Low-cost Technical Solution for Emptying and Transporting Sludge from Narrow Road

Nafiza Anjum¹, Zafrian Ikbal Shuvo², Nelay Chandra Das^{2,*}, Abu Bakkar Siddik², Rakibul Alam², Md Abid Hasan³

¹ Assistant Professor, Department of Mechanical Engineering, Shahjalal University of Science and Technology, Syleht, Bangladesh

² Student, Department of Mechanical Engineering, Shahjalal University of Science and Technology, Syleht, Bangladesh

³ Assistant Project Officer, Practical Action Consulting in Bangladesh

ABSTRACT: Almost 80% area of Bangladesh including some developed areas are served by on-site sanitation (OSS) system. However, OSS systems in Bangladesh are developed with none consideration for the management of fecal sludge. Disposal of fecal sludge in low-lying areas is causing serious environmental degradation and endangering public health. This study presents an assessment of the standard fecal sludge management scenario in selected urban areas (slums, narrow road areas) of Bangladesh. In many urban areas that are supposed to be served by a septic tank system, the system is altogether absent, and toilet wastewater is directly discharged into storm drains or sewers. There is a scarcity of awareness among City Development Authorities, Municipalities, and land developers about the importance of FSM, and therefore the urban authorities don't have the required capacity (both in terms of coaching and manpower) to watch the design of OSS facilities. Among the various components of fecal sludge management, the emptying and collection services are available within the urban areas studied. Since manual emptying is very hazardous, also existing FSM services are costlier and unreachable, so we propose a new system for emptying and transporting the sludge with locally-fabricated equipment. There is significant scope for innovations within the design of mechanical emptying equipment, and also in the development of FSM business models involving the private sector.

Keywords: Fecal Sludge Management; Circular Economy; Locally-fabricated Technology; Social Awareness; FSM Business Model.



Sensor Based Global Positioning Monitoring System for Fecal Sludge Management-Impact on Manual Monitoring Improvement by Technological Support

Rubayet Ahmed^{1, *}, Md. Shahidul Islam¹, Sadia Hossain Dristi¹, Md. Abdul Karim¹ and Sonia Shahid²

¹ International University of Business, Agriculture, and Technology, Dhaka, Bangladesh

² General Manager, Practical Action Consulting in Bangladesh

ABSTRACT: In Fecal Sludge Management (FSM) system in Bangladesh still monitored manually, where some problem occurs. Labors and management authority still depends on paper documents which might not be justified directly. Labors are not introduced with better technological equipment and they are not technically trained, so sufficient safety precautions are not even taken. To improve the total monitoring system of Fecal Sludge Management (FSM) by a Hub which will be controlled by the authority and subsequently can be significantly improved further using several factors and policies. The sludge collection data will evaluate the revenue from Fecal Sludge Treatment Plant (FSTP). A Global Positioning System Module (GPSM) will monitor the septic tank evacuation data and subsequent measures using sensors to the Hub. The GPS tracker is a terminal with a built-in GPS module and a mobile communication module. The GPS tracker will transmit the positioning data obtained by the GPS module to a server through internet based monitoring Hub. The main goal of this project is to use the GPS system as a tracker which has the advantages of evaluating the required time for sludge collection, evacuation and thereby simplifying the work process for the sludge collector workers. The GPS tracker will easily track the septic tank that needs to be emptied and guide the Vacutug. This study will reduce the hustle of manual calculation of the septic tanks evacuation. Furthermore, it will establish an easy work platform for technically trained person thereby improvise the workload.

Keywords: Fecal Sludge Management (FSM), Fecal Sludge Treatment Plant (FSTP), Global Positioning System (GPS), Module, Monitoring Hub, Vacutug.



Road towards sustainable urban bio-waste management: Review of diversion practices of Baguio City, Philippines

Jeffrey Z. Duran^{1*}, Marcelino N. Lunag, Jr ¹, Eugene D. Buyucan², Jessie C. Elauria³

¹ School of Advanced Studies, Saint Louis University, Baguio City, Philippines

² General Services Office, Baguio City Hall, Baguio City, Philippines

³ Institute of Agricultural Engineering, College of Engineering and Agro-industrial Technology, University of the Philippines.

ABSTRACT: *Urbanization in developing countries such as the Philippines has brought about several environmental concerns. In perspective, Baguio City's solid waste problem has grown intense throughout the years, with the present solid waste management considered insufficient in dealing with the overwhelming amount of waste generated. Among the classification of solid waste, biodegradable wastes (bio-waste) has the largest composition in weight percentage. With this, the study intends to discuss the current bio-waste management scheme in the city and promote feasible treatment methods that could potentially augment to the present system. On a projection perspective and considering the limited space in the city, decentralized composting treatment may account to 43.14% of the total bio-waste, which gives promising result for Baguio's sustainability. Furthermore, the proposed waste-to-energy facility offers a viable option that could accommodate the wastes not only in Baguio, but also from nearby towns within the Benguet Province.*

Keywords: *bio-waste management; decentralized composting; hill station; sustainable development; urbanization; waste diversion*



International Variations in MSW Practice - Why the Differences

Ronald L. Mersky*

¹ Widener University, USA

ABSTRACT: *Multiple options exist for management of municipal solid wastes, including landfill, waste-to-energy, recycling, composting and informal management. Among the world's countries the implementation of these options varies greatly: the United States, for example, recycles 35% of its generated waste and burns 13% while Japan 's recycling is 21% and burning is 80% and the respective recycling and burning percentages for the UK are 27% and 32%.*

What are these reasons for these large variations? Quantifiable variations are examined, including economic variables, land availability and urbanization. Other factors, such as culture and governmental structure are also proposed and examined.



Environmental analytics in the Hungarian waste management practices.

Dr. Csaba Ágoston*

Chemist, Professor in chemical analysis, Hungary

ABSTRACT: In Hungary which is the member of the European Union, the waste management and infrastructure system are operated according to the directives of the European Union. In accordance with the waste management, the circulating economy principle plays important role, so well a growing proportion of waste is recycled.

The analytical investigations related to the waste management are grouped as the concepts below:

- The recognition of the waste properties (e.g. water soluble mineral content, total concentrations), or the aim of disposal with landfill. The investigation of the disposal waste regulated according to a Hungarian legislation which prescribe the analysis of the waste before landfill. Waste treated by incineration, the emission of the incinerator should be investigated.
 - Recyclable materials of the waste. In Hungary the structural-degradation (selectively degraded concrete, brick) rubbish analysis started recently. Investigations focus on the determination of the water soluble mineral content. The production of solid reused fuel from domestic waste also started recently which is regulated according to an international standard.
 - Investigations of the effects on the environmental elements of the waste management institutions. During the operation of the waste treatment and disposal institutions the analysis of the groundwater, if necessary air and soil, determined inorganic and organic compounds. Special investigations needed when the populace is disturbed by smell caused by odorants during the disposal of sewage sludge or tankage.
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Plastic waste management in Hungary

Hilda Farkas*

Councillor Science and Technology, Embassy of Hungary New Delhi

ABSTRACT: *In Hungary, the selective collection of waste is required by law. This applies to both economic operators and to the public. The system is based on two legal constraints. On the one hand, it is the responsibility of the waste producer to ensure the proper treatment of the waste generated by him, and on the other hand, he is obliged to bear its costs (polluter pays principle). In addition, economic companies are also obliged to ensure that the waste generated by them is reused or recycled as far as possible, following the waste hierarchy. To this end, the waste is collected selectively at the site of generation and then handed over to the appropriate operator under contract. This is reported to the environmental authority, which inspects it. In case of residents, selective collection is organized by local governments, and its cost is covered by the monthly waste fee invoiced to the household. Plastic waste generated by the people is collected in a separate container, which is collected door-to-door by the public service on a weekly basis. The selectively collected plastic is first sent to a sorting plant, where it is sorted by type of material. PET is the most valuable fraction that can be sold very well in the market. The sorting company pays for the useful material fractions that can be sold in the market. With this revenue, the public service provider reduces the waste fee paid by the public. Consequently, if the people collect more waste selectively, the waste fee will be cheaper for them.*

Key Words: *plastic waste, separate collection, waste producer responsibility, polluter pays principle*



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IX. Waste Water



Effect of Physicochemical Parameters on Biodegradation of 4-Nitrophenol by an isolated Indigenous Bacterial Consortium

Priyanka Sarkar¹, Apurba Dey^{1*}

¹ Department of Biotechnology, National Institute of Technology Durgapur, Durgapur, West Bengal, India

ABSTRACT: Biological degradation processes are influenced by several factors which determine the rate of the reaction. This study reports the effects of various physicochemical parameters such as temperature, pH, agitation, inoculum size, and media components on the biodegradation of 4-nitrophenol by an isolated consortium. Change of One Variable at a Time (COVT) approach was applied to investigate the influence of each of the factors on the biodegradation of 4-Nitrophenol. The establishment of optimal parameters is a prerequisite for the enhanced degradative performance of the microbial population. The consortium could utilize 700 mg/L of 4-Nitrophenol as a sole carbon source. The optimal conditions for 4-Nitrophenol biodegradation are found to be pH 9.5, temperature 32°C, agitation 160 rpm, inoculum dose 0.5 OD₆₀₀, 0.15 g/L MgSO₄·7H₂O, 0.036 g/L CaCl₂·2H₂O and 0.5 g/L Phosphate. The isolated 4-Nitrophenol degrading bacterial consortium exhibits enhanced 4-Nitrophenol degradation under the optimized conditions and is a potent candidate for wastewater detoxification.



Effect of the electrode on the treatment of coconut industry effluent using Microbial Fuel Cell

Sanju Sreedharan^{1*}, Dr. Renu Pawels¹

¹Civil Engineering Division, School of Engineering, Cochin University of Science and Technology, South Kalamassery, Kochi, Kerala, India

ABSTRACT: Resulting in the globalization of the Indian economy, the coconut market economy has also been elevated to the situation of competition. A large number of various value-added products are introduced into the market along with traditional products such as copra, coconut oil, etc. These industries generate a huge amount of wastewater; mainly waste coconut water from mature coconuts. Wasted coconut water builds a high level of contamination, because of the high concentration of organic compounds such as glucose, amino acids, proteins, vitamins, etc., present in it. Microbial fuel cell (MFC) is a bio-electrochemical reactor that effectively degrades organic compounds with zero energy usage. During the reaction, fuel cells extract bioenergy from the degraded organic compounds, which enhances the biodegradation.

The present study focused on the effect of the electrode on the efficiency of treating waste coconut water from coconut processing industries using a dual-chambered MFC in batch mode. MFC using a plain Aluminium electrode of 50 mm x 50 mm produced a reduction in COD from 46218 mg/L to 20732 mg/L, within 102 hours of detention period using KMnO₄ concentration of 2000 mg/L at pH 5 as Catholyte. On comparing Aluminium electrode with Steel and conductive carbon cloth electrodes, maximum efficiency was achieved for carbon cloth. On spatial distribution of carbon cloth electrode in Anolyte, COD of waste coconut water reduced from 49597 mg/L to 18487 mg/L within 102 hours of detention period with a maximum power density of 325.96 mW/m². According to treatment efficiency achieved, the system is effective in the treatment of small-scale coconut processing industries compared to conventional anaerobic bioreactors.

Keywords: Coconut industry effluent; Treatment efficiency; Waste coconut water; Electrodes; Microbial Fuel Cell.



Hydrophilicity improvement of Polysulfone Membrane using Different Weight Percentages of Polyvinylpyrrolidone and a Performance Study in Dairy Wastewater Ultrafiltration

Somakraj Banerjee¹, Arijit Mondal¹, Ranjana Das¹, Chiranjib Bhattacharjee^{1*}

¹ Chemical Engineering Department, Jadavpur University, Kolkata, India

ABSTRACT: Asymmetric polymeric ultrafiltration (UF) membranes were synthesized from homogeneous Polysulfone (PSF) solution in Dimethylacetamide (DMAc) solvent with Polyvinylpyrrolidone (PVP) as an additive. The effect of additive on ultrafiltration properties of the membrane was studied. Morphological characterization of prepared membranes was done using field emission scanning electron microscope (FESEM). Liquid-Liquid Displacement Porosimetry (LLDP) method was used for membrane characterization. Average pore size was found to be 2.28 to 2.38 nm for different membrane compositions. Molecular weight cut-off (MWCO) of the membranes was determined by a semi-empirical method and found to be varying between 14kDa to 15kDa. Permeation performance of the membrane was assessed through pure water flux (PWF) and hydraulic permeability study. The hydrophilic nature of the membranes was determined by water contact angle and equilibrium water content (EWC). Solute rejection tests of synthesized membranes were done using Bovine serum albumin (BSA) in a dead-end filtration module. A cleaning solution of Sodium hydroxide and Sodium hypochlorate was used to recover membranes which yielded a more than 90% flux recover. From the above investigations, the best membrane was chosen to study separation characteristics for simulated dairy wastewater. The pure water flux enhanced from 305 l/m²h to 348 l/m²h and contact angle decreased from 69° to 52° with increasing weight percentage of PVP. A highest of 90.87% rejection in case of BSA and 79.2% rejection of total protein in simulated dairy wastewater ultrafiltration was found. This study investigates the optimum ratio of additive in the membrane and the understanding of the ultrafiltration behavior of the membrane under different pressure and pH conditions. This study aims to help in choosing perfect membrane composition and operating conditions for a wastewater treatment application.

Keywords: Ultrafiltration, polysulfone, porosity, molecular weight cut-off, hydrophilicity, dairy wastewater.



Utilization of Agro-Waste Material as Potential Adsorbent for Wastewater Treatment

Sumaiya Sulaiyam Alyaaqubi¹, Murutza Ali Syed^{1,*}, Feroz Shaik²,
Mohammed Nayeemuddin²

¹ National University of Science and Technology, Muscat, Sultanate of Oman

² Prince Mohammad Bin Fahd University, Al Khobar, Kingdom of Saudi Arabia

ABSTRACT: Slaughter houses generates a lot of wastewater during its processing activities. These wastewater consists of many pollutants and it should be treated before disposal. Low cost activated carbons were prepared from waste orange (ACO) and kiwi (ACK) peels. The slaughter house wastewater (SHW) was treated using prepared ACO and ACK in a series of batch adsorption experiments. The performance of the activated carbons was evaluated through the percentage removal efficiency of various parameters such as dissolved oxygen (DO), chemical oxygen demand (COD), biological oxygen demand (BOD), total dissolved solids (TDS), and phosphate content. The maximum percentage removal efficiency of 36%, 38% and 62% for DO, COD, and TDS, respectively was achieved through ACO and 95% for BOD through ACK. The experimental data was fitted to Freundlich and Langmuir Adsorption isotherms. Freundlich isotherms seems to be better fitted with the experimental data.

Keywords: Activated carbon, adsorption, kiwi peel, orange peel, wastewater treatment, adsorption isotherms.



Wastewater Ultrafiltration and Hydrophilicity improvement of Polysulfone membrane Using Polyvinylpyrrolidone

Somakraj Banerjee^{1*}, Arijit Mondal¹, Ranjana Das¹, Chiranjib Bhattacharjee¹

¹Chemical Engineering Department, Jadavpur University, Kolkata, India

ABSTRACT: Asymmetric polymeric ultrafiltration (UF) membranes were synthesized from homogeneous Polysulfone (PSF) solution in Dimethylacetamide (DMAc) solvent with Polyvinylpyrrolidone (PVP) as an additive. The effect of additive on ultrafiltration properties of the membrane was studied. Morphological characterization of prepared membranes was done using field emission scanning electron microscope (FESEM). Liquid-Liquid Displacement Porosimetry (LLDP) method was used for membrane characterization. Average pore size was found to be 2.28 to 2.38 nm for different membrane compositions. Molecular weight cut-off (MWCO) of the membranes was determined by a semi-empirical method and found to be varying between 14kDa to 15kDa. Permeation performance of the membrane was assessed through pure water flux (PWF) and hydraulic permeability study. The hydrophilic nature of the membranes was determined by water contact angle and equilibrium water content (EWC). Solute rejection tests of synthesized membranes were done using Bovine serum albumin (BSA) in a dead-end filtration module. A cleaning solution of Sodium hydroxide and Sodium hypochlorate was used to recover membranes which yielded a more than 90% flux recover. From the above investigations, the best membrane was chosen to study separation characteristics for simulated dairy wastewater. The pure water flux enhanced from 305 l/m²h to 348 l/m²h and contact angle decreased from 69° to 52° with increasing weight percentage of PVP. A highest of 90.87% rejection in case of BSA and 79.2% rejection of total protein in simulated dairy wastewater ultrafiltration was found. This study investigates the optimum ratio of additive in the membrane and the understanding of the ultrafiltration behavior of the membrane under different pressure and pH conditions. This study aims to help in choosing perfect membrane composition and operating conditions for a wastewater treatment application.

Keywords: Ultrafiltration, polysulfone, porosity, molecular weight cut-off, hydrophilicity, dairy wastewater, wastewater treatment.



An Appraisal on a Meso-Scaled Study for Surface Water Pollution Level Measurement in Durgapur Industrial Region, West Bengal, India

Suman Chatterjee¹, Kaniska Sarkar^{2,*}

¹ Department of Geography, Jadavpur University, Kolkata, India

² Assistant registrar, Jadavpur University, Kolkata, India, Jadavpur University, Kolkata, India

ABSTRACT: Since each environmental monitoring programme involves enormous resources and labour, frequent monitoring leads to the heavy expenditure of resources. Regional-scale studies are often recommended for persistent and long range transport (LRT) pollutants. The dearth of baseline data and prior knowledge of a region leads the investigator to make subjective decisions in such scenarios. Numbers of variables or parameters in a monitoring program significantly effects the monitoring cost in each step of the program hence reducing these numbers also reduces the monitoring costs substantially. This paper deals with a methodological aspect with a short case study. The methodological aspect is about systematic prioritization and reduction water quality parameters without degrading data quality and efficacy using a novel decision-making approach with multi-criteria decision-making technique. And the case study deals with assessment of industrial pollution's impact on the surface water quality of the Durgapur industrial region, India, in a meso scale process. The surface water quality of the region has been assessed in the spatio-seasonal domain by analysing its several physicochemical parameters with the Water Quality Index. The study reveals the efficacy and flexibility of this parameters' prioritisation cost reduction approach. The study identified Raniganj, Andal, Jamuria, Pandaveswar, and Durgapur as regions of concern. Phenol, oil and grease and nickel were found to be alarming in the surface waters of the region. The Tamla canal is identified as the most polluted canal in the region.

Keywords: Industrial pollution, water quality, spatio-seasonal assessment, cost reduction process, prioritizing parameters, regional-scale study.



Removal of Fluoride from Wastewater by Precipitation and Coagulation in a Continuously Fed Stirred Tank Reactor

Anup P. Pardey¹, Dr. Avijit Bhowal^{1,2*}, Dr. Papita Das^{1,2*}, Sudhanya Karmakar¹

¹ Department of Chemical Engineering, Jadavpur University, Kolkata

² School of Environmental Studies in Industrial Pollution Control Engineering, Jadavpur University

ABSTRACT: The presence of excessive fluoride in drinking water creates serious health issues like dental and skeletal fluorosis in human life. According to the World Health Organization (WHO), the optimum limit for fluoride into drinking water is less than 1.5 mg/l. So, the removal of fluoride from water is one of the major research areas nowadays. From the literature survey, various techniques have been identified for the removal of fluoride which is expensive and energy-intensive. So that effective, modest and cheap technology is a need. Among these, precipitation and coagulation are commonly used in industries, because of simplicity in operation and cheap source of reactants like alum and lime. So, the objective of this work is to examine the performance of alum and lime in a Continuous Stirred Tank Reactor (CSTR). The change in parameters like flow rate of influents, fluoride concentration, agitation speed in CSTR and reactants concentration was experimentally studied. The results indicated that the coagulation and precipitation is only relevant mechanism for fluoride removal and this techniques achieved maximum fluoride removal 82% at fluoride concentration 25 mg/l and it increases as when fluoride concentration decreases. The flow rate of influent as well as reactant, fluoride concentration, pH, and reactant concentration are the controlling parameters in CSTR

Keywords: Fluoride, Alum, Lime, CSTR



Bioaugmentation approach to enhance aerobic granular reactor (AGR) performance in industrial wastewater treatment: a mini review

S. Ghosh^{1*}, S. Chakraborty^{1,2}

¹Ph.D scholar, Centre for the Environment, Indian Institute of Technology Guwahati, Assam 781039, India

²Professor, Department of Civil Engineering, Indian Institute of Technology Guwahati, Assam 781039, India

ABSTRACT: The chemical toxicity, recalcitrance, high carbon loads, changing characteristics and existence of multiple pollutants in industrial effluents are the drawbacks to achieve a stable biological treatment. Bioreactors often suffer from insufficient bacterial population to catabolically degrade or bio-transform the target pollutants into less toxic compounds. Bioaugmentation is a process of incorporating pre-adapted pollutant degrading bacterial strain, a mixed consortia or genetically modified strains in a bioreactor to enhance its performance. On other hand, compact settleable sludge granules with diverse microbial population, toxicity tolerance and simultaneous pollutant removal capacity reducing 20-75% energy and space consumption of aerobic granular reactors (AGR) have added a new dimension in biological wastewater treatment. While treating phenols, cresols and p-nitrophenols (PNP) coupling of AGR systems with bioaugmentation of auto or co-aggregating strains and *Acinetobacter* dominated PNP degrading activated sludge provided 99% removal of 250 mg/L of phenolics. About 10-27% (w/w) augmentation of *Rhizobium* sp. and pJP4 plasmid and augmentation were effective in AGRs providing augmented species dominated strong microscopic granule structures while biodegrading pyridine, 2,4-dichlorophenoxyacetic acid and chlorophenol contaminated wastewater, respectively. In acetate wastewater treatment, direct addition of N-acyl homoserine lactone (AHL) producing quorum sensing bacterial strain encapsulated in sodium alginate beads in AGRs promoted excellent granule settling with 37 mL/g of sludge volume index (SVI) with high integrity coefficient (4.4%). Hence, raising enzymatic reaction rates, optimizing bioaugmentation doses to avoid biomass washout from AGR and observation of biosystem ecology and dynamics reveals potential research scopes in granulation technology to achieve a sustainable environmental bioremediation.

Keywords: Industrial wastewater; Recalcitrant pollutants; Bioremediation; Aerobic granular reactor; Bioaugmentation; Sludge modification; Performance enhancement; Pollutant Degradation



Natural Adsorbent Incorporated Polymer Composite Membrane for Waste Water Treatment

Chiranjib Bhattacharjee^{1*}, Paramita Das¹,

¹Jadavpur University

ABSTRACT: Organic pollutants like synthetic dyes usually pose serious threats to the environment as well as to public health since they traverse through the entire food chain and lead to bio-magnification. These hazardous pollutants are continuously discharged through industrial effluents and simultaneously contaminate the water streams. Among different remediation methodologies available for removal of such pollutants from water, adsorption and membrane based separation have proved themselves as very efficient techniques. Incorporation of some green adsorbent into synthetic polymeric matrix in terms of composite membrane not only enhances the dye removal capacity of the polymer membrane but also lowers the production expenses as they are abundant in nature. The present study focuses on the synthesis of a polymer composite membrane by incorporation of a natural adsorbent for the removal of a cationic dye, crystal violet from its aqueous solution. Before incorporation of the green adsorbent into the polymer matrix, it was washed thoroughly to make it free from dirt, oil and other impurities. The synthesized membranes were characterized by FTIR, XRD, TGA, SEM etc. The influence of operating pressure, feed concentration and operating time on the permeate flux and percent rejection were investigated. Both flux and percentage rejection were found to increase significantly with the incorporation of natural adsorbent thereby encouraging the usage of the prepared composite membranes for waste water treatment.

Keywords: Synthetic dyes, polymer, natural adsorbent, composite membrane, waste water treatment



Environmental issues of the river Saraswati: a perception based study from Tribeni to Nasibpur, Hooghly

Arkadeep Dutta^{1*}, Sandipan Chakraborty¹, Manua Banerjee¹

¹JIS University, Agarpara, Kolkata ;

ABSTRACT: Environment related problematic issues are a result of mismanagement of human activities, population growth, urbanization and so-called economic development. To understand the environmental problems imposed on the river Saraswati, water and soil samples were physically collected from Tribeni to Nasibpur in the Hooghly district of West Bengal. The main objective of this study is to highlight the present condition of the Saraswati River and to try and identify the different environmental issues, especially, micro analysis in order to delineate and rectify the hazards. Focus is given on how rapid urbanization and lack of environmental consciousness affect the historic river-flow. We aim to unravel how a civilized society played a vital role for the drying up of this river. Analytical perspectives obtained through the different qualitative measurements and water quality assessments (physicochemical and biological parameters) allowed us to decipher the anthropogenic damage caused to the river. We therefore identify and highlight the environmental impacts associated with this study area (as per natural and anthropogenic aspect). We further suggest proper management and restoration techniques to rejuvenate river Saraswati.

Keywords: Anthropogenic, restoration, rejuvenation



Applicability of industrial solid waste as a low-cost adsorbent for removal of toxic phenol from wastewater

Ashanendu Mandal¹, Sudip Kumar Das^{1*}

¹ University of Calcutta, Kolkata

ABSTRACT: Phenol in wastewater is considered a priority pollutant due to its toxicity. Its removal from wastewater is essential. There are several methods developed for phenol removal. However, adsorption is popular because of its simplicity and low-cost. In this research, three industrial solid wastes viz., rice husk ash, red mud, and clarified sludge from basic oxygen furnace are used to investigate their applicability as adsorbents. All these waste materials are generated in huge quantities and usually discarded from their plants. They are thus available at low-cost or even free of cost. Each adsorbent was initially characterized by SEM, XRD, FTIR, and BET analyzers. The percentage removal of phenol from simulated wastewater by each adsorbent was studied separately with the variation of initial phenol content, initial pH, adsorbent quantity, contact time, and temperature. The maximum phenol removal percentage observed was 95%, 87.5%, and 63% for rice husk ash, red mud, and clarified sludge, respectively. The kinetic study showed that the pseudo-second-order, Elovich, Reichenberg, Fick, Boyd, and Furusawa-Smith models supported each adsorbent. The isotherm study showed that Langmuir, Freundlich, and Dubinin-Radushkevich models were best fitted for rice husk ash, red mud, and clarified sludge, respectively. The thermodynamic study suggested that the adsorption process was random, endothermic, spontaneous for rice husk ash and red mud, whereas it was random, endothermic, non-spontaneous for clarified sludge. The experiments were repeated with the real industrial wastewater collected from a coke-oven plant, and similar results were observed like simulated wastewater. The regeneration, safe disposal, and scale-up design were studied for finding out their suitability for commercial applications. The novel prediction analysis was studied using MLR and ANN modeling. The research established that these industrial solid wastes are useful for phenol removal from wastewater and contribute to a circular economy in the third world countries.

Keywords: Phenol, Wastewater, Adsorption, Industrial solid wastes, Rice husk ash, Red mud, Clarified sludge, Kinetics, Isotherms, Thermodynamics



Applicability of different adsorption isotherms for adsorption Samanwita Bhattacharya¹, Baisali Rajbansi² Sudip Kumar Das^{3*}

¹²³ University of Calcutta, Kolkata

ABSTRACT: Adsorption is a popular process for the removal of heavy metals and dyes from wastewater. Researchers keep investigating adsorption behavior with the help of adsorption isotherms. Generally, isotherms are initially classified as monolayer adsorption and multilayer adsorption.

In monolayer adsorption, all the adsorbed molecules are in contact with the surface layer of the adsorbent. In multilayer adsorption, the adsorption space accommodates more than one layer of molecules, and not all adsorbed molecules are in contact with the surface layer of the adsorbent.

In the case of monolayer adsorption, Henry's law is the simplest isotherm having only one parameter. Freundlich, Langmuir, Elovich, Temkin, Flory–Huggins, Dubinin–Radushkevich, Volmer, Jovanovich, Ritchie models are discussed under two-parameter isotherms. Redlich–Peterson, Sips, Khan, Fritz–Schluender, Radke–Prausnitz, Toth, Jossens, Koble–Carrigan, Hill, Kiselev, Hill–de Boer, Unilan, Frumkin, Fowler–Guggenheim, Vieth and Sladek, Brouers–Sotolongo are widely used isotherm models having three parameters. Weber–van Vliet, Dubinin–Astakhov, Fritz–Schluender, Baudu, models are examples of four-parameter isotherms. An example of the five parameter isotherm model is the Fritz and Schluender model.

In the case of multilayer adsorption, the Halsey model is used as a two-parameter isotherm model. Brunauer–Emmett–Teller (BET), Frenkel–Halsey–Hill (FHH), MacMillan–Teller (MET), Aranovich, Harkins–Jura, Redhead are examples of the three-parameter model. n-Layer BET, Guggenheim Anderson de-Boer (GAB), Anderson (IV), Dubinin–Serpinsky, are the four-parameter models. Anderson (V) is a complex model having five parameters.

The available isotherms for adsorption studies have been discussed concerning their application and physical significance.

Keywords: Adsorption, Isotherm, Monolayer, Multilayer



Scale-up Design Methodology of the adsorption process

Munmun Banerjee¹, Sudip Kumar Das¹

¹ University of Calcutta, Kolkata

ABSTRACT: Discharge of toxic heavy metals into our nature causes severe harm. Different plant operation generates heavy metal-bearing wastes, and discharge of these wastes causes various damages to the living beings. Among the harmful elements, heavy metals played a major role as a pollutant because of its high toxicity and high persistence. Adsorption is an economical and efficient technique used for heavy metal removal.

Various natural bio-adsorbents, agricultural wastes, agricultural by-products, and bio-polymers are available at low-cost, green with good adsorptive capacity.

The adsorption column's design using suitable adsorbents for industrial-scale minimizes the operating cost for wastewater treatment, which is beneficial for developing countries' small and medium scale industries. The batch study and continuous column study both are essential for the scale-up design for industrial purposes.

Experiments were carried out to estimate various adsorbents' sorption capacity and the effects of various operating parameters such as pH, temperature, adsorbent dose, contact time, column bed depth, influent flow rate, and influent metal ion concentration on the adsorption process. Different kinetic models were applied to the experimental result to investigate process breakthrough curves and best models that will be further used for scale-up designing. In this study, a novel methodology of scale-up design for both batch and continuous operation is proposed. The results suggested that selected adsorbents could be used further for industrial wastewater treatment. An economic feasibility study suggested that water treatment using selected adsorbents made the adsorption process very economical.

Keywords: Biosorption; heavy metals; batch and continuous process; scale-up design



An inclusive review on possible adsorption mechanism of the heavy metals or organic pollutants present in wastewater with the agricultural waste and its by-products

Koushik Ghosh¹, Indrajit Ghosh², Asit Baran Biswas³, Sudip Kumar Das^{4,*}

¹ Research Scholar, Department of Chemical Engineering, University of Calcutta, Kolkata, India

² Research Scholar, Department of Chemical Engineering, University of Calcutta, Kolkata, India

³ Assistant Professor, Department of Chemical Engineering, University of Calcutta, Kolkata, India

⁴ Professor, Department of Chemical Engineering, University of Calcutta, Kolkata, India

ABSTRACT: Environmental pollution is a core issue worldwide. Several researchers are working in environmental biology, eco-toxicology, eco-chemists, pathologists, and engineers to combat industrial and municipal pollution. The dissolution of polluting agents from industries activities, particularly in small and medium-sized industries in the rural areas of the 3rd World countries, leading cause of environmental pollution. With increasing scientific knowledge, socioeconomic awareness, human health problems, and ecological apprehensions, people are more concerned about adverse health effects. Several removal technologies have been proposed and implemented to address these pollutions and sustainable and eco-friendly development in this background. Biosorption using naturally inspired sources, i.e., agricultural waste and its by-products, have considerable advantages due to its cost-effectiveness. Hence, they are considered a potential alternative to the conventional methods used for decontamination.

The agricultural waste and its by-products are cellulosic and contain cellulose, hemicellulose, lignin, and a minimal amount of specialty chemicals are the main constituents. Cellulose is a polysaccharide consisting of a linear chain of several hundred to many thousands of $\beta(1\rightarrow4)$ linked D-glucose units. Hemicellulose belongs to a group of heterogeneous polysaccharides formed through biosynthetic routes but different from that of cellulose. Mannose is the essential hemicellulose monomer, followed by xylose, glucose, galactose, and arabinose. Some mannose is acetylated at the C2 or C3 positions, with, on average, one substitute group for every three to four hexose units. Lignin is an alkyl-aromatic polymer.

When the cellulosic materials are used adsorbent for either heavy metals or organic present in wastewater, then the functional groups present are responsible for the binding through electrostatic attraction, hydrogen bonding formation, $n-\pi$ interaction, and $\pi-\pi$ interaction. These interactions may not give very high adsorption capacity than the synthetic adsorbents, but very useful for the rural areas in the 3rd World countries. This paper deals with the possible mechanism of binding the heavy metals or organic pollutants present in wastewater with the agricultural waste and its by-products.

Keywords: Adsorption; Agricultural waste; 3rd World Countries.



Impact of Agricultural Pollutants on Aquatic Ecosystem and its Management: A Review

Munish Sharma¹, Navneet², Munit Sharma^{3,*}

¹ Department of Plant Sciences, Central University of Himachal Pradesh, Shahpur, Kangra, India

^{2,3} Department of Botany and Microbiology, Gurukula Kangri Vishwavidyalaya, Haridwar, India

ABSTRACT: Emergence in farming and agriculture is a necessary means of survival for living beings. During the past, agriculture was done by natural processes that did not harm the land and aquatic ecosystem. But the use of various products in modern agricultural practices leads to the process of agricultural pollution. These products also degrade the water quality of different water bodies i.e. rivers, lakes, ponds, and reservoirs which ultimately effects the aquatic flora and fauna. Surface and groundwater pollution not only affect the aquatic ecosystems but also costs for various commercial, recreational and cultural activities. Due to upsurge in the human populace, the demand for food security also increases which raises the pressure on the environment. Adulteration in the quality of surface water bodies by the discharge of various agricultural pollutants is broadly documented as an area of concern; however, a fragmented approach to scientific research is still needed. Discharge of pollutants and toxic products from agriculture are progressively recognized as a key contributor to surface and groundwater pollution. Pollutants discharged from agricultural runoff, forestland, mining land, construction sites, and other associated areas is one of the non-point sources of water pollution receiving bigger attention. As we know, all the point sources are being under control and administered under permit systems, it is important to control the non-point source also for improvements in water quality. The aim of this chapter is to reviews the impact of agricultural pollutants on the aquatic ecosystem and its management.

Keywords: Agricultural pollutants, aquatic ecosystem, aquatic biota, water quality, pollution management.



Adsorption of Malachite Green over modified Bambusa Tulda: Taguchi Optimization

Nirban Laskar^{1,*}; Arpan Herbert²; Upendra Kumar²

¹ Department of Civil Engineering, Mizoram University, India

² Department of Civil Engineering, National Institute of Technology Silchar, India

ABSTRACT: *The aim of the present investigation is to utilize Bambusa Tulda in modified form as an effective bio-adsorbent for treating Malachite Green (MG) dye from wastewater. The Taguchi L16 orthogonal array design was established to find out the most favourable conditions. The involvement of every factor was reconnoitred. The results displayed that the dominating degree factors for MG dye removal in decreasing order was: pH > Initial Concentration of dye > Contact Time > bio-adsorbent. The optimum conditions as per Response Table for SNR was pH- 3, Initial concentrations of dye- 100 mg/L, bio-adsorbent Dosage-0.20 g/100 mL and equilibrium time- 90 minutes. The adsorption system follows Langmuir isotherm models which signifies monolayer adsorption process. The level of COD found to be under the allowable limit in wastewater. Bamboo bio-waste can be a good source of sustainable energy. Bamboo bio-waste can reuse for energy generation. Thus, it was observed that NCBT is an effective, efficient bio-adsorbent for the removal of Malachite Green (MG) dye from wastewater.*

Keywords: *Adsorption; Bamboo; Dye; Malachite Green; Taguchi Design; Wastewater.*



Exploration of River Bank Filtration and its Performance along River Damodar, West Bengal, India

Amita Mondal,^{1,3} Udayan Mondal,^{1,2} Harish Hirani,^{1,4} Naresh C. Murmu,^{1,2} Priyabrata Banerjee^{1,2,*}

¹ CSIR-Central Mechanical Engineering Research Institute (CMERI), Durgapur, West Bengal, India

² Academy of Scientific and Innovative Research at CSIR-Central Mechanical Engineering Research Institute (CMERI), Durgapur, West Bengal, India

³ Department of Chemistry, National Institute of Technology, Durgapur, West Bengal, India

⁴ Department of Mechanical Engineering, Indian Institute of Technology Delhi, New Delhi, India

ABSTRACT: *The third world is at high risk because of the day by day increasing demand of clean water. Hence, to meet this concerning issue, development of apposite water treatment technologies are of noteworthy significance. Despite of the exploration of various new water management technologies, a primitive natural water treatment process, River Bank Filtration (RBF) is an effectual and inexpensive process, where river water is purified during its infiltration throughout the river bed. In this connection, a collation of various RBF processes, which are running and sustaining within Indian territory, has been explored herein, which includes a precise discussion on the ecological circumstances, type of wells and the influence of bank percolation on chemical, physical and biological characteristics of water. From this thorough review, it can be concluded that, this natural and inexpensive RBF process route can be employed in various parts of India to provide a sustainable and low-cost potent solution to the society in an attempt to fulfill the increasing demand of potable water.*



Weighted Arithmetic Index Method-A Complementary Tool for Generating Water Quality Indices

M. Musabbir Ahnaf¹, Islam M. Rafizul², M. Badiuzzaman Shuvo³

¹ Department of Civil Engineering, Khulna University of Engineering & Technology, Bangladesh

² Department of Civil Engineering, Khulna University of Engineering & Technology, Bangladesh

³ Dept. of Computer Science & Engineering, Khulna University of Engineering & Technology, Bangladesh

ABSTRACT: Water quality index (WQI) is the easiest way to express the water quality by a dimensionless number. The WQI value is necessary for comparing the quality of water from different sources as a function of certain location, time, and influencing factors. The objective of the study was to calculate the WQI of groundwater of the area near to the Rajbandh landfill site, Khulna, Bangladesh both for dry and rainy season. Groundwater samples were collected from twenty selected different tubewells of that area in some sterile bottles (1 litre capacity) under aseptic conditions. And then transported to the laboratory for analysis. In the laboratory, samples were analyzed for eighteen physico-chemical parameters namely pH, electrical conductivity, nitrates, sulphates, dissolved oxygen, manganese, iron, phosphates, chromium, copper, lead, zinc, nickel, cadmium, arsenic and chemical oxygen demand (COD). WQI values were calculated by weighted arithmetic index method by a desktop app which was developed by using Python programming language. Moreover, PYQT5 library was used to create graphical user interface (GUI) and Matplotlib library was also used for graphical representation of the acquired value. All of the used libraries were integrated with the apps. WQI was calculated for the twenty sampling points individually for the collected samples both for dry and rainy season. For dry season, about 80% groundwater sources lie between 76-100 WQI values which clearly indicates that the water quality is very poor in those sources. In addition, 20% was above 100 which indicates that the water sources are unsuitable for daily use purposes. Moreover, for rainy season, 5% lies between 51-75, 70% lies between (76-100), while, 25% is above 100. The result reveals that the contamination of ground water was found comparatively higher in the nearest tubewells and decreases in relation to the increasing of water sampling distances. The outcome of this study will further be helpful for other researchers to quantify the level of contamination of groundwater from tubewells.

Keywords: Waste landfill, groundwater, physico-chemical parameters, WQI, weighted arithmetic index method, MATLAB.



Wastewater Reuse in Morocco: challenges to change in perceptions towards social acceptance

Tarik CHFADI*¹, Driss DHIBA², Souad El HAJJAJI³, Abdelghani CHEHBOUNI⁴

¹²³⁴ Mohammed VI Polytechnic University (UM6P), International Water Research Institute (IWRI). Ben Guerir 43150, Morocco

ABSTRACT: Like other countries in the MENA region, Morocco is a semi-arid country that witnesses a situation of significant water stress; especially in the southern regions, less rich in natural water resources. Since the 1960s, the state has invested in a renewed effort to better manage the country's water resources through building dams, to secure water supply and to develop sanitation services.

Recently, the government has also invested in a non-conventional water resources such as seawater or brackish water desalination and in urban wastewater treatment effort, with many environmental benefits. The reuse of treated wastewater, especially in agriculture, presents an additional economic advantage. However, in many regions of the country, wastewater was already used for irrigation, even without prior treatment, involving serious risks to human health, documented in Morocco and elsewhere. Despite the gravity of this situation, very little -published- research effort has been made to document policy makers, farmers and general public reflections and attitudes regarding the reuse of wastewater in Morocco.

Our project aims to provide deep insights and some answers by addressing the unique situation thus described, with the simultaneous "de facto" reuse of treated and untreated wastewater. We are especially interested in drawing the comparison between the social acceptance of treated and untreated wastewater, by the general public, and by farmers.

To incorporate the dimension of disparity in water availability in the country, we selected two regions for this study, one in the North with a relatively good water availability, and one in the South, with lesser water resources and a long tradition of wastewater reuse.

The result from this study will be compared to water reuse practices in developed countries where wastewater reuse has been successfully implemented.

The lessons learnt from the study will help in giving voice to the public and in informing public policies, particularly on communication regarding wastewater reuse.

Keywords: Social acceptance; Wastewater; Reuse; Sustainability; Morocco



Modeling steady-state performance of MBBR treating municipal sewage

P. Sankar Ganesh^{1*}, Rishi Raj Verma², Shilpa V Mishra³,

¹²³ Birla Institute of Technology and Science, Pilani, Hyderabad

ABSTRACT: This study focuses on modeling the steady-state performance of Moving Bed Biofilm Reactor (MBBR) system using the GPS-X 8.0 software. The effect of aeration rate on the biofilm formation and concomitant treatment efficiency was investigated. The aeration rate simulation was performed using two types of aeration methods: Diffused Air Method and Mechanical (surface aeration) Method. The results showed that biomass production was inversely proportional in all the cases in both methods i.e Diffused Air Method and Mechanical Aeration Method. Cases here refer to various specific oxygen transfer parameters. Biomass formation in Diffused Air Method were 1558.804 kg, 1524.1276 kg and 1722 kg for KLa, DO Controller and Entering Airflow parameters respectively. The Entering Airflow parameter had the highest biomass production. In Mechanical Aeration, three different oxygen-transfer parameters namely, DO Controller, Entering KLa and Entering Mechanical Power were used. Similarly, in the Mechanical Aeration method was the higher biomass production using KLa Method (1713 kg) as compared to the other two parameters: DO Controller (1524 kg) and Mechanical Power(1555kg). In the Diffused Air Method, the biofilm thickness was directly proportional to Nitrogen removal, TSS and VSS content which may have been due to a higher population of anammox bacteria. While in both the aeration methods, pH and Total Phosphorus removal were inversely proportional to Biofilm thickness. Since Nitrogen removal causes pH reduction which may not be optimal for the phosphorus removal. The findings of this study were substantiated and corroborated with the research available in the public domain. The outcome of the study will be validated with the results obtained using the lab-scale MBBR system.

Keywords: MBBR, Wastewater, biofilm thickness, biomass production



Recovering water from Textile Effluent using Solar dryer

Nilofar Nisha J ^{1*}, Devi Priyanka R ¹, Arum Prakash M ¹, Vignesh P¹ , Bharath Ponvel M¹, Kirubakaran V¹

¹ Gandhigram Rural Institute. Tamil Nadu

ABSTRACT: Recovery, and recycling of wastewater have become a growing trend in the past decade due to rising water demand. Wastewater reuse minimizes the volume and environmental risk of discharging it. Through reusing, wastewater is no longer taken as a "pure waste" that potentially harms the environment, but rather an additional resource that can be harnessed to achieve water sustainability. The textile industry is a conventional and a pillar industry, which possesses an extensive part of the national economy. Textile industries stand for considerable environmental difficulty because of their vast water consumption. The discharge of colored wastewater from textile industries represents a severe ecological crisis and community health worries. On account of that, wastewater management is a crucial factor to enrich our environment. In India, the government is more concerned and spending a vast amount of money on cleaning and conserving the water bodies. Many technologies are readily available to treat the wastewater at large quantum. However, in a small industry like the Hand Loom Textile & Dying unit, the wastewater generated is less in quantity, and the existing technology is not cost-effective for treatment. This study investigates the recovery of moisture from solar drying processes. For recovering water, a heat exchanger can be installed outside the solar dryer and is connected to an air extractor, which ejected the vapor produced during the process. This setup's objective was to condense vapor produced while collecting the textile wastewater inside the solar dryer.

Keywords: Wastewater, solar dryer, evaporation, condensation.



Treating of Water Bodies of Dhaka City by Vetiver Based Phytoremediation

Samira Tasnim Progga^{1,*}, Mohammad Shariful Islam²

^{1,2}Bangladesh University of Engineering and Technology (BUET), Dhaka , Bangladesh.

ABSTRACT: Among many problems, water pollution is one of the major concerns that Bangladesh is facing currently. Though almost all the rivers and other water bodies are facing this problem, rivers and lakes inside and in the neighbourhood of the Dhaka city are at the worst risk due to unplanned urbanization and industrialization, tanneries, dying factories, brickfields, unhygienic open latrines, dirty utensils and cloths washed by slum dwellers, untreated wastes thrown into the rivers by industries, oil spilled by boats, agrochemical in agricultural lands etc. From several studies it is seen that the two major rivers, Buriganga and Turag, along with some other lakes, such as Hatirjheel, Gulshan, Dhanmondi, Uttara, Banani and Ramna, in recent years have deteriorated severely. Immediate actions to restore these water bodies is a big agenda. In this paper a detailed picture of the actual pollution is presented with possible solution. The pH, DO, BOD, COD, EC, Turbidity, TDS, TSS, Chloride etc parameters of the above mentioned surface water sources are far above their standard threshold. Among many solutions, phytoremediation is a very useful measure, where a plant is used for removal, degradation or containment of contaminants in soil, surface water and ground water. Laboratory based small-scale studies showed that Vetiver (*Vetiveria zizanioids*) is effective in the improvement of water quality of the above mentioned sources. A pilot project has been planned with floating garden with the grass that can be very economically feasible, energy efficient and environment friendly.

Keywords: Phytoremediation; Vetiver; water pollution: water quality parameters



Adsorption of (methylene blue) onto natural oil shale: kinetics of adsorption, isotherm and thermodynamic studies

Maryem RAHMANIa*¹, Ahmed MOUFTI², Mohamadine EL'MRABET³, Abdelmalek DAHCHOUR⁴, Souad EL HAJJAJI¹

¹University Mohamed V, Av IbnBattouta

³University Hassan 1, Education and Training. Casablanca-Settat. Morocco

⁴Hassan II Agronomic and Veterinary Institute

ABSTRACT: This study reports the adsorption of methylene blue (MB) dye onto natural oil shale (NOS), and the characterization of adsorbent: DRX, FTIR, SEM, before and after adsorption process. The total of results showed that the adsorption of MB onto NOS is best by pseudo second order fitting model, on the other hand the adsorption process was described well by Langmuir isotherm. The effect of temperature on the adsorption of the dye was also evaluated and the thermodynamic parameters were determined. The negative values of the three thermodynamic parameters ΔH° , ΔG° and ΔS° of the NOS/MB system indicate that the adsorption is spontaneous and exothermic.

Keywords: Adsorption, dyes, methylene blue, oil shale, kinetics study, isotherm models, thermodynamic study.



Constructed wetland technology for wastewater treatment in Morocco

Maria Benbouzid^{1,*}, Jamal Mabrouki¹, Souad El Hajjaji¹, Abdelmalek Dahchour²

¹Mohammed V University in Rabat, Morocco

² Agronomy and Veterinary Institute Hassan II, Rabat, Morocco

ABSTRACT: Constructed wetlands (CWs) are engineered systems that were first explored by Käthe Seidel in Germany in the early 1950s. This technology uses natural processes to remove pollutants and to improve wastewater quality, in order to reuse it or to discharge it safely. Compared to conventional wastewater treatment processes, CW is a cost-effective treatment that uses no chemicals. The present work aims to review and evaluate sixteen studies that have been done on wastewater treatment using CWs systems in Morocco. CWs performances were evaluated according to type of vegetation, type of wetland system, and type of substrate. Actually, CWs have been successfully used for treating various type of wastewaters in this country. Results of several researches shown that the most used vegetation species is the common reed (*Phragmites Australis*) and attained good removal rates for DBO5, TSS, and DCO. However, better results were recorded for CWs planted with different species in the same system. Also, two designs according to the wastewater flow direction are reviewed: horizontal flow (HF) and vertical flow (VF) systems. The most used in Morocco is the VFCW, but the combination of both system types achieved better removal rates for Total Nitrogen (TN) and COD, reaching more than 65% and 90% respectively, due to the possibility of combining aerobic and anaerobic processes. Regarding the substrate, the most used type in Morocco is composed of gravel in different sizes. The average removal efficiencies of CWs using gravel as substrate are respectively 79.8%, 92.6%, 50.6% and 45% for COD, TSS, TN and TP

Keywords: Constructed wetland; Morocco; Wastewater; treatment; *Phragmites australis*.



Methylene blue removal by Adsorption using low-cost material as adsorbent

Nora Samghouli^{1,*}, Fatima Zahrae Abahdou¹, N. Labjar and Souad El Hajjaji¹

¹ Mohammed V University, Av Ibn Battouta, Rabat ,Morocco

ABSTRACT: Wastewater pollution is one of the major problems threatening our ecosystem. The desire to resolve this general problem is marked both by a notion of time and of the type of pollutants discharged. Dyes, released in liquid effluents from textile industries, are notorious non-biodegradable pollutants and don't decompose naturally. Among the effects of dyes, there are mutagenesis, toxicity, and carcinogenicity. They can also cause allergies and dermatitis. Meanwhile, dyes have many effects on the aquatic environment, such as inhibiting photosynthesis of aquatic plants, odor, color, salinity...etc., so there is a need for them to be disposed of. The aim of this work is to study the removal of methylene blue by Moroccan *Olea Europaea* stones (OS) as a low-cost material by adsorption technique. Fourier transform infrared and X-ray diffraction were used for the characterization of the material. A series of experiments were conducted to study the influence of some parameters on the adsorption capacity such as time, concentration, and temperature. The results showed that the equilibrium time obtained is 115 minutes. Moreover, the rising temperature showed a negative effect on the adsorption process. The adsorption capacity was 6.8 mg/g at the equilibrium time 115min with a dose of 0.5 g/L, initial concentration 5ppm, and a pH 7.76. The findings of kinetic and isotherm models have shown that the adsorption of MB onto OS is well represented by the Langmuir isotherm and the pseudo-second-order kinetic models. The thermodynamic study has shown that the adsorption process occurs spontaneously and exothermically, and the type of the adsorption process is physisorption.

Keywords: Adsorption; *Olea Europaea*; Methylene blue; Isotherm; Kinetic; Physisorption.



Natural products AS ADSORBENT FOR TREATMENT OF WASTEWATER FOR REUSE

Souad El Hajjaji^{1*}, Abdelmalek Dahchour², Driss Dhiba³

¹ Mohammed V University in Rabat, Av Ibn Battouta, BP1014, Agdal, Rabat, Morocco

² IAV Hassan II

³ International Water Research Institute IWRI, University Mohammed VI Polytechnic (UM6P), Benguerir, Morocco

ABSTRACT: Various countries in arid areas have oriented their efforts to use WWs as alternative to face water deficiency. Usage of recycling WWs depends on successful infrastructure, reliable treatment process, financial and economic analysis, public acceptance (overcome health and environmental concern).

Basically, wastewater may contain excreted pathogens (bacteria, viruses, protozoa and helminths (worms) that cause gastro intestinal diseases, highly poisonous chemical toxins, and hazardous material from hospital waste, heavy metals and hormones and antibiotics. The magnitude of pollution of WWs was evaluated according to the importance of the population.

Various reports attest to the failure of the different treatment processes used to clean WWs; raising concern about the remaining pollutants in WWs released in the rivers or reused in agriculture. Usage of local material could improve the quality of WW.

Adsorbents have been prepared from apatite or some vegetable waste of nuts and/or fruits by pyrolysis (500 -700°C) at a reduced level of oxygen or by chemical treatment. In this process, a kind of biochar polymer will form. This material has been grinded to different diameter of granules. Fractions of 0-45 and 45-100 µm and tested.

Individual tests of adsorption have been performed with each pollutant and different adsorbents. Isotherms of adsorption have been derived in batch experiments. Different equilibrium concentrations of the pollutants will enable us to draw the isotherm and to compare different common models such as Freundlich or Langmuir. The parameters of adsorption have been deduced from the more fitting model to the data. Effects of different physical-chemical parameters such as pH, CEC, Conductivity..., on the performance of the tested sorbents have been studied using experimental designs.

Keywords: Adsorption; Wastewater; removal rates; water quality.



Review paper on a business model of a wastewater treatment plant in India

Krishanu Hait^{1*}, Sadhan K Ghosh²

¹ Research Scholar, Jadavpur University, Kolkata, India

² Professor, Jadavpur University, Kolkata, India,

ABSTRACT: *The socio-economic and sustainable environmental aspect of a project can be enhanced through knowledge sharing (Ex. from buyer perspective, technological landscape, new technological ecosystem and vendors motivation towards innovation.), dissemination and eco-industrial design upgradation. As per Globe Newswire Report of 2020; the wastewater treatment plants market stood at India around \$2.4 billion as of 2019 and planned to climb around \$4.3 billion by 2025 through the incremental increase demand of qualitative and quantitative municipal water as well as water treatment plant across the country. Implementation of strict government legislation; like zero discharge regulation for effluent before discharging into the water streams is expected to demand for economical and sustainable WTP by 2025. However, variation in the price of raw material and operating and maintenance cost for wastewater treatment plant is a major challenging issues towards sustainable growth. A high level closed loop supply chain design for wastewater treatment processing plant needed including stakeholders assessment and business modeling of the opportunities at the macro, micro and implementation level for successful implementation, widespread awareness and proactive identification of the project. A Pilot project scalability and supply chain replication can be simulate through the cost benefit analysis and market feasibility research. WTP market in India can be differentiated by the type, plant category, process, operating mode, end user industry and region. Now in terms of process; Moving Bed Biological Reactor (MBBR) is dominating the market as of 2019. In terms of regional development, South region stand in the top of market share in 2019, followed by West, North and East regions. However with the increasing rate of ground water depletion over the last few years, the movement towards circular economy begins; it is expected that increasing number of manufacturing facilities in any region is expected to contribute to the increasing demand for wastewater treatment plants as well in that region in coming days through innovative business modeling and implementation. Our main objective in this study is to evaluate and forecast the growing trends of WTP market in India, identify the major driving challenges, identify major customers and vendors, identification of major stakeholders and companies which works on WTP markets and last but not the least socio-economic and cost benefit analysis of WTP market in India.*

Keywords: *Socio-economic development, sustainable development, stakeholders, business modeling, wastewater treatment plant, ground water depletion, circular economy.*



The Study of Hydrochemical Composition of Wastewater of the Capital City of Georgia

Natela Dzebisashvili (Dvalishvili)¹, Mariam Tabatadze²

^{1,2} Institute of Hydrometeorology at Georgian Technical University, D. Agmashenebeli ave. 150g, Tbilisi, Georgia

ABSTRACT: *Water resources is one of the most important national treasure of the country, to defend it is the duty of each humans. To protect the cleanness of natural water is vital important to ensure favorable living conditions for the state population, effective functioning of economy and to maintain the healthy environment as well. Wastewater plays an important role in the process of salinity balance of the rivers in Georgia, since wastewater treatment plant of Tbilisi (Gardabani WWTP) operated only mechanical and semi-biological treatment and serves only part of the city. As a result, wastewater caught in the sewerage and without any treatment flow into the small rivers located in Tbilisi.*

The main goal of our research was to identify chemical composition of wastewater, which flows into small rivers of capital city of Georgia.

As a result of study of hydro-chemical parameters of some wastewater which flow into the small rivers were identified that the main of the pollution component of wastewater is biogenic and surface active synthetic substances, whose permissible exposure limits (PELs) exceed 2-10 times.

Keywords: *Wastewater, Management, Pollution, Hydrochemical Composition, River.*



Assessing the extent of antibiotic pollution in hospital wastewater using HPLC

S. Bhattarai^{1,*}, R. Joshi¹, R. Bhatta¹, S. L. Shyaula¹

¹ Kathmandu University, Dhulikhel, Nepal

ABSTRACT: Hospital wastewater is further contaminated with antibiotics excreted by the inward patient and laboratory leftovers. This study aims to evaluate the occurrence of commonly prescribed antibiotics in two hospitals (Stupa community hospital and Dhulikhel hospital) wastewater stream using HPLC. Identification of the most commonly used antibiotics is done through a questionnaire survey. Sample extraction is done by composite sampling followed by microfiltration, pH adjustment and solid phase extraction (SPE). Suitable HPLC method is developed for the determination of different antibiotics present in the sample. The results indicate that among the antibiotics under investigation, seven antibiotics were present in the wastewater of Stupa Community Hospital whereas one antibiotic was detected in the wastewater of Dhulikhel Hospital. The maximum detected concentration of antibiotics was in the range of 2000 ppm. Study of physico-chemical parameters of the wastewater reveals the slightly high pH, high conductivity, high total dissolved solid and also high BOD & COD value. Successful solid phase extraction and application of HPLC in the detection and quantification of antibiotics in hospital wastewater is demonstrated. Advanced Oxidation Process (AOPs) is recommended for the treatment of hospital wastewater.

Keywords: Hospital wastewater, Antibiotics contamination, HPLC



Development of Layered Double Hydroxide Derived Adsorbents for Removal Of Arsenic Toxicity

Manjusha Chakraborty, Ranjana Das, Chiranjib Bhattacharjee

Chemical Engineering Department, Jadavpur University, Kolkata, India

ABSTRACT: Arsenic pollution in ground water has become a worldwide environmental issue and is a serious threat to human health. In nature, Arsenic (As) exists as the inorganic oxyanionic forms As(V) and As(III) depending on the environmental conditions of the aquifer. As(III) has been reported to have greater toxicity than As(V) and it is difficult to remove As(III) by adsorption processes and therefore, pre-oxidation of As(III) to As(V) is required prior to adsorption, precipitation or ion exchange process in order to achieve a higher removal effect.

Diverse methods exist for removing heavy metals from wastewaters while many of them are expensive and have various limitations. To remove undesired toxic components from aqueous streams adsorption is commonly used due to its cost effectiveness, easy operation, high efficiency, simplicity of the equipment and easy regeneration of materials. However, most adsorbents that are efficient for wastewater purification are electrostatically neutral or carry anionic charges and hence are only suitable for removing cationic pollutants. Here, nanotechnology is considered to play a crucial role and nanobased adsorbents is quite efficient for arsenic removal from contaminated water.

Layered double hydroxides (LDHs), a two dimensional, nanostructured promising layered materials are very useful in water conservation and purification due to their large surface areas, high anion exchange capacity, good thermal stability and low treatment cost. They are highly efficient for removing oxometalates and have potential to remove inorganic contaminants such as oxyanions (e.g., arsenite, arsenate) from aqueous solutions by the processes of adsorption and ion exchange. The iron-based LDHs which are non-toxic, low cost, and easily accessible in large quantities and thus promising candidates for arsenic removal from water and widely used as anion exchangers and adsorbents.

Keywords: Arsenic Removal, adsorption, groundwater treatment, nanobased adsorbent, layered double hydroxides.



Efficiency of Utilisation of Wastewater sludge in Agriculture Supporting Circular Economy

Hosam E.A.F.^{1*}, Bayoumi Hamuda²

¹Professor, Óbuda University, Budapest, Hungary

²President of International Council of Environmental Engineering Education

ABSTRACT: Rapid increases in global population, industrialization and high requirements for food and energy production, wastewater sludge are the raw material for this purpose. According to the UNs General Assemblies and the EC, the use of wastewater sludge as a source for energy and fertilizer is an excellent alternative waste management considering the legislation requirements and the circular economy principles. The Sewage Sludge Directive 86/278/EEC encourages the use of wastewater sludge in agriculture and to regulate its use without harmful impacts on agroecosystem. The organic matter and nutrients are the two main elements that make the spreading of this wastewater sludge on agricultural land as an organic soil improver suitable. For these reasons, the idea of the circular economy can be applied in any industrial activity, including the wastewater treatment sector. The idea of circular economy is actually one of the priority ideas of economic development underlying the current global and EU policy in the field of environmental protection and waste management. This positive influencing is most pronounced on degraded soils, which are poor in organic matter. While it makes the structure of sandy soils more cohesive, in the case of strongly bound soils it produces a looser structure, so it can be used successfully in both extreme types. Since 1997, we carried out pot experiments using different soil and plant types with different applying doses to investigate the effect of these waste materials on the plant production, physiochemical and biological activities, and to what extent to certain doses, the results are positive significantly, taken in the consideration the low heavy metal contents.

Keywords: Wastewater sludge; application technology; soil improvement; plant production, pot experiments, soil components; agroecosystem quality; soil physiochemical properties.



Concentration of sucrose solution by Air Stripping in Rotating Packed bed

Moumita Sharma^{1*}, Avijit Bhowal¹, Siddhatha Datta¹

¹Department of Chemical Engineering, Jadavpur University;

ABSTRACT: The concentration of solution has a significant role to play in sectors like food processing among others. The sucrose is concentrated for reduction in the volume of end product, easy transportation and packaging and also to lessen the overall expenditure. Sucrose solution is also added as an intermediary step in making of liquid syrups, jams, jellies, condensed milk, confectioneries, aerated drinks etc. Conventionally Evaporators are used for the concentration of liquids in industries. Few pressure-driven membrane processes (Osmotic Distillation, Reverse Osmosis, Filtration techniques) were also studied for the concentration of sugar solution. But most of them are expensive and time consuming. Degradation of the membrane and limitation in achieving desired level of concentration were also few other disadvantages noted. In this study, Air Stripping is carried out in a rotating contactor as an alternative for water activity reduction in sucrose solution. Rotating packed bed are 'donut' shaped packing elements where the mass-transfer takes place at high centrifugal acceleration which is about 100 times to gravitational force (g). Stacks of wire mesh acts as the packing material which is rotated inside two concentric discs driven by a motor. Warm sucrose solution comes in contact with air inside the rotor in a countercurrent mode. The concentration of sucrose solution was measured using a pocket Refractometer (Atago, Japan). The performance of the rotating contactor in terms of concentration (OBrix) was calculated by changing the operational parameters (air flow rate, rotational speed, liquid flow rate and temperature). A comparative study with conventional wiped film evaporator was also done. Under optimal condition, sucrose solution was concentrated from 10 OBrix to 27 OBrix within 2 hours of operation which was highly efficient. So, Air Stripping in a rotating bed can be considered as a feasible technique for concentration.

Keywords: Concentration, rotating packed bed, air stripping.



Treating Water Bodies of Dhaka City by Vetiver Based Phytoremediation

Samira Tasnim Progga^{1,*}, Mohammad Shariful Islam²

¹Department of Civil Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka 1000, Bangladesh.

²Professor, Department of Civil Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka 1000, Bangladesh.

ABSTRACT: Among many problems, water pollution is one of the major concerns that Bangladesh is facing currently. Though almost all the rivers and other water bodies are facing this problem, rivers and lakes inside and in the neighbourhood of the Dhaka city are at the worst risk due to unplanned urbanization and industrialization, tanneries, dying factories, brickfields, unhygienic open latrines, dirty utensils and cloths washed by slum dwellers, untreated wastes thrown into the rivers by industries, oil spilled by boats, agrochemical in agricultural lands etc. From several studies it is seen that the two major rivers, Buriganga and Turag, along with some other lakes, such as Hatirjheel, Gulshan, Dhanmondi, Uttara, Banani and Ramna, in recent years have deteriorated severely. Immediate actions to restore these water bodies is a big agenda. In this paper a detailed picture of the actual pollution is presented with possible solution. The pH, DO, BOD, COD, EC, Turbidity, TDS, TSS, Chloride etc parameters of the above mentioned surface water sources are far above their standard threshold. Among many solutions, phytoremediation is a very useful measure, where a plant is used for removal, degradation or containment of contaminants in soil, surface water and ground water. Laboratory based small-scale studies showed that Vetiver (*Vetiveria zizanioids*) is effective in the improvement of water quality of the above mentioned sources. A pilot project has been planned with floating garden with the grass that can be very economically feasible, energy efficient and environment friendly.

Keywords: Phytoremediation; Vetiver; water pollution: water quality parameters.



A Review of Macrophytes as Phyto- Filters: for WasteWater Treatment

Tanya Gupta^{1*}, Sadhan K Ghosh¹

¹ Jadavpur University, Kolkata, India

ABSTRACT: One of the most environmentally friendly solutions for the problem of purification from urbanised territories are Phytofilters. As it serves the purpose and yet incorporate a monitoring and maintenance system efficiently. There is little or no need for a filter replacement as living entities digest whatsoever is already available. The cost-effective green emerging technology with long-lasting applicability epitomises by enhancing lower energy needs, reduces pollution and causes no known health risks.

It follows water trickling (root-zone) i.e. rhizofiltration methods through the reed bed cleaned by micro living organisms on the root system undergoing rhizodegradation utilizing the sewage for growth nutrients, resulting in a clean effluent. The performance of above macrophytes in remediating the wastewater also contributes in green chemistry showing higher tolerance against heavy metals. Some of these metals are micronutrients necessary for plant growth and converted into value-added products to increase the economic success of the energy generation from waste and enhance circular economy. Phytofilters have application in diverse sector like schools, hospitals, restaurant, office buildings, government buildings; with the increased world wide concern about global warming and carbon emission reduction. This technology helps to deal with those problems; because of as it was design with high energy savings capabilities in both heating and cooling. Our objective in this study is to check the aesthetics, cost effectiveness, functional process, safety and security of the production and sustainability with the historical preservation.

Key Words: Rhizofiltration, sustainability, Phytofilters and Circular Economy.

The authors acknowledge the support from EU and DBT funded project “INDIA H2O Bio-mimetic and phyto-technologies designed for low-cost purification and recycling of water”, and Jadavpur University.



Removal of Ofloxacin using advanced process from wastewater with Toxicity analysis of end product and moving towards sustainable technological development

Krishanu Hait^{1*}, Sadhan K Ghosh², Asok Adak³

¹ Research Scholar, Jadavpur University, Kolkata 700031, India,

² Professor, Jadavpur University, Kolkata 700031, India,

³ Associate Professor, IEST Shibpur, Howrah 711103, India,

ABSTRACT: Emerging contaminants (ECs) are synthetic and/or naturally occurring chemicals or microorganisms not commonly monitored in the environment; among various ECs, occurrence of antibiotics in wastewater has drawn much attention in recent trends because of development of antibiotics resistance pathogenic strains due to long term exposures of various antibiotics. Through the huge application of antibiotics in human and veterinary medicine and uncontrolled discharge in the environment, microbiota get an open exposures to generate resistance mechanism through gene mutation; as a results selective antibiotics losses it's effectiveness for treating a particular disease. Since the elimination of antibiotics in conventional wastewater treatment plant is incomplete and unnecessary exposures to microorganism; so special treatment required for control this effluent before discharging into wastewater. Advanced oxidation process (AOP) using UV-H₂O₂ is an oxidative water treatment process used to treat toxic emerging contaminants. In the UV-H₂O₂ process, UV light is being absorbed by the hydrogen peroxide (H₂O₂) and undergoes rapid decomposition to form hydroxyl radicals (OH*) which is highly reactive with organic compounds and improve the effectiveness of treatment against direct UV treatment. Here advanced oxidation process using hydroxyl radicals are being studied for removal of ofloxacin (OFL) from aqueous solution using a UV reactor. The data were analysed using different kinetic models to find out the time based rate constant as well as fluence based rate constant. The experimental results exhibit pseudo-first-order kinetics for the UV-H₂O₂ process against OFL. Effect of different parameters such as H₂O₂ dosages, pH, initial concentration, and surface water and wastewater matrix on the efficiency of degradation of OFL was investigated in details. In the investigation process to analyse the degradation rate of OFL it was found that at pH-7, molar ratio 5 (MR= [H₂O₂] / [OFL]) and with 100 mg/L initial concentration, 95% degradation for OFL were achieved within 60 minutes. The details study shows; the potentiality of the UV-H₂O₂ process for the degradation of ofloxacin. At last for the assessment of future scope of the work toxicity analysis was carried out through bio-assay; results show the process is much capable on controlling the toxicity of intermediates.

Keywords: Emerging contaminant, Degradation, Antibiotics, Ofloxacin, Advanced oxidation process, UV-H₂O₂, Toxicity, Bio-assay, sustainable development.



Wastewater Treatment and Resource Circulation in the East Africa Community (EAC)

Amb. Prof. Michael K. Koech*¹, Mr. Kaburu J. Munene¹

¹ School of Environmental Studies, Department of Environmental Sciences and Education
Kenyatta University, Kenya

ABSTRACT: The study examined various methods of wastewater treatment in the East Africa region. The study also highlighted the contribution of wastewater treatment to environmental sustainability and the improvement of human health. Significant sources of wastewater in the East African Community were identified. The study adopted a desk review research. The rapid expansion of major urban centers coupled with intensive agricultural activities in the region has caused a massive generation of wastewater. Modern and sustainable techniques of wastewater treatment were analyzed and discussed to derive more information on how to carry out an effective treatment process. Successful resource circulation practices, policies, and technologies across the East African Community were also examined and discussed in an in-depth approach. Industrial plants, non-governmental organizations, individuals, and governments have started to initiate waste recycling practices to reduce the accumulation of waste in the environment. Resource circulation in the region is guided by the 3Rs program that includes recycling, reusing, and reducing waste generated. The study also highlighted the importance of resource circulation to the environment and small-scale businesses as they are the main actors in resource circulation in the region.



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X. Water Management



Modeling and Analysis of Linear Irrigation System

Md. Touseef Ahamad^{1,*}, P.Jahnavi¹, Khaleel Abdul Hur Ali²

¹ Department of Mechanical Engineering, University College of Engineering & Technology, Acharya Nagarjuna University.

² Karbala Technical Institute, Al-Furat Al-Awsat Technical University

ABSTRACT: *There are many means of irrigation across the world. The conventional ones use lots of water and is comparatively much effort requiring. At this point of time, the need for modern techniques is accelerating, as there is depletion in resources at an alarming rate. This topic is of great concern around the world and a huge research is going on in this sector. Many new techniques like drip irrigation, fixed sprinkler irrigation came into place across the world. However, they are also costly and less affordable by the farmers in a developing country like India. Hence, we find very little application of such systems across the country. Our aim is to provide a better form of linear irrigation that would fulfill the demands of the farmers while not causing a burden to them. We designed a model of linear irrigation system and made analysis on the pressure acting on the system due to flowing water in the pipes.*

Keywords: *Irrigation, drip irrigation, fixed sprinkler irrigation.*



Modelling and Analysis of Portable Water Hyacinth Remover

Mohammad Touseef Ahamad^{1,*}, M. Sai chand¹, A. Bharat Kumar¹, Khaleel Abdul Hur Ali²

¹ Department of Mechanical Engineering, ANU College of engineering and technology, Guntur

² Karbala Technical Institute, Al-Furat Al-Awsat Technical University

ABSTRACT: Water hyacinth (*Eichhornia Crassipes*) is a floating plant that grows in still or slow-moving fresh water bodies and considered as world's one of the waste aquatic weed. The water hyacinth has ability to grow rapidly and forms high dense floating mats on the surface of water, which causing sever impacts on irrigation systems, water transportation, biodiversity etc. To overcome this problem various methods like chemical control, physical control and biological control are practised. Out of this physical control has some advantage over other two control methods. In physical control using machinery is one of the effective ways for removal or control of water hyacinth. In this paper, a portable water hyacinth remover was modelled which can able to operate in minimum 2 feet depth water and narrow water passages of 2 meters wide. The remover has capacity of 50 kg collecting the weed. The modelling is carried in two stages, one is conveyor setup another is floating setup. The floating setup with collecting tank is attached with ladder type chain conveyor setup. By varying the loads, the stability of the system in water was analysed.

Keywords: Water hyacinth, aquatic weed, physical control, conveyor setup, floating setup, stability analysis.



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XI.

Additional Abstracts:

**Circular Economy; Covid 19; Bio Economy;
Waste Management; Sanitation; Water
Management.**



LPG Reticulated System instead of Conventional LPG Cylinders for Residential Flats: A Step to Reduce Physical Intervention Essential for Combating COVID-19

Ashanendu Mandal, Sudip Kumar Das*

¹ Chemical Engineering Department, University of Calcutta

ABSTRACT: COVID-19, the most dangerous pandemic disease of the present era, has spread across the globe rapidly due to the outbreak of novel coronavirus. Thousands of people are dying daily as a proper vaccine is yet to be developed. Staying at home, sanitizing hands, using a face mask, and keeping social distancing are some of the measures imposed to combat this deadly disease. Lots of steps are also being introduced to avoid physical interventions among people. However, many people in India, who stay in residential flats of the cities and use liquefied petroleum gas (LPG) cylinders as cooking fuel, cannot avoid physical intervention altogether since the LPG cylinders are replaced manually by LPG delivery persons. There are also many people involved in the entire LPG cylinder distribution system, such as in the LPG bottling plant or the LPG cylinders' transportation. The LPG reticulated system may be introduced in the Indian cities instead of the conventional LPG cylinders to tackle such a situation. In this system, a common gas storage tank is installed on the residential premises where the individual houses are connected through the pipeline. This system helps the people reduce physical intervention and help them have the uninterrupted gas supply, to pay as per actual consumption, to save cylinder spaces, to avoid the hardships of cylinder movement, and to reduce safety hazards, etc. This also helps LPG industry save bottling costs and reduce transportation and inventory costs. This innovative system will also be useful in the post-COVID era due to its more straightforward, safer, and cheaper results.



Circular economy adoption in textile and clothing industries in Bangladesh

Dr Krish Saha*

Birmingham City University

ABSTRACT: *Our study explored the current state of the circular economy in the textile and clothing (TC) industry. We analysed a multi-country survey data to identify the challenges and opportunities facing the TC manufacturers and proposed implementation strategy for the CE adoption.*

Our analysis evidenced that CE can improve the environmental and social sustainability of the TC industry. The lack of financial, technological, and human resource, along with management's reluctance and end user's indifference to sustainability are the biggest challenges for CE implementation. The research further derives that the TC firms are unable to eradicate the challenges to CE implementation without a holistic approach that involves the collective effort from the industry, host government's incentives, their buyers and above all the conscience of the end-users.

We proposed that the collaborative efforts, knowledge sharing in sustainability management across the value chain, and marketisation of the waste recycling among others are a few actions the stakeholders of the TC industry must adopt for implementing CE successfully.



Circular Economy in Small and Medium-sized Enterprises in the United Kingdom

Jamal Lea*

Project Manager, Low Carbon SMEs Project, Aston University

ABSTRACT: *Small and medium-sized enterprises (SMEs) face many barriers to growth owing to poor sustainable business practices and disproportionately high-energy costs borne by energy intensive processes, that are reliant on outdated and energy inefficient equipment. This study demonstrates the impacts of an EU-funded collaborative project, 'Low Carbon SMEs', that actively supported 100 SMEs situated in the Midlands UK, in reducing their carbon footprint and improving overall sustainability performance. Key stakeholder participants include industry experts, Aston University academics and SME owners-managers.*

Method: SME participants received a series of interventions comprising energy efficiency audits (diagnostics), grant support towards upgrading plant machinery and equipment, long-term support by leading academics and interactive workshops. Tools deployed to measure carbon reduction impacts in companies include energy management maturity benchmarking and carbon foot printing baselining techniques.

Findings: The participating SMEs demonstrate positive correlation between the adoption of low carbon practices and improved business performance. Successful adoption of green operations transformed the SMEs' competitiveness by improving resource and energy efficiency, optimising processes and logistics, and enabling the businesses to adopt effective renewable energy, eco design and waste management strategies. This led to increased overall efficiency, and improved the productivity, performance and social welfare standards of the businesses.

Implications / limitations: extending the carbon performance-measurement period from 2 to 5 years may have provided greater insights into the longer-term impacts of low carbon interventions, during the maturity stage.

Originality: the analysis of the cases highlights the value of academic-industry collaboration in the regional decarbonisation of the SME sector, whilst driving company-level economic growth and productivity



Circular Economy Via the Closed Loop Supply Chain in Small and Medium Sized Enterprises in the European Union

Prasanta Kumar Dey*

Aston Business School, Aston University

ABSTRACT: The aim of this research is to facilitate small and medium sized enterprises (SMEs) of the European Union (EU) to achieve higher sustainability performance via the implementation of tenets of circular economy (CE). We do this by addressing two research questions. First, what is the current state of CE in the EU countries and second, which closed loop supply chain functions contribute more to CE adoption, and what improvement measures across the functions of closed loop supply chain contribute to enhanced CE adoption for higher sustainability performance. The study underpins reduce, reuse and recycle principles of circular economy along with transformation of supply chain from linear to circular using resource-based view (RBV) theory and adopts a multimethod approach using data from around 100 SMEs in four EU countries – Greece, France, Spain and the UK. This research reveals that CE adoption through closed loop supply chain in the EU is likely to help achieve higher environmental performance of SMEs compared to economic and social performance. The ‘design’ function in closed loop supply chain currently facilitates most SMEs to adopt CE, whereas ‘reverse logistics’ function contributes the least. Additionally, while SMEs customers are proactive to support SMEs to adopt CE, SMEs self-motivation and support from policymakers has rooms for improvement.

Key words: Circular economy, sustainability performance, small and medium sized enterprises, closed loop supply chain



A bioeconomy strategy and synergies with circular economy for Eastern Africa.

Rocio Diaz-Chavez^{1*}, Ivar Virgin¹

Stockholm Environment Institute

ABSTRACT: Eastern Africa countries have a rich biodiversity and strong bio-resource production base. Over 30% of the region's GDP can be directly attributed to agriculture and other bioeconomy related sectors. The Bioeconomy Strategy in Eastern Africa project (BiSEA) has worked for the last two years to develop this regional strategy. It has worked in collaboration under the coordination of the Eastern Africa Science and Technology Commission (EASTECO) with five regional partners and national governments in Burundi, Kenya, Rwanda, South Sudan, Tanzania, and Uganda.

This Regional Bioeconomy Strategy focuses on the creation of new biobased products that add value to natural resources in novel, innovative and sustainable ways. It seeks the optimization and innovative use of biomass and biological resources derived from agriculture, aquaculture and forestry and includes alternative sources of food and feed, health, and bioenergy products. It integrates Agenda 2063 and the UN 2030 Agenda for Sustainable Development into intersectoral national development plans, and the regional aspiration contained in EAC Vision 2050 supporting commitments to environmental sustainability, climate change adaptation and mitigation. Within this context, it also builds up on a sustainable circular economy based on the principles of eliminating waste and pollution, keeping products and materials in use, and regenerating natural systems. That is, the basis for modern bioeconomy is optimal and sustainable use of renewable biological resources. In this form the bioeconomy strategy supports a transition away from the fossil fuels industrial base.



Fibre Based Bio-plastics a sustainable replacement to fossil-based plastics and their role in fostering the growth of the circular economy.

Hya Bioplastics*

Ssekimpi Dennis

ABSTRACT: Biomaterials from plant fibres have been an emerging trend as a replacement for fossil feedstock due to the environmental benefits and the low cost of sourcing the raw materials in nature. The ability to biodegrade offers a reduced impact on the environment compared to the synthetic materials which have been observed to accumulate in landfills, makes them a much safer alternative in several applications including packaging, construction, and among others. The use of these novel materials in production of bioplastics is a way to bring the plastics economy from its linear nature to a circular approach. However, a major drawback to their application in some applications is the insufficient mechanical properties exhibited by most of these materials. This deficiency requires innovation and technological advancement in the processing of biomaterials for more applicability. Microfibrillated cellulose (MFC) a component of the cellulosic plant fibre which are raw materials for the biomaterials has been identified as a way of improving the mechanical properties of the fibres used in various applications. The material has several methods of extraction from natural plant fibre depending on the scale and application of the biomaterial. The use of plant fibre as a source of biomaterials can yield improved mechanical properties for the material if enhanced with micro fibrillated cellulose and therefore foster the growth of the circular bioplastics industry. This paper addresses the documented trends in the extraction of micro fibrillated cellulose from cellulosic fibres and compares the applicability of each method.e.



Bio-Processes Applied To Industrial Waste Remediation

Karoli N. Njau*

BioConversion Technology Africa Co. Limited (BIOCON)

P.O. Box 1597 Arusha, Tanzania.

ABSTRACT: *The Bioinnovate Africa Program supported the establishment of an enterprise to market integrated bio-process innovation for treatment of agro-processing wastewater in Eastern Africa. BioConversion Technology Africa Company Limited (BioCon) has been registered in Tanzania and Uganda for the purpose. A sister company in Addis Ababa, Ethiopia is being registered. Some projects have been implemented showing how bio processes can alleviate environmental disaster that arise from inadequate treatment and subsequent discharge of industrial wastewaters into the environment. What is presented herein is practical application of the innovations developed jointly by Universities of Addis Ababa in Ethiopia, Makerere in Uganda and Nelson Mandela African Institution of Science and Technology in Tanzania. In this paper, performance of established waste treatment systems is shared to show case that bio-processes can innovatively been assembled to provide sustainable solution to the agro-processing industry waste problem while also realizing resources recovery which if properly harnessed can contribute to the competitiveness of the local industry.*

Biography

Dr. Ir. Karoli N. Njau is a professor of environment at the Nelson Mandela African Institution of Science and Technology and the Managing Director of BioCon (TZ). Being educated in Chemical and Process engineering at the university of Dar es salaam, Tanzania he has been involved in many research projects aiming at improving water quality. He has also supervised many students and published over 100 scientific papers and manuscripts. Dr. Njau's passion is to apply engineering knowledge to develop smart systems that solve the challenges facing our society today.

encourage the young generation to apply science and innovation in tackling our own problems.



Current state of Affairs of waste management and Prospects in Circular Economy A case of Juba City, South Sudan

Clara Lumori*

Hai Mayo Residential Area, Juba, South Sudan ,P.O. Box 1597 Arusha, Tanzania.

ABSTRACT: *Juba is the capital and largest city of the Republic of South Sudan. The city is situated on the White Nile and also serves as the capital of Central Equatoria State, with a population of 403,000. Juba is one of the fastest growing cities in the world with a projected population of 522,000 by 2026. The projection can be attributed to internal and external immigration due to man made and natural disasters resulting to movement of people in search of safety, jobs and new opportunities thus increasing urbanization. In many countries, increasing urbanization may subsequently result to overall increase in the rate of waste generation.*

Waste management is one of the three main pillars of Sudan Integrated Environment Project (SIEP) in South Sudan that currently focuses on solid waste management in Juba city. According to a survey conducted by JICA in Juba town, the estimated waste generated amounted to 1,337 tons/day in 2017 while waste collection amounted to 34.3 tons/day with a rate of collection of 2.6%. In Juba City, the type of landfill is controlled with a soil cover, but with the armed conflicts in most parts of the country, this has negatively impacted solid waste management and access to landfill. The absence of legal framework has exaggerated the need to specifically address waste management in the country. The draft National Environment Policy, 2015-2025, a Waste Management Plan has been established to raise the collection ratio in Juba City Council up to 34% by 2023 however the plan is not progressing, due to the tight budget of Juba City council and the rapid population growth of the city.

Although there are many challenges such as financial constraints, illegal dumping, burning and political instability in managing waste, there are excellent opportunities for Juba city to provide a wide range of urban services including waste management in the formal and informal settlements. This will have a direct positive impact on resident's health, but importantly creation of employment, poverty reduction and use, recover and regenerate products and materials from such waste in a sustainable basis. These means that policies, regulations and action plans need to be formulated a round circular economy to enable waste management finding value and redirect it back to the community.



Prospects of Circular Economy in Ethiopia: Challenges and Opportunities

Kassahun Tesfaye^{1*}, Teklehaimanot Haileselassie²

¹Ethiopian Institute of Biotechnology (EBTi),

² Institute of Biotechnology, Addis Ababa University.

ABSTRACT: Agriculture is the mainstay of the Ethiopian economy, accounting for about 43 % of GDP, 76 % of national employment and 28 % of total export earnings. The country is a center of origin and diversity for many crop species and has several unique agroecologies. However, the contribution of agro-processing to the overall GDP, employment opportunities and earning from export has been very minimal. Ethiopia's agro-exports are currently limited entirely to primary and unprocessed goods despite the increase in global and domestic demand for Processed Agricultural Products (PAPs). The country realized that industrialization will closely depend on transforming the agricultural sector as reflected in the consecutive Growth and Transformation Plans I and II. Their main objective is to transform Ethiopia into a middle-income country by 2025 and one of the key pillars for reaching the target is the development of light manufacturing activities. The industrialization approach includes developing specialized industrial parks. To facilitate this Ethiopia established Industrial Parks Development Corporation (IPDC) in 2014 with Ministerial Regulation No. 326/2014 and Industrial Parks proclamation 886/2015 which provides that industrial parks can be developed by public and private enterprises. Accordingly, several Industrial parks have been constructed in various corridors of the country specializing in sectors such as textile and garment, leather and leather products, sugar and pharmaceuticals. Another type of industrial parks established in the country are the Integrated Agro-Industrial Parks (IAIP) which aims to revolutionize the agriculture sector. The business model of the IAIPs promotes value addition and efficiency of the commercial food supply chain. It is an end-to-end approach linking production to the market. However, this can still be enhanced by incorporating the principles of the circular economy, through which the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste is minimized. A sustainable and circular bioeconomy will help to address global and local challenges such as climate change and land and ecosystem degradation that are exacerbating the demand for food, feed and energy. This presentation will highlight the prospects for circular bioeconomy for the development of Ethiopia and existing challenges and opportunities.



Transitioning South Africa towards a Waste to resource Circular Economy

Cristina Trois*

University of Kwazulu Natal.

ABSTRACT: *This presentation focuses on the nexus waste and climate change and how integrated Waste-to-Resources Management in South African municipalities not only can activate the circular economy through the correct localisation of appropriate waste management technologies, but also demonstrates how the systematic implementation of sound integrated waste to resources management strategies (Through the implementation of the WROSE methodology in the decision making process at municipal and national level) can promote active diversion of waste from landfills and result in the systematic reduction of greenhouse gas emissions (GHG) from the South African waste sector.*

Waste management in South Africa is a transdisciplinary issue with no “one size fits all” solution. Integrated Solid Waste Management illustrates the most effective waste management solutions that can be employed to decrease the impacts of GHG emissions on the atmosphere and promote good waste disposal practices. The WROSE model is a zero-waste decision-making tool developed by UKZN in 2010 to assist municipalities and the private sector in aligning with national legislative requirements and achieving zero waste. It incorporates multiple indicators (environmental, economic, social and institutional) with the inclusion of associated health risks of preferred waste management practices.

The WROSE model can be used to assist municipalities in the development and review of their Integrated Waste Management Plans and Waste Minimization Strategies, and in general to make the best decision with respect to integrated waste management strategies for the alternative use of waste, for the diversion of waste away from landfills, for reduction of GHG emissions, integration of wastewater/MSW treatment, sustainable management of food waste and energy production. This will be achieved through the application of the waste hierarchy into municipal solid waste management practices as well as through the promotion of the circular economy.

At the moment, the SARCHI WaCC group is working on the application of WROSE along with several municipalities (eThekweni, City of Cape Town, Garden Route District, uMgungundlovu District) to effectively reduce GHG emissions from the waste sector. The final goal is to achieve the full mapping of South Africa (province by province) to create a stabilisation wedge for climate change from the waste sector, while also minimising health risks associated with the exposure of municipal workers as well as citizens to specific waste management practices.

Keywords: *GHG emissions, integrated waste management strategies; climate change stabilisation wedge, decision-making; localisation of appropriate technologies, municipal solid waste; risk-adjusted strategies; WROSE model/tool.*



Sustainable Sanitation Alliance Latin America Network

Lourdes Valenzuela^{1,*}

¹ Regional SuSanA Coordinator (Latinoamérica) / Aguatuya Communication Director - Bolivia

ABSTRACT: *Networking must be understood as the set of relationships and interactions that are generated between a group of subjects or institutions to achieve a common goal. They are open and multicenter systems that, through a dynamic exchange between the members of a group and with members of other groups, enable the empowerment of the resources they possess and the generation of novel alternatives for solving problems or replicating solutions to needs. The Sustainable Sanitation Alliance (SuSanA) was formed in 2007 with the objective of promoting and influencing the sustainability of basic sanitation in the context of the Millennium Development Goals, with a systems approach and emphasizing the sustainability aspects of the service. SuSanA is an open network (a global community), where partners promote sustainable sanitation systems. In the last 10 years, SuSanA has contributed significantly to the development of the sector. From SuSanA "Regional Chapters" are dropped, such as the Chapter in India, Africa and the Middle East. SuSanA Latin America, is promoted, thanks to the financing of the Swedish Embassy in Bolivia through the coordination of the Aguatuya Foundation (www.aguatuya.org). The objective of SuSanA Latin America is to promote the regional production of knowledge on sanitation and the exchange, so that best practices are adopted, promoting inclusive access to sustainable services and in this way contribute to the achievement of the sustainable development objectives (SDGs), specifically SDG 6.1 and 6.2.*

Keywords: *Sanitation, sustainability, sustainable development objectives, Latin America.*



Brazil as the go-to market for biogas production

Alessandro Amadio^{1,*}

¹ UNIDO Representative for Brazil and Venezuela, Brasilia-DF, Brazil. During 27 years of work, he operated mainly in East Asia, the Middle East, North Africa and Latin America. Master's degree in Agriculture from the University of Florence (Italy)

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ABSTRACT: According to the Brazilian Biogas Association (ABiogás), Brazil has the greatest biogas potential in the world, estimated in 81 billion cubic metres of biogas each year. However, data from ABiogás and from the International Centre of Renewable Energy (CIBiogás) shows that Brazil currently exploits only 2% of its total biogas potential. If Brazil's potential for biogas production were to be fully exploited from agriculture, the sugar sector and municipal solid waste, biogas could supply up to 36% of the country's national electricity demand or cover 70% of its diesel oil consumption. Brazil is also the fourth biggest consumer of fertilizer in the world, but currently imports 65% of the fertilizer it uses. With that enormous potential in mind, the Brazil GEF Biogas Project, coordinated by the Ministry of Science, Technology and Innovations (MCTI) and implemented by the United Nations Industrial Development Organization (UNIDO), acts in Brazil as a focal point to streamline and accelerate local biogas production and value chains. The project, funded by the Global Environment Facility (GEF) aims at reducing CO₂ emissions through the development of the biogas sector and value chains in Brazil. The project promotes innovation, sustainability and employment by assisting agroindustry ventures in Brazil to develop a robust biogas value chain that converts organic waste into electric power, thermal energy and fuel for transportation. The Brazil GEF Biogas Project stimulates multi-sector partnerships between government agents, public policy makers, research institutions and the private sector towards using biogas to transform the Brazilian energy mix. For more information, please contact: contato@gefbiogas.org.br.

Keywords: Biogas, circular economy, partnerships, sustainability.



Grassroot network for knowledge exchange, capacity building and biodigesters development for Latin America; the circular economy we do need!

Mariela Pino^{1,*}

¹ M.Sc. General Coordinator Latin American Biogas Network, Santiago, Chile

ABSTRACT: *The Latin American Biogas Network was created in 2009 as an answer to knowledge exchange between biogas, in regards to the installation of applied technologies to provide vulnerable rural households with solutions for biogas generation in order to improve their life standards. In Latin America the widespread model of low cost biodigester is an adaptation of the plug flow model, but built on polyethylene, which can be taught and financed easily, and therefore capacity building its relatively simply and feasible to reach. The network has now 11 years of development and one of its main objectives it's the wide promotion of the technology for the whole society and the environment benefits, and therefore it did open up its scope. RedBioLAC addresses nowadays larger scales (productive scale), and other substrates rather than only animal manure, but agricultural and agro industry residues, municipal solid waste, etc. through academic and applied research. Lately we had identified that stronger emphasis has to be put on municipal solid waste treatment alternatives which are truly circular, and not harmful for the planet, the environment or the living organisms. We aim at promoting social cohesion and awareness against Waste to Energy (incineration and its variations) lobby in Latin America but widespreaing the implementation of anaerobic digestion. At the presentation we will highlight our mechanism for gathering experts and practitioners beyond the objective of the network, and the services and products that we delivery to the latin American community.*

Keywords: *Grassroot networks, domestic and productive biogas plants, proper circular economy, collaborative development*



Pandemic response plans in Water Companies: Results from the online network in Brazil and Peru

Carolina B. G. Cabral^{1,*}, Christoph Platzter², Matheus Valle³, Bruno Silva⁴

^{1,2,4} Engineer, Rotaria do Brasil, Florianópolis – SC - Brazil,

³ Consultant, Belo Horizonte, MG - Brazil

ABSTRACT: *With the spread of the COVID-19 pandemic, for water and sanitation services users, the continuity of the water supply becomes, more than ever, a primary public health issue. Faced with this situation, the Potable Water and Sanitation Services Companies from Brazil and Peru face a series of challenges. In order to strengthen the work and resilience of urban sanitation service providers in the face of the COVID-19 Pandemic, a support network was created, with a series of webinars and online courses on actions of sanitation service providers. This paper aims to describe the lessons learned from this experience and the results of the pandemic reaction plans developed with the support of this network. The network has adapted existing emergency plans from other countries, as well as gathered local experiences to jointly develop useful material for the water companies to establish clear pandemic response processes and procedures. This paper presents the main and necessary points for sanitation companies to consider in a response plan, such as: how to protect their workers from the virus by reducing staff to an absolute minimum and reorganizing work structures, preparing to react dynamically in the face of problems such as the rapid increase / decrease in local demand for water and the interruption of supply chains. At the same time, as the main providers of water, how to respond to the needs of those who are not connected to existing water networks and who lack sufficient resources to meet the necessary standards of personal hygiene. The results gather the experience from over 50 water companies from Brazil and Peru, that participated in this project.*

Keywords: *COVID-19 pandemic; response and emergency plans; water companies; water supply, learning network, Latin America.*



Circular Economy and Water Technology: Perspectives from a partnership between The Netherlands and Brazil

Luewton Lemos F. Agostinho ^{1,*}

¹ Researcher and professor, Wetsus, European Centre of Expertise for Sustainable Water Technology and NHL Stenden University of Applied Sciences – The Netherlands

ABSTRACT: *Circular Economy has been part of the European Union ambitions for the last decades. The current research and development strategy shows the topic on many levels, i.e. in the pursuing for Water-Smart cities, in the Smart Industry concepts, in the increasing efforts to promote transversal cooperation between technical (beta) and economical social (alfa) sciences. In The Netherlands, the concept is (clearly) seen in the so called Top Sectors and the Country Knowledge and Innovation Agenda (KIAs). There, ambitions like zero water industries, green industries, zero emission waste water treatment plant, biobased economy and plastic pacts are currently pushing the academic and the professional society to peruse more circular goals and implement green and circular processes. In this talk, the Dutch perspective and strategy towards a more circular economy will be presented. Furthermore, some experiences originated from a cooperation between The Netherlands and Brazil, specially related to Water Technology, will be presented as well. The latter, to stress how experiences and opportunities have been shared between these two countries.*

Keywords: *Circular economy; innovation; water technology, partnership.*



Circular Economy Innovations: Quantity of Faecal Sludge in Lusaka for Resource Recovery – A possible key to Zambia’s Deforestation Problem?

Flora K. Chitalu*

University of Zambia, School of Engineering, Department of Mechanical Engineering, P. O. Box 32379, Lusaka, Zambia

ABSTRACT: *Urban communities in most parts of Zambia, particularly Lusaka, have limited access to both improved sanitation and affordable clean fuel. With an urban population of over two-and-a-half million in Lusaka, over 70% of these inhabitants reside in peri-urban areas. Additionally, in these peri-urban areas of Lusaka, the predominant mode of sanitation is on-site; in the form of septic tanks and pit latrines, with over 90% of people using pit latrines. Furthermore, charcoal is widely produced and there is an increasing number of people engaged in charcoal production and use in and around Lusaka; with charcoal use higher than 115,000 tonnes per annum. Through a review of several studies, this paper evaluated the potential for resource recovery from faecal sludge (FS) through faecal sludge carbonisation and its projected impact on wood derived charcoal use in peri-urban areas of Lusaka. Generation rates of FS in Lusaka are approximately 22,000 tonnes per annum which translates into a FS derived charcoal generation potential of nearly 2000 tonnes per annum. With technologies such as slow pyrolysis and hydrothermal carbonisation, calorific values as high as 17 MJ/kg have been determined for FS derived char compared to 28MJ/kg for wood derived charcoal. Taking into account cultural and social reservations with regard to FS-derived charcoal, this translates into a projected impact of nearly 2% on conventional charcoal use in Lusaka’s peri urban areas. Through optimisation of existing thermochemical treatment technologies as well as improved pre-treatment and collection efficiency of FS this could be marginally improved. However, the possibility of co-treatment with other carbon-rich waste streams such as agricultural and biodegradable municipal solid waste remains the greatest alternative to significantly increasing the production yield as well as improve the fuel characteristics of the FS-derived charcoal.*

Keywords: *Faecal sludge, Faecal Sludge Derived Charcoal, Sanitation, Wood Derived Charcoal, Deforestation.*



Eco Friendly Strategies for the Degradation of Azo Dyes

Usha R*, Jeevana Lakshmi P, Indhravathi Ch and Padmini. C

Department of Biotechnology, Sri Padmavati Mahila Visvavidyalayam, Tirupati, Andhra Pradesh, India

ABSTRACT: Industrialization has increased the use of dyes extensively in paper, cosmetic, textile, leather and food industries. Various dyes and their structural compounds used have harmful effects on plants, animals and humans. Synthetic dyes are more resistant to physical and chemical methods for remediation than natural dyes making them more difficult for the process of decolorization in the environment. Bacterial decolorization and degradation of azo dyes under certain environmental conditions has gained momentum as a method of treatment as it is inexpensive, eco-friendly and can be applied to wide range dyes. Measuring the metabolites involved by using Dye decolorization Assay helps in the identification of the enzymatic mechanisms involved in the bacterial degradation process.

The current study identifies the capability of two bacterial strains isolated from the textile dye waste waters to discolorize the three food dyes i.e., keshar dye, orange red and apple red. The bacteria with distinct morphological characteristics were selected, isolated and maintained in pure cultures. The percentage of degradation was noted and the results exhibited the capability of the bacterial strain to decolourize the food dyes effectively. The percentage and stime of decolourization were calculated. The pelleted bacterial strains retained their original colour and were not deeply coloured because of absense of adsorption indicating that the discolorization was not due adsorption but by decolorization. The bacterial colonies belonged to species of Bacillus and Cocci based on microscopy and biochemical characteristics. The two bacteria were able to decolorize the three dyes keshar dye, orange red and apple red by 5th day at an incubation period of 120hours. The degradation of the three dyes was studied and the maximum degradation was observed with Bacillus on apple green dye attaining -79% discolorization by 120 hours.

Keywords: Dye Decolorization Assay, Azo dyes Decolorization and Degradation.



Circular Economy of Agriculture Wastes in Plastic alternatives for Food Packaging

Manal A. Sorour^{1,*}, Marwa M. Helmy¹, Amira S. E¹, Mahrouky¹, Aml S. Elnawawy¹, Salwa R. Mostafa²

¹ Food Technology Research Institute, Agricultural Research Center, Egypt

² Chemical Engineering Department- Faculty of Engineering - Cairo University, Egypt

ABSTRACT: *Plastics are used in almost every place such as, in routine house hold packaging material, in bottles, cell phones, printers etc. It is also utilized by manufacturing industries ranging from pharmaceutical to automobiles. They are useful as synthetic polymer because, their structure can be chemically manipulated to a number of strengths and shapes to obtain higher molecular weight, low reactivity and long durable substances. Plastics are important material as they are durable and cost efficient to everybody. Plastics have become a large environmental problem.*

Keywords: *Bioplastic, plastic alternatives, food packaging, biodegradable plastic, processing.*



Utilization of Sodium Alginate Recovered from Brown Algae for Production of Edible Films

S.R. Mostafa^{1,*}, K.S. Nagy², M.A. Sorour²

¹ Professor of Reactor Design, Chemical Engineering Department, Faculty of Engineering, Cairo University, Egypt

² Food Engineering and Packaging Department, Food Technology Research Institute, ARC, Cairo, Egypt

ABSTRACT: Alginate ($C_6H_8O_6$)_n is an indigestible biomaterial produced by brown seaweeds, it has a potential to form biopolymer film or coating component because of its unique colloidal properties. Water permeability of edible film made from Alginate with different concentrations (1, 1.5%) was investigated. Water vapor transmission rate, water vapor permeability and gas permeability was measured. The results observed that water vapor permeability was higher for Alginate edible (1.5%) than (1%), also for gas permeability Alginate (1.5%) has higher gas permeability than (1%). In order to investigate the water sorption behavior and isotherms of the film, the water sorption data were fitted to Peleg model.

Keywords: Alginate, Edible film, Permeability of water vapor, Gas permeability, water sorption.

Resource Efficiency through Circular Economy



Dr. Sadhan Kumar Ghosh, Professor and Ex-HOD, Mechanical Engineering and Ex-Dean, Faculty of Engineering and Technology and the founder Chief-coordinator of the Centre for SD & REM at Jadavpur University, Kolkata, India. He is a renowned personality in the field on Waste Management, Green Manufacturing, Circular Economy and TQM. He served as the Director, CBWE, Ministry of L&E, Govt. of India and L&T Ltd. Prof Ghosh is the founder and Chairman of the IconSWM and the Founder and President of ISWMAW. He has been awarded the Distinguished Visiting Fellowship 2012 by the Royal Academy of Engineering, UK to work on 'Energy Recovery from MSW'. He received the Boston Pledge and NABC 2006 award for the most eco-friendly innovation "Conversion of plastics & jute waste to wealth" in the ESP/50K Business Plan Competition at Houston, Texas, USA.

He has been awarded research projects, Horizon2020 (2018-22), Indo-Hungarian Industrial Project (2021-23), OPTOCE project 2020-21, UKIERI and many others. He has been Principal Investigator of more than 26 research projects funded by different national and international bodies. Prof. Ghosh is the leader of the research project, "Global Status of implementation of Circular Economy" with experts from 40 countries. He is the founder chair of the Consortium of Researchers in International Collaboration (CRIC).

He was the convener of ISO TC 61 WG24, member in the Indian mirror committee of ISO TC 207. He works as the international expert/consultant in UNCRD, SACEP and IGES. He is the international expert of the Asian Productivity Organization (APO), Japan and China Productivity Council (CPC) on Green manufacturing and Green Factory. He is the member in steering committee and editorial board in many international conferences in many countries and delivered more than 150 keynote and plenary speeches in India and abroad. He is the Associate Editor of Int. Journal of Waste Management and Materials Cycles. He wrote nine books, more than 45 edited volumes, more than 250 national and international publications. Received Indian patent on "eco-friendly plastics recycling" and "Automatic High Speed Jute Ribbing Machine" in Bangladesh. He is the member of TG- Sustainable Technologies, for formulating India's new Science, Technology, and Innovation Policy (STIP 2020). He was the West Bengal State Level Advisory Committee Member of Plastics Waste (Management & Handling) Rules 2011 and is the expert committee member of the ministry of housing and urban affairs, govt of India for standardization of RDF for cement kiln. He is available at: sadhankghosh9@gmail.com. Website : www.sadhankghosh.com.

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