Waste

1- Sustainable Practice in Pavement Engineering through Value-Added Collective Recycling of Waste Plastic and Waste Tyre Rubber

By:
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Abstract

Waste plastics, such as waste polyethylene terephthalate (PET) beverage bottles and waste rubber tyres are major municipal solid wastes, which may lead to various environmental problems if they are not appropriately recycled. In this study, the feasibility of collectively recycling the two types of waste into performance-increasing modifiers for asphalt pavements was analyzed. This study aimed to investigate the recycling mechanisms of waste PET-derived additives under the treatment of two amines, triethylenetetramine (TETA) and ethanolamine (EA), and characterize the performances of these additives in modifying rubberized bitumen, a bitumen modified by waste tyre rubber. To this end, infrared spectroscopy and thermal analyses were carried out on the two PET-derived additives (PET-TETA and PET-EA). In addition, infrared spectroscopy, viscosity, dynamic shear rheology, and multiple stress creep recovery tests were performed on the rubberized bitumen samples modified by the two PET-derived additives. We concluded that waste PET can be chemically upcycled into functional additives, which can increase the overall performance of the rubberized bitumen. The recycling method developed in this study not only helps alleviate the landfilling problems of both waste PET plastic and scrap tyres, but also turns these wastes into value-added new materials for building durable pavements. (C) 2021 THE AUTHORS. Published by Elsevier LTD on behalf of Chinese Academy of Engineering and Higher Education Press Limited Company.

Waste

Keywords
Author Keywords
Waste polyethylene terephthalateWaste tyre rubberRubberized bitumenRecycling mechanismSustainability
Keywords Plus
MODIFIED ASPHALTCRUMB RUBBERPOLYETHYLENE TEREPHTHALATEFATIGUE PROPERTIESLOW-TEMPERATUREPETSTIFFNESSBEHAVIORBINDERSBOTTLES

2- Beyond Mechanical Recycling: Giving New Life to Plastic Waste

By:
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Abstract

Increasing the stream of recycled plastic necessitates an approach beyond the traditional recycling via melting and re-extrusion. Various chemical recycling processes have great potential to enhance recycling rates. In this Review, a summary of the various chemical recycling routes and assessment via life-cycle analysis is complemented by an extensive list of processes developed by companies active in chemical recycling. We show that each of the currently available processes is applicable for specific plastic waste streams. Thus, only a combination of different technologies can address the plastic waste problem. Research should focus on more realistic, more contaminated and mixed waste streams, while collection and sorting infrastructure will need to be improved, that is, by stricter regulation. This Review aims to inspire both science and innovation for the production of higher value and quality products from plastic recycling suitable for reuse or valorization to create the necessary economic and environmental push for a circular economy.

Keywords
Author Keywords
catalysischemical recyclingcircularityplastic wastesolvolysis

Waste

Keywords Plus

HIGH-DENSITY POLYETHYLENESUPERCRITICAL CO2 EXTRACTIONTHERMAL-DECOMPOSITIONENERGY RECOVERYIONIC LIQUIDSCATALYTIC GLYCOLYSISCYCLE ASSESSMENTCARBON-DIOXIDEPYROLYSISDEPOLYMERIZATION

3- Mechanical, chemical and hydrothermal activation for waste glass reinforced cement

By:
Sun, JB (Sun, Junbo) [1] ; Wang, YF (Wang, Yufei) [2] ; Liu, SK (Liu, Shukui) [3] ; Dehghani, A (Dehghani, Ayoub) [4] ; Xiang, XL (Xiang, Xiaolei) [1] ; Wei, JJ (Wei, Jianjun) [5] ; Wang, XY (Wang, Xiangyu) [6] , [7]
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Abstract

Land disposal of waste glass results in hazardous environmental contamination. Such waste material should be reclaimed because it is inert and consequently nondegradable. The main component of glass is silica showing pozzolanic properties in cementitious matrices. Thus, the use of waste glass as a supplementary cementitious material in concrete is a sustainable solution to the land disposal of such waste materials. However, concrete incorporating waste glass suffers from deleterious expansion arising from alkali-silica reaction (ASR). This paper shows the effects of different activation approaches, including mechanical, chemical, hydrothermal, and combined activation, used to mitigate ASR. To this aim, activated waste glass powder (WGP) was produced using the aforementioned approaches and used in concrete as sand replacement at percentages of 0%, 10%, 20%, and 30%. The water to cement ratio remained unchanged for all mixes. Results showed that the combined activation was the optimal approach to increase mechanical property. The hydrothermal activation effectively reduced the detrimental ASR expansion, while the chemical treatment induced excessive expansion even for mixtures with a low WGP content of 10%. Also, microstructural analyses showed erosion on the surface of WGP activated by chemical and combined activation methods. Besides, few CH crystals were observed on 75 mu m WGP mortar samples, illustrating the excellent pozzolanic activity on finer WGP.

Keywords
Author Keywords
Waste glass powderActivation methodologyCompressive strengthFlexural behaviorAlkali-silica reaction

Waste

Keywords Plus

FLY-ASHCONCRETEBEHAVIORSILICAFINEAGGREGATEALGORITHMMODULUSSEARCHSAND

4- Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution

By:
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Abstract

Plastic pollution is a planetary threat, affecting nearly every marine and freshwater ecosystem globally. In response, multilevel mitigation strategies are being adopted but with a lack of quantitative assessment of how such strategies reduce plastic emissions. We assessed the impact of three broad management strategies, plastic waste reduction, waste management, and environmental recovery, at different levels of effort to estimate plastic emissions to 2030 for 173 countries. We estimate that 19 to 23 million metric tons, or 11%, of plastic waste generated globally in 2016 entered aquatic ecosystems. Considering the ambitious commitments currently set by governments, annual emissions may reach up to 53 million metric tons per year by 2030. To reduce emissions to a level well below this prediction, extraordinary efforts to transform the global plastics economy are needed.

Keywords
Keywords Plus
MICROPLASTICS

5- COVID pollution: impact of COVID-19 pandemic on global plastic waste footprint

By:
Benson, NU (Benson, Nsikak U.) [1] ; Bassey, DE (Bassey, David E.) [2] ; Palanisami, T (Palanisami, Thavamani) [3]
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Abstract

Plastic products have played significant roles in protecting people during the COVID-19 pandemic. The widespread use of personal protective gear created a massive disruption in the supply chain and waste disposal system. Millions of discarded single-use plastics (masks, gloves, aprons, and bottles of sanitizers) have been added to the terrestrial environment and could cause a surge in plastics washing up the ocean coastlines and littering the seabed. This paper attempts to assess the environmental footprints of the global plastic wastes generated during COVID-19 and analyze the potential impacts associated with plastic pollution. The amount of plastic wastes generated worldwide since the outbreak is estimated at 1.6 million tonnes/day. We estimate that approximately 3.4 billion single-use facemasks/face shields are discarded daily as a result of COVID-19 pandemic, globally. Our comprehensive data analysis does indicate that COVID-19 will reverse the momentum of years-long global battle to reduce plastic waste pollution. As governments are looking to turbo-charge the economy by supporting businesses weather the pandemic, there is an opportunity to rebuild new industries that can innovate new reusable or non-plastic PPEs. The unanticipated occurrence of a pandemic of this scale has resulted in unmanageable levels of biomedical plastic wastes. This expert insight attempts to raise awareness for the adoption of dynamic waste management strategies targeted at reducing environmental contamination by plastics generated during the COVID-19 pandemic.

Waste

Keywords
Author Keywords
COVID-19Single-use pl

6- Municipal solid waste management: Dynamics, risk assessment, ecological influence, advancements, constraints and perspectives

By:
Vyas, S (Vyas, Shaili) [1] , [2] ; Prajapati, P (Prajapati, Priya) [1] , [2] ; Shah, AV (Shah, Anil V.) [1] ; Varjani, S (Varjani, Sunita) [1]
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Abstract

Global energy consumption has been increasing in tandem with economic growth, putting pressure on the world's supply of renewable energy sources. Municipal Solid waste (MSW) has been reported contributing immensely to the improvement of a secure environment and renewable sources. Energy scarcity and conventional MSW disposal methods in developing countries lead towards many environmental and economic issues. Scientists have been able to experiment with various waste-to-energy conversion technologies in light of this situation. This communication highlights and reviews WtE technologies to convert MSW and other feedstocks into electricity, hydrogen gas, bioethanol along with other value added products like fertilizer(s), platform chemicals as an environmentally friendly products. This review comprehensively summarized the dynamics, risk assessment, ecological influence, advancements, constraints and perspectives altogether in field of municipal solid waste management and treatment. Stare-of-the-art information on ecological influence and risk assessment in handling and transportation of municipal solid waste has been provided. Advanced trends involved in remediation of emerging pollutants and resources obtained from municipal solid wastes have been uncovered. Lastly, this paper comprises constraints and perspectives for uncovering MSW based circular bioeconomy aspects.

Keywords
Author Keywords
Risk assessmentTreatment technologiesLandfillSustainable energyWaste to energy
Keywords Plus

Waste

MECHANICAL BIOLOGICAL TREATMENTMICROBIAL FUEL-CELLSANAEROBIC-DIGESTIONENVIRONMENTAL ASSESSMENTOCCUPATIONAL-HEALTHCOLLECTION ANALYSISBIOFUEL PRODUCTIONAIR-POLLUTIONHEAVY-METALSLANDFILL

Waste

7- Transformation towards a circular economy in the Australian construction and demolition waste management system

By:
Shooshtarian, S (Shooshtarian, Salman) [1] ; Maqsood, T (Maqsood, Tayyab) [1] ; Caldera, S (Caldera, Savindi) [2] ; Ryley, T (Ryley, Tim) [3]
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Australia's increasing rate of construction and demolition (C&D) waste generation indicates low resource efficiency in the architecture, engineering and construction (AEC) industry. This study aims to identify C&D waste disposal reduction (WDR) opportunities and barriers in various stages of the construction materials lifecycle using a systematic literature review approach. The review is guided by the Less of Waste, More of Resources (LoWMoR) model. Overall, 58 barriers and 73 opportunities are identified from 62 Australian literature sources published over the last two decades. The results show that the most opportunities are presented at the design stage, followed by the transport and landfilling elements. Furthermore, the review identifies 20 stakeholders who play a significant role in realising these opportunities including key stakeholders such as project managers, government organisations, industry associations and waste operators. The study recommends improvements in fostering broader research collaboration, harmonising waste management systems, and analysing key stakeholders involved in C&D waste management. The research findings are valuable to various stakeholders in the AEC industry and waste management and resource recovery (WMRR) sector, to drive a circular economy and improve resource efficiency. Further research is recommended in the following areas: the benefits of University-Industry Engagement (UI-E) in the AEC and WMRR industries; the impact of technologies in achieving waste minimisation objectives in Australia; waste minimisation opportunities during construction material transportation; and the direct impact of sustainability rating tools in C&D waste minimisation.

Keywords

Waste

Author Keywords
Circular economyC&D waste management in AustraliaResource efficiencyBuilt environmentConstruction industryPolicy developmentLess of wasteMore of resources
Keywords Plus
REVERSE
LOGISTICSBARRIERSIMPLEMENTATIONCOLLABORATIONPROJECTSBENEFITSATTITUDESPRODUCTDESIGN

8- Municipal solid waste as a sustainable resource for energy production: State-of-the-art review

By:
Shah, AV (Shah, Anil V.) [1] , [2] ; Srivastava, VK (Srivastava, Vijay Kumar) [2] ; Mohanty, SS (Mohanty, Swayansu Sabyasachi) [1] , [3] ; Varjani, S (Varjani, Sunita) [1] , [2]
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Abstract

Solid waste treatment and disposal is a global challenge for the development of a sustainable society. The problem has been exacerbated by a rise in waste products as a result of population growth and urbanization. Ever-increasing municipal solid waste, together with its high proportion of organic waste and its unscientific disposal, contributes to Greenhouse gas emissions and other air pollutants. Municipal solid waste (MSW) mismanagement not only has harmful environmental consequences but also poses public health risks and raises other socioeconomic concerns. The mitigation approach requires an environmentally sustainable interpretation of the waste for its management and treatment. The waste-to-energy conversion provides a solution to environmental issues such as Greenhouse gas emission and waste management, thereby helping to achieve a green environment with a simultaneously prospering economy. This paper provides a comprehensive review of municipal solid waste generation and its characteristics. It provides a bird's-eye view of the suitability of various technologies for energy production, providing up-to-date information about it. It also covers challenges and perspectives in this field of research.

Keywords
Author Keywords
Municipal solid wasteEnergyCleaner productionSustainabilityCompostingAnaerobic digestion

Waste

Keywords Plus

LIFE-CYCLE ASSESSMENTANAEROBIC CO-DIGESTIONGASIFICATION PROCESSPLASMA GASIFICATIONSUPPLY CHAINMANAGEMENTINCINERATIONPYROLYSISRECOVERYGENERATION

9- Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19

By:
Klemes, JJ (Klemes, Jiri Jaromir) [1] ; Van Fan, Y (Van Fan, Yee) [1] ; Tan, RR (Tan, Raymond R.) [2] ; Jiang, P (Jiang, Peng) [3]
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Abstract

The COVID-19 pandemic has had growing environmental consequences related to plastic use and follow-up waste, but more urgent health issues have far overshadowed the potential impacts. This paper gives a prospective outlook on how the disruption caused by COVID-19 can act as a catalyst for short-term and long-term changes in plastic waste management practices throughout the world. The impact of the pandemic and epidemic following through the life cycles of various plastic products, particularly those needed for personal protection and healthcare, is assessed. The energy and environmental footprints of these product systems have increased rapidly in response to the surge in the number of COVID-19 cases worldwide, while critical hazardous waste management issues are emerging due to the need to ensure destruction of residual pathogens in household and medical waste. The concept of Plastic Waste Footprint (PWF) is proposed to capture the environmental footprint of a plastic product throughout its entire life cycle. Emerging challenges in waste management during and after the pandemic are discussed from the perspective of novel research and environmental policies. The sudden shift in waste composition and quantity highlights the need for a dynamically reponsive waste management system. Six future research directions are suggested to mitigate the potential impacts of the pandemic on waste management systems.

Keywords
Author Keywords
Plastic waste footprintDynamic waste managementEnvironmental footprints reductionCOVID-19 pandemic

Waste

Keywords Plus

MANAGEMENT

Waste

10- Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic

By:
Sharma, HB (Sharma, Hari Bhakta) [1] ; Vanapalli, KR (Vanapalli, Kumar Raja) [2] ; Cheela, VRS (Cheela, V. R. Shankar) [1] , [5] ; Ranjan, VP (Ranjan, Ved Prakash) [1] ; Jaglan, AK (Jaglan, Amit Kumar) [3] ; Dubey, B (Dubey, Brajesh) [1] , [2] ; Goel, S (Goel, Sudha) [1] , [2] ; Bhattacharya, J (Bhattacharya, Jayanta) [2] , [4]
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Abstract

The crisis brought upon by the COVID-19 pandemic has altered global waste generation dynamics and therefore has necessitated special attention. The unexpected fluctuations in waste composition and quantity also require a dynamic response from policymakers. This study highlights the challenges faced by the solid waste management sector during the pandemic and the underlying opportunities to fill existing loopholes in the system. The study presents specific cases for biomedical waste, plastic waste, and food waste management - all of which have been a major cause of concern during this crisis. Further, without active citizen participation and cooperation, commingled virus-laden biomedical waste with the regular solid waste stream pose significant negative health and safety issues to sanitation workers. Single-use plastic usage is set to bounce back due to growing concerns of hygiene, particularly from products used for personal protection and healthcare purposes. It is expected that household food waste generation may reduce due to increased conscious buying of more non-perishable items during lockdown and due to concerns of food shortage. However, there is a chance of increase in food waste from the broken supply chains such as food items getting stuck on road due to restriction in vehicle movements, lack of workers in the warehouse for handling the food products, etc. The study also stresses the need for building localized resilient supply chains to counter such situations during future pandemics. While offering innovative solutions to existing waste management challenges, the study also suggests some key recommendations to the policymakers to help handle probable future pandemics if any holistically.

Keywords

Waste

Author Keywords
COVID-19 wasteBiomedical wastePlastic wasteFood supply chainFood wasteSolid waste management
Keywords Plus
HYDROTHERMAL CARBONIZATIONBIOMASS

Waste

11- Nitrate reduction to ammonium: from CuO defect engineering to waste NOx-to-NH3 economic feasibility

By:
Daiyan, R (Daiyan, Rahman) [1] , [2] ; Tran-Phu, T (Tran-Phu, Thanh) [3] , [4] ; Kumar, P (Kumar, Priyank) [1] , [2] ; Iputera, K (Iputera, Kevin) [5] ; Tong, ZZ (Tong, Zizheng) [5] ; Leverett, J (Leverett, Joshua) [1] , [2] ; Khan, MHA (Khan, Muhammad Haider Ali) [1] , [2] ; Esmailpour, AA (Asghar Esmailpour, Ali) [1] , [2] ; Jalili, A (Jalili, Ali) [1] , [2] ; Lim, M (Lim, Maggie) [1] , [2] ;
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Abstract

Critical to the feasibility of electrochemical reduction of waste NOx (NOxRR), as a sustainable pathway and to close the NOx cycle for the emerging NH3 economy, is the requirement of inexpensive, scalable and selective catalysts that can generate NH4+ with high yield, as indicated by our economic modelling. To this end, we carry out density functional theory (DFT) calculations to investigate the possible contribution of oxygen vacancy (OV) defects in NOxRR catalysis, discovering that an increase in defect density within CuO is leading to a decrease in adsorption energy for NO3- reactants. Using these findings as design guidelines, we develop defective CuO nanomaterials using flame spray pyrolysis (FSP) and mild plasma treatment, that can attain a NH4+ yield of 520 mu mol cm(-2) h(-1) at a cell voltage of 2.2 V within a flow electrolyser with good stability over 10 h of operation. Through our mechanistic investigation, we establish the beneficial role of oxygen vacancy defects (with one free electron) in CuO for NOxRR and we reveal a direct correlation of oxygen vacancy density with the NH4+ yield, arising from improved NO3- adsorption, as evidenced from our theoretical calculations. Our findings on defect engineering to improve NH4+ yield and its economic feasibility display the potential of NOxRR as an alternative pathway to

generate green NH3, which can also serve as an energy vector for the emerging hydrogen economy and close the NOx cycle.

Keywords
Keywords Plus
CARBON-DIOXIDEELECTROCHEMICAL REDUCTIONACTIVE-SITESCOPPERCATALYSTSNITROGENOXIDESCO2

12- Fracture behavior of a sustainable material: Recycled concrete with waste crumb rubber subjected to elevated temperatures

By:
Tang, YC (Tang, Yunchao) [1] , [2] ; Feng, WH (Feng, Wanhui) [1] ; Chen, Z (Chen, Zheng) [2] ; Nong, YM (Nong, Yumei) [1] ; Guan, SH (Guan, Shuhong) [1] ; Sun, JB (Sun, Junbo) [3]
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Abstract

Recycled aggregate concrete (RAC) made from construction and demolition wastes has several environmental benefits. Fire is one of the most common disasters in buildings, and RAC is a brittle construction material; therefore, the bearing capacity of RAC structures under high temperatures should be considered. According to previous studies, crumb rubber made of waste tires can further reduce damages to RAC under high temperatures. Meanwhile, fracture behaviors are one of the key characteristics of concrete materials that need to be considered, but few studies have focused on their behavior when subjected to elevated temperatures. Rubber-modified RAC (RRAC) notched beam specimens with three recycled aggregate substitutions (0%, 50%, and 100%), and four rubber contents (0%, 2%, 4%, and 6%), exposed to high temperatures (200 degrees C, 400 degrees C, and 600 degrees C), were tested using the three-point bending test. The fracture behaviors of the RRAC, including the crack mouth opening displacement, fracture energy, and fracture toughness were analyzed. The results show that the effect of rubber particles on the unstable fracture toughness is greater than that on the initial cracking toughness of RAC after exposure to high temperatures. However, the enhanced effect of rubber on the fracture resistance decreases after subjecting it to a high-temperature treatment owing to the softening and eventual decomposition of rubber at high temperatures. Consequently, in order to avoid the drawbacks introduced by rubber, a rubber content of more than 4% is not recommended considering the mechanical and fracture performance of RRAC.

Waste

Keywords
Author Keywords
Rubber-modified recycled aggregate concreteElevated temperaturesFracture propertiesDouble-K criterionMeso-structural analysis
Keywords Plus
HIGH-STRENGTH CONCRETEAGGREGATE CONCRETEDURABILITY PERFORMANCESILICA FUMECOLUMNSPAVEMENTSTRAIN

Waste

13- Active and intelligent biodegradable packaging films using food and food waste-derived bioactive compounds: A review

By:
Bhargava, N (Bhargava, Nitya) [1] ; Sharanagat, VS (Sharanagat, Vijay Singh) [1] ; Mor, RS (Mor, Rahul S.) [1] ; Kumar, K (Kumar, Kshitiz) [2]
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Review

Abstract

Background: The growing environmental concern of plastic packaging disposal has led to the innovation of biodegradable biopolymers. Consumer demand and health concern further necessitate the emergence of active and intelligent packaging system to monitor the quality of packed food. Whereas, the use of chemical dyes as an indicator in smart packaging is not suitable for food packaging because of their high toxicity and harmful effects on human health and the environment. Hence, the researchers are focused on natural pigments derived from plants and food waste as indicating substance in biodegradable packaging and also for the valorization of food waste.

Scope and approach: This paper summarizes the research on the utilization of naturally derived food- and food waste-based pigments (anthocyanins, curcumin, betalains, carotenoids, chlorophyll, brazilin, quercetin, etc.) with biopolymeric matrices (starch, cellulose, chitin, gums, agar, etc.) to fabricate "smart biodegradable films", for effective monitoring of spoilage and quality of meat products, seafood, milk, and others.

Key Findings and Conclusions: The results show that the smart packaging material developed by the biopolymers with plant-based pigment has the potential to replace the traditional plastic packaging materials. The extracted from food and food waste act as an indicator in smart packaging and promotes the valorization of food waste. The biodegradable packaging is economical, safe, non-toxic, sensitive, and natural pigments act as a quality indicator in packaging systems. Further, these packaging films can be optimized and commercialized and to be employed as active and intelligent packaging for visual quality evaluation of fresh food products.

Waste

Keywords
Author Keywords
Active packagingIntelligent packagingFood wasteBioactive compounds
Keywords Plus
PH-SENSITIVE FILMSKAPPA-CARRAGEENANCASSAVA STARCHANTIOXIDANT PROPERTIESROSELLE ANTHOCYANINSPHENOLIC-COMPOUNDSPOLYVINYL-ALCOHOLOXIDATIVE STRESSRED CABBAGENATURAL DYE

Waste

14- Sustainable fuzzy multi-trip location-routing problem for medical waste management during the COVID-19 outbreak

By:
Tirkolaee, EB (Tirkolaee, Erfan Babaee) [1] ; Abbasian, P (Abbasian, Parvin) [2] ; Weber, GW (Weber, Gerhard-Wilhelm) [3] , [4]
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Abstract

The performance of waste management system has been recently interrupted and encountered a very serious situation due to the epidemic outbreak of the novel Coronavirus (COVID-19). To this end, the handling of infectious medical waste has been particularly more vital than ever. Therefore, in this study, a novel mixed-integer linear programming (MILP) model is developed to formulate the sustainable multi-trip location-routing problem with time windows (MTLRP-TW) for medical waste management in the COVID-19 pandemic. The objectives are to concurrently minimize the total traveling time, total violation from time windows/service priorities and total infection/environmental risk imposed on the population around disposal sites. Here, the time windows play a key role to define the priority of services for hospitals with a different range of risks. To deal with the uncertainly, a fuzzy chance-constrained programming approach is applied to the proposed model. A real case study is investigated in Sari city of Iran to test the performance and applicability of the proposed model. Accordingly, the optimal planning of vehicles is determined to be implemented by the municipality, which lakes 19.733 h to complete the processes of collection, transportation and disposal. Finally, several sensitivity analyses are performed to examine the behavior of the objective functions against the changes of controllable parameters and evaluate optimal policies and suggest useful managerial insights under different conditions. (C) 2020 Elsevier B.V. All rights reserved.

Keywords
Author Keywords

Multi-trip location-routing problemInfection riskSustainable developmentWaste managementCOVID-19 pandemic

Keywords Plus

MATHEMATICAL-MODELALGORITHMS

15- Valorization of biomass waste to engineered activated biochar by microwave pyrolysis: Progress, challenges, and future directions

By:
Foong, SY (Foong, Shin Ying) [1] , [2] , [3] ; Liew, RK (Liew, Rock Keey) [4] ; Yang, YF (Yang, Yafeng) [1] ; Cheng, YW (Cheng, Yoke Wang) [5] ; Yek, PNY (Yek, Peter Nai Yuh) [6] ; Mahari, WAW (Mahari, Wan Adibah Wan) [2] , [3] ; Lee, XY (Lee, Xie Yi) [2] , [3] ; Han, CS (Han, Chai Sean) [2] , [3] ; Vo, DVN (Vo, Dai-Viet N.) [7] ; Le, QV (Quyet Van Le) [8] ;
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Article

Abstract

Biomass waste represents the promising surrogate of fossil fuels for energy recovery and valorization into value-added products. Among thermochemical conversion techniques of biomass, pyrolysis appears to be most alluring owing to its low pollutant emission and diverse products formation. The current pyrolysis applications for valorization of biomass waste is reviewed, covering the key concepts, pyrolysis mode, operating parameters and products. To date, existing types of pyrolysis include conventional pyrolysis (poor heat transfer due to non- selective heating), vacuum pyrolysis (lower process temperature because of vacuum), solar pyrolysis (entirely "green" with solar-powered), and a newly touted microwave pyrolysis. In microwave pyrolysis of biomass, the heat transfer is more efficient as the heat is generated within the core of material by the interaction of microwave with biomass. The plausible mechanisms of microwave heating are dipole polarization, ionic conduction and interfacial polarization. The lack of top-tier reactor design is identified as the main obstacle that impedes the commercialization of microwave pyrolysis in biomass recycling. Based on the existing works, it is surmised that microwave pyrolysis of biomass produces solid biochar as a main product. To confront the great market demand of activated biochar, it is proposed that the solid char could be upgraded into engineered activated biochar with desirable properties for wide application in pollution control, catalysis and energy storage. Hence, the production of engineered activated biochar from microwave pyrolysis process and its applications are reviewed and explicitly discussed to fill the research gap, and the key implications for future development are highlighted.

Waste

Keywords
Author Keywords
Biomass pyrolysisMicrowave heatingWaste valorization/recyclingEnergy recoveryBiocharSustainable production
Keywords Plus
PALM KERNEL SHELLHIGH-SURFACE-AREAASSISTED CO-PYROLYSISOIL MILL EFFLUENTHIGH-TEMPERATURE PYROLYSISBIO-OILVACUUM PYROLYSISPOROUS CARBONCHEMICAL ACTIVATIONRICE HUSK

16- A critical review on biochar for enhancing biogas production from anaerobic digestion of food waste and sludge

By:
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Abstract

The conversion of food waste and sludge into biogas via anaerobic digestion technology is gaining attention in recent years, which plays a significant role in waste valorization into bioenergy and promotes environmental sustainability. Biochar is a carbonaceous material produced via thermochemical conversion of biomass waste, and tailoring biochar for diverse environmental applications adheres to the principle of circular economy. The emerging application of biochar as an additive in the anaerobic digestion of food waste and sludge has been intensively investigated in the last few years. However, a comprehensive understanding of multifunctional roles of biochar and its mechanisms in the production of biogas via miscellaneous/complex anaerobic digestion process is yet to be attained. This review scrutinizes the key roles of biochar as an additive and emphasizes the influences of biochar characteristics on the anaerobic digestion processes and their capability to address the foremost challenges. This review also evaluates the techno-economic and environmental impacts of biochar synthesis and its emerging application for biogas production via anaerobic digestion to make the integrated process more economical and environmentally sustainable, and identifies challenges and prospects for future studies.

Keywords
Author Keywords

Waste

Waste valorizationPyrolysisBlack carbonBiomethane productionCircular economyEnvironmental sustainability

Keywords Plus

INTERSPECIES ELECTRON-TRANSFERMUNICIPAL SOLID-WASTELIFE-CYCLE ASSESSMENTMICROBIAL COMMUNITYMETHANE PRODUCTIONSEWAGE-SLUDGECO-DIGESTIONAMMONIA INHIBITIONSEMICONTINUOUS OPERATIONPOTENTIAL ENHANCEMENT

Waste

17- Lightweight Fe3C@Fe/C nanocomposites derived from wasted cornstalks with high-efficiency microwave absorption and ultrathin thickness

By:
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Abstract

As a typical lightweight material, carbon materials have great application prospects in fabricating microwave absorbers. In this work, the Fe3C@Fe/C composites with porous microstructure are obtained by a simple and environmentally friendly method with wasted cornstalks as raw materials. The reflection loss of absorbing composites reaches the minimum value which is less than -50 dB when the thickness is 1.13 mm, while widest effective absorbing bandwidth reaches 5.1 GHz when thickness is 1.50 mm. The stalk-made nanocomposites' excellent absorbing ability is mainly credit to excellent impedance matching and attenuation characteristics of composites, which is further credit to a synergistic influence of the dielectric loss from the multiple interfaces in porous microstructure and magnetic loss from iron nanoparticles. A low-cost method to obtain microwave absorption materials and realize high-value utilization of agricultural waste to reduce pollution caused by burning cornstalks is put forward.

Keywords
Author Keywords
Carbon materialsMicrowave absorptionCornstalksPorous microstructure
Keywords Plus: COMPOSITES

18- Processes and prospects on valorizing solid waste for the production of valuable products employing bio-routes: A systematic review

By:
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Abstract

Humanity is struggling against a major problem for a proper management of generated municipal solid waste. The collected waste causes natural issues like uncontrollable emission of greenhouse gases and others. Even though, escalation of waste results in minimizing the areas accessible for disposing the waste. Creating awareness in the society to use organic products like biofuels, biofertilizers and biogas is a need of an hour. Biochemical processes such as composting, vermicomposting, anaerobic digestion, and landfilling play important role in valorizing biomass and solid waste for production of biofuels, biosurfactants and biopolymer. This paper covers the details of biomass and solid waste characteristics and its composition. It is also focused to provide updated information about reutilization of biomass for value creation. Technologies and products obtained through bioroutes are discussed in current review paper together with the integrated system of solid waste management. It also covers challenges, innovations and perspectives in this field.

Keywords
Author Keywords
BiomassWaste characteristicsBiochemical processesBiofuelsSustainabilityComposting
Keywords Plus

Waste

ANAEROBIC-DIGESTIONORGANIC FRACTIONFOOD WASTEBIOHYDROGEN PRODUCTIONBIOETHANOL PRODUCTIONHYDROGEN-PRODUCTIONBIOSURFACTANT PRODUCTIONLIGNOCELLULOSIC BIOMASSCURRENT PERSPECTIVESINDUSTRIAL-WASTES

19- Insight into the performance and mechanism of persimmon tannin functionalized waste paper for U(VI) and Cr(VI) removal

By:
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Abstract

Herein, using dialdehyde waste paper (DAWP) as a cross-linking agent to immobilize persimmon tannin (PT) was first used to remove the U(VI) and Cr(VI) via the "waste control by waste" concept. The microscopic and macroscopic surface properties of the as-prepared adsorbent was characterized by the advanced characterization techniques. Factors that affected the elimination process such as variable pH, coexistence ions and equilibrium time were investigated by batch techniques. The results showed that the maximal removal capacities of U(VI) and Cr(VI) on DAWP-PT were 242.3 mg/g (pH = 6.0) and 178.7 mg/g (pH = 2.0) at 298 K, which exhibited competitiveness with most of the reported solid materials. Meanwhile, adsorption data were fitted perfectly to the Langmuir and Pseudo-second-order equations, which indicated that the monolayer and homogenous chemisorption dominated the removal process. The SEM-EDX, DFT and XPS analysis conformed that adsorption of U(VI) was mainly via surface complexation, while the elimination of Cr(VI) was a redox reaction process, and about 65.33% of Cr(III) and 34.67% of Cr(VI) co-existed onto the surface of DAWP-PT. Thus, this study would provide a high-efficiency and low-cost adsorbent for radionuclide and heavy metal treatment.

Keywords
Author Keywords
Waste paperPersimmon tanninU(VI)Cr(VI)Adsorption

Waste

Keywords Plus: EFFICIENT REMOVALADSORPTION BEHAVIORAU(III)ADSORBENTSREDUCTIONRECOVERYIONSVI

20- Energy trilemma based prioritization of waste-to-energy technologies: Implications for post-COVID-19 green economic recovery in Pakistan

By:
Shah, SAA (Shah, Syed Ahsan Ali) [1] ; Cheng, LS (Cheng Longsheng) [1] ; Solangi, YA (Solangi, Yasir Ahmed) [1] ; Ahmad, M (Ahmad, Munir) [2] ; Ali, S (Ali, Sharafat) [3]
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Abstract

As lockdown eases, economic activities resume in Pakistan. If the country continues to follow business as-usual (BAU) then it is anticipated that carbon output could surge past pre-COVID-19 levels that means more disasters in future. Thus, it is an unprecedented opportunity to shift from BAU and achieve carbon-neutral and nature-positive economic recovery green economic recovery (GER). To fuel the GER, access to modern, equitable, affordable and sustainable energy is paramount. This study explores waste-to-energy (WtE) as an alternative green fuel for GER. Seven WtE technologies are prioritized based on the concept of energy trilemma energy security, energy equity, and environmental sustainability. For the evaluation, an energy trilemma based decision support framework is developed using most prominent multi-criteria decision-making (MCDM) methods. The fuzzy set theory is integrated with MCDM methods to minimize uncertainty in results. Sixteen experts are engaged to score each WtE technology with respect to every energy trilemma dimension and sub-dimension. Gasification technology is found to be the most feasible option for WtE generation in Pakistan whereas Torrefaction technology is least favorable. It is concluded that the need to shift towards sustainable energy is more than ever to limit the carbon emission and prevent future crisis.

Keywords
Author Keywords
COVID-19Green economic recoveryWaste-to-EnergyRenewable energySDG 7MCDM

Waste

Keywords Plus

MUNICIPAL SOLID-WASTESUSTAINABLE DEVELOPMENTANAEROBIC-DIGESTIONFUZZY AHPVIKORRESOURCES

21- Water in waste-derived oil emulsion fuel with cetane improver: Formulation, characterization and its optimization for efficient and cleaner production

By:
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Abstract

The present study aims to formulate the water emulsified waste-derived biodiesel with cetane improver and find its optimum concentration for an efficient and cleaner production from the diesel engines. A waste-derived Lemon peel oil (LPO) is emulsified in diesel fuel along with water, and 2-Ethylhexyl nitrate (EHN). Four levels of each parameter have been chosen for the fuel preparation. The experiments are performed in a naturally aspirated diesel engine at maximum brake power conditions based on the L16 orthogonal array. A grey-relational analysis is opted to optimize the performances and emissions responses, and the statistical influence of the operating parameters is estimated based on the analysis of variance. A comprehensive study has also been conducted to understand the improvement in performance and emission parameters at the optimum level. From the results, the optimum condition of LPO, water, and EHN is identified as 20%, 10%, and 2%, respectively. The water concentration in base fuel has a contribution of 65.94% on overall engine behavior, whereas the contribution of LPO and EHN is 26.72% and 7.34%, respectively. Besides, the confirmation experiment at the optimum condition shows that the signal-to-noise ratio is improved by 40.8% compared to the initial best condition.

Keywords
Author Keywords

Waste

Lemon peel oilWater emulsionCetane improverMultiple response optimizationEnergy impactEnvironmental impact

Keywords Plus

LEMON PEEL OILCOMBUSTION CHARACTERISTICSPERFORMANCEBIODIESELEMISSIONPARAMETERSIGNITION

Waste

22-Opportunities and knowledge gaps in biochemical interventions for mining of resources from solid waste: A special focus on anaerobic digestion

By:
Vyas, S (Vyas, Shaili) [1] ; Prajapati, P (Prajapati, Priya) [1] , [2] ; Shah, AV (Shah, Anil, V) [1] , [3] ; Srivastava, VK (Srivastava, Vijay Kumar) [3] ; Varjani, S (Varjani, Sunita) [1] , [3]
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Abstract

In demographics, the world population has grown at an incredible rate. As reported by Food and Agriculture Organization the population will rise to approximately 9.3 billion in 2050 which was nearly 3 billion in 1960 and 7 billion in 2010. The high population results in increased waste generation. Energy production has been reported to the highest extent from the waste along with other value-added products. The demand of renewable resources for energy production has enhanced worldwide as most of the fossil fuels are utilized as an energy source. Nowadays, anaerobic digestion is preferred as a sustainable and an alternative method which produces bio-based fuel from waste with simultaneous management of waste in sustainable manner. In order to increase the production and quality rate of biogas there are various technologies trending in the biogas industry. Biogas utilization can be done for the production of energy in urban and rural areas. This review paper aims at the health and environmental impacts of waste which rises the need for converting the waste into different types of renewable energy sources. The state-of-the-art information provided on biological method (anaerobic digestion) for converting waste into biogas including the enhancement in the yield employing various pretreatment methods which are ignored by the researchers would generate a comprehensive literature on the subject. This paper ends with knowledge gaps and perspectives for understanding the challenges and opportunities for an effective management of waste in order to develop sustainable environment and society.

Keywords
Author Keywords

Waste

Anaerobic digestionBiogasFeedstocksPre-treatment methodsSustainable energyWaste to energy

Keywords Plus

THERMAL HYDROLYSIS PRETREATMENTIONIC-LIQUID PRETREATMENTHYDRAULIC RETENTION TIMEBIOGAS PRODUCTIONLIGNOCELLULOSIC BIOMASSFOOD WASTEMETHANE PRODUCTIONTO-ENERGYMECHANICAL PRETREATMENTBIOLOGICAL PRETREATMENT

Waste

23- Polyphenolic extracts from pomegranate and watermelon wastes as substrate to fabricate sustainable silver nanoparticles with larvicidal effect against Spodoptera littoralis

By:
Saad, AM (Saad, Ahmed M.) [1] ; El-Saadony, MT (El-Saadony, Mohamed T.) [2] ; El-Tahan, AM (El-Tahan, Amira M.) [3] ; Sayed, S (Sayed, Samy) [4] ; Moustafa, MAM (Moustafa, Moataz A. M.) [5] ; Taha, AE (Taha, Ayman E.) [6] ; Taha, TF (Taha, Taha F.) [1] ; Ramadan, MM (Ramadan, Mahmoud M.) [7]
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Abstract

The agricultural wastes adversely affect the environment; however, they are rich in polyphenols; therefore, this study aimed to employ polyphenol-enriched waste extracts for silver nanoparticles synthesis, and study the larvicidal activity of silver nanoparticles fabricated by pomegranate and watermelon peels extracts (PPAgNPs and WPAgNPs) against all larval instars of Spodoptera littoralis. The polyphenol profile of pomegranate and watermelon peel extracts (PP and WP) and silver nanoparticles was detected by HPLC. The antioxidant activity was estimated by DPPH, and FARP assays and the antimicrobial activity was evaluated by disc assay. The Larvicidal activity of AgNPs against Egyptian leaf worm was performed by dipping technique. The obtained AgNPs were spherical with size ranged 15-85 nm and capped with proteins and polyphenols. The phenolic compounds in silver nanoparticles increased about extracts; therefore, they have the best performance in antioxidant/reducing activity, and inhibit the growth of tested bacteria and yeast. The PPAgNPs were the most effective against the first instar larvae instar (LC50 = 68.32 mu g/ml), followed by pomegranate extract with (LC50 = 2852 mu g/ml). The results indicated that obvious increase in polyphenols content in silver nanoparticles enhance their larvicidal effect and increasing mortality of 1st larval of S. littoralis Egyptian leafworms causing additive effect and synergism. We recommend recycling phenolic enriched agricultural wastes in producing green

silver nanoprticles to control cotton leafworm that causes economic loses to crops. (C) 2021 The Author(s). Published by Elsevier B.V. on behalf of King Saud University.

Keywords
Author Keywords
Fruit peelsPolyphenolsSilver nanoparticlesAntioxidantAntimicrobialLarvicidal
Keywords Plus
LEAFWORM PRODENIA LITURAANTIMICROBIAL ACTIVITYANTIBACTERIAL ACTIVITYANTIOXIDANT ACTIVITYPEEL EXTRACTIONSACID

24- Improving construction and demolition waste collection service in an urban area using a simheuristic approach: A case study in Sydney, Australia

By:
Yazdani, M (Yazdani, Maziar) [1] ; Kabirifar, K (Kabirifar, Kamyar) [1] ; Frimpong, BE (Frimpong, Boadu Elijah) [1] ; Shariati, M (Shariati, Mahdi) [2] ; Mirmozaffari, M (Mirmozaffari, Mirpouya) [3] ; Boskabadi, A (Boskabadi, Azam) [4]
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Abstract

Urbanization and population growth have resulted in a significant increase in the amount of generated construction and demolition (C&D) waste worldwide. Improper C&D waste management has led to a tremendous landfilled C&D waste, which has placed a great concern over its adverse impacts on the environment and natural resources. Appropriate C&D waste recycling mechanism as a remedial action saves our resources from deterioration, which can be guaranteed through a systematic apportion of the construction projects to C&D waste recycling facilities. Previous studies in waste collection routing problem have almost exclusively assumed that parameters are deterministic; however, uncertainty associated with waste collection routing makes deterministic models inapplicable to real-life systems. To tackle this problem, this research proposes a novel simheuristic based on an integrated simulation-optimization approach, in which an efficient hybrid Genetic Algorithm (GA) is applied in order to optimize vehicle route planning for C&D waste collection from construction projects to recycling facilities. A comparative analysis with existing well-known approaches is performed to represent the strength and effectiveness of the proposed approach. The results demonstrate high performance of the proposed simheuristic algorithm. This study has also benefited from a real case of construction projects apportion to recycling facilities in Sydney, Australia for better evaluation. This research strongly contributes to academics by lighting up the ways to optimize future waste collection problems in a wider range and more precise manner. Meanwhile, this study recommends to C&D waste decision makers and practitioners to

allocate generated C&D waste to recycling facilities precisely with respect to the capacity of produced C&D waste, capacity of recycling facilities, distances, and vehicle capacities.

Keywords
Author Keywords
Construction and Demolition wasteWaste collectionRoutingSimheuristicGenetic algorithm
Keywords Plus
LOCATION-ROUTING-PROBLEMTRANSFER STATIONSGENERATION RATESMANAGEMENTOPTIMIZATIONMODELALGORITHMSSYSTEMMETAHEURISTICSBUILDINGS

Waste

25- Adsorption of congo red and methylene blue dyes on an ashitaba waste and a walnut shell -based activated carbon from aqueous solutions: Experiments, characterization and physical interpretations

By:
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Abstract

Activated carbons were prepared from ashitaba waste and a walnut shell to study the adsorption mechanism of congo red and methylene blue dyes in aqueous solution. These adsorbents were characterized via XRD, FTIR and SEM techniques and the dye adsorption isotherms at three temperatures were quantified. A statistical physics model was applied to interpret the adsorption mechanism of tested dyes and adsorbents. Modeling results showed that these dyes were practically separated in the solution leading to an absence of the aggregation process. Adsorption orientations of dye molecules on the adsorbents changed depending on the temperature and nature of systems. The adsorption capacity of ashitaba waste activated carbon for the removal of congo red was significant thus indicating strong interactions between this dye and tested adsorbent. Calculated adsorption energy varied from 7.25 to 20.43 kJ/mol and they showed that the adsorption of both adsorbates occurred via physical interactions at different temperatures where the removal process was endothermic.

Keywords
Author Keywords
Ashitaba wasteWalnut shellMethylene blueCongo redPhysical modelingActivated carbon
Keywords Plus

Waste

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