SNR 1st 2019 SSWM

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لاستدامة الموارد الطبيعية
الإدارة المستدامة للنفايات الصلبة

رؤيـة VISION 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

Abstracts Book

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Introduction

Saudi Arabia›s per capita consumption is considered among the highest in the world for some goods and services, which led to increased volume of solid waste generation. As a result, natural resources will be depleted and deteriorated due to this high consumption rates, which is regarded as an unsustainable practice.

Raising community awareness and addressing the challenges resulting from the risks associated with waste generation are the responsibility of every member of the society. All parties in the society were strongly urged to participate in awareness campaigns, educational forums and intellectual and economic forums and scientific conferences aimed at increased efficiency and raise awareness to curb natural resources depletion in Saudi Arabia.

Objectives

- **Clear Vision:**

  Contribute to the preparation and development of a vision towards sustainable waste management at regional, national and international levels.

- **Rational Cost:**

  Forecast the economic and environmental costs of wasting habits in Saudi Arabia and internationally, and to develop the most appropriate managerial policies.

- **Appreciation of Food Value:**

  Discuss the best methods to manage and reduce food waste at food supply chain and consumer level.

- **Rewarded Opportunities:**

  To urge integration of all partners and disciplines for sustainable waste management practices.

- **Attractive Investment:**

  Determination of attractive opportunities for investment in waste recycling industry in the Kingdom.

- **Ambitious Investment:**

  Study of investment hindrances in waste recycling industry in Saudi Arabia.

- **Responsible Citizen:**

  Establishing a system of awareness raising, educational and environmental trainings that will target all sectors of society to achieve the desired goals.

- **Interconnected Team:**

  Link scientific research and studies in Saudi and international universities with development requirements to meet national challenges.

Topics

First Topic:

Effective management: Sustainable and integrated solid waste management at all stages and at all levels.

Second Topic:

Appreciating food value: Management of food loss and food wastage at the level of production and consumption.

Third Topic:

Attract investers: Investment in waste recycling industry: transformation-manufacturing industries

Fourth Topic:

Responsible citizen: Wise waste management from religious , and cultural perspectives.

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Academic advisor for the Vice Chancellor of the University of Gezira, Sudan

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Associate Professor in the Department of Civil Engineering, Uttara University, Dhaka, Bangladesh and Adjunct Associate Professor in the Department of Civil & Construction Engineering, Swinburne University of Technology, Melbourne, Australia.

First Session

Responsible Citizen and Food Value Appreciation

Keynote Plenary :
Prof. Hussein Suliman Adam
Academic advisor for the Vice Chancellor of the University of Gezira, Sudan

Chairs
Dr. Abdulrahman Salih Hariri,
Director, Department of Environmental Capacity Development,Environment Agency, Ministry of Environment, Water and Agriculture

Eng. Mohammed Almutiri *

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Director of Sustainable Development Center - Qassim University

Initiative of Qassim University as Sustainable University

Mr. Majed Abdulrahman AlOsailan
Chief Executive Officer - City Cement Company

City Cement Journey to Sustainability

Mr. Ahmed Bajahlan
Deputy of General Administartion - General Administration for Legislation and Environmental Management
Performance Deputy Ministry of Environment - Ministry of Environment, Water and Agriculture
Future of Solid Waste Management in Saudi Arabia

Eng. Ali Alinizi
Municipal Services Advisor - Ministry of Municipal and Rural Affairs

Program of Sorting Waste from the Source

Dr. Abdul Aziz Alkhwaiter
Director of the Department of Sanitary Landfill and the Waste Management Initiative - Qassim Municipality

Municipal Waste Treatment Project in the Green Oasis Environmental Facility at the Qassim Municipality

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Attractive investment

Keynote Plenary :
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Head of Unit Waste Resources Management
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Chairs
Prof. Waleed M. Zahid
Dean of the College of Engineering
King Saud University

Prof. Mohamed E. Ali *

Thermal Insulating Characteristics of Wasted Materials Made of Apple of Sodom and Palm Tree Surface Fibers as New Insulation Materials for Buildings (in English)

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Dr. Majed F. Alinizzi
Assistant of Vice-Rector
Assistant Professor - College of Engineering
Qassim University

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Dr. Amimul Ahsan
Uttara University, Bangladesh
and Swinburne University of Technology
Australia.

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Prof. Hussein Suliman Adam
Academic advisor for the Vice Chancellor of the University of Gezira, Sudan

Chairs
Dr. Abdulrahman Salih Hariri,
Director, Department of Environmental Capacity Development,Environment Agency, Ministry of Environment, Water and Agriculture

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Mr. IbrahimSaleh Alrebdi

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Dr. Abdul Aziz B. Alharbi
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Agriculture and Veterinary College
Qassim University

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Dr. Abdelhadi Abdelwahab
Arabian Gulf University, Bahrain

Dr. Turki Mesfer Alaboud

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Abstracts

Mechanisms to rationalize the food consumption of Saudi families As an entry point for food waste management in Saudi Arabia

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Abstract :

The National Vision sought to improve the urban structure of Saudi cities and improve the quality of municipal services by developing management policies and controlling urban development. The management of municipal solid waste is one of the challenges facing major city administrations in Saudi Arabia. Social transformations and economic and population growth over the past three decades have affected the food consumption patterns of Saudi households, accompanied by an increase in the volume of waste generated. Local statistics indicate that the level of food waste in Saudi cities exceeds 34%, with a loss of 250 kg per capita per year. Therefore, this paper aims to develop a number of mechanisms to rationalize food consumption and reduce bad food behaviors, which reflects positively on reducing the volume of waste generated in Saudi cities. The paper uses the theoretical and descriptive analytical approach based on reviewing a number of local and international literature and experiences and drawing the main lessons learned. To analyze the local reality, a class sample of 80 specialists and professionals from the Saudi Council of Engineers was extrapolated. The results found that 35% of the study sample spend between 1625%- of their monthly income in food consumption, with an average expenditure of 20%. The average consumer spending in Saudi Arabia is only 18%. However, the food consumption of 60% of Saudi households is above their actual needs, and there are no clear mechanisms to get rid of surplus food, where the percentage of food waste of the sample examined exceeds 1130%- of the total monthly waste. As a result, the study recommends the development of a comprehensive strategy for the management and rationalization of food waste within the framework of the initiative to establish a national program to reduce waste and waste from food consumption, integrating the role of society, government agencies, private sector institutions, charitable and cooperative sector.

Keywords :

Mechanisms, Rationalization, Food, Consumption, Waste, Waste Management, Saudi Arabia.

A Strategic Hierarchical Food Loss and Waste Management Approach for Transforming KSA into Circular Economy

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Abstract :

In the recent decades, the concept of bio-economy has been a global trend applicable for adequate and sustainable approach to management of solid waste with special emphasis on organic and food components. Globally, food losses and waste management (FLWM) has been a problem posing significant challenges to sustainable development of many countries. Particularly, in Kingdom of Saudi Arabia (KSA), a number of socio-economic factors have immensely been responsible for huge volume of generated food losses and wastes (FLW) challenging attainment of its sustainable development goals. Thus, this paper examines and evaluates the existing issues related to FLWM in KSA while addressing factors responsible for the huge FLW and professing respective sustainable solutions. The apparent lack of proper and coordinated management strategy in place for FLW has aggravated the current situation. The annual tons of total municipal solid waste generation in excess 15 million composing of approximately 75 % organic waste having up to 3750.6- % FW of total MSW which is projected to double in next decade under current scenario. Thus, adequate management of FLW requires a well-planned holistic strategy to add value to KSA target sustainable development goals as targeted in the most recent VISION 2030 of KSA. Bio-materials productions and waste-to-energy recovery processes with technological improvements and innovations have great potentials to contribute. Thus, in relation to global trends pertaining FLWM, a holistic hierarchical FLWM is proposed for strategically reduction in food losses while transforming KSA from linear-economy into circular economy via bio-refineries with vast contributions of feedstock from the enormous quantity of unavoidable food wastes generated annually.

Keywords :

Sustainability; food loss and waste reduction; Saudi Arabia Vision 2030; strategic hierarchical management; waste to energy, food waste bio-refineries; circular bio-economy

Automatic Waste Sorting using Deep Learning

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Abstract :

Object detection by using deep learning can be time saving and easy approach for waste sorting. Globally there is rapid industrialization and increasing population, the rate of waste generation increases simultaneously, thus waste management has gained popularity as an issue that requires immediate attention and action. Waste segregation is the most important step in this process, to solve this problem a study is conducted using Faster R-CNN to categorize waste into three different types of plastic, paper, and metal. They can be recycled and reuse by getting it sorted at the source itself. We presented a new approach for categorizing waste based on image dataset collected using Faster R-CNN. To conduct our study, we collect and label three dataset fields of view consisting of around 950 objects. We achieved Mean Average Precision (mAP) higher for testing the model on real images of waste. This shows promising results.

Keywords :

Waste sorting, Recycle. Deep Learning, Object detection, Faster R-CNN, Mean Average Precision (mAP) , Environment.

Exploring the efficacy of new edible coatings in maintaining postharvest quality of fresh fruits and vegetables: Propolis a case study

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Mehdi Maqbool, Syed Zulfiqar Ali Shah

Abstract :

Different natural products are commonly used as edible coatings for enhancing shelf life of fresh fruits and vegetables. Propolis is natural resinous glue produced by honey bees. The main constituents are phenolic compounds and their esters, flavonoids, essential oils, vitamins and waxes. Due to its chemical composition it is widely being used in pharmaceutical industry. And it is considered safe for human health. But the constituents of propolis vary with its origin of harvest. However, in the present study the efficacy of green Brazilian propolis was evaluated as edible coating material for preservation of fresh fruits and vegetables.

Keywords :

Green propolis, waste management, fruit, vegetables

Smart Recycle Bin for Smart Home: A Novel Approach to Improve Home Waste Management

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Abstract :

Over the past few years, the demand for energy and generation of waste in the developing countries has increased considerably because of high rates of urbanization and population growth. Implementation of processes which help in the treatment and management of waste is vital not only on the basis of sanitation but also because of the environmental and economic values such as the ability to contribute to energy generation in underdeveloped countries. Majority of the developing countries have embraced integrated waste management systems which helps in the maximization of revenues generated from waste management such as recyclables, fuels, energy, chemicals, heat as well as the creation of business and job opportunities. Therefore, waste is no longer considered as garbage but instead viewed as a resource used in the generation of clean fossil fuel. According to the United Nations (UN), the Kingdom of Saudi Arabia (KSA) is among the countries with the highest rate of wasted food worldwide. As a result, the UN designed a Sustainable Development Goal which is focused on reducing the amount of food wastage by both retailers and consumers by the year 2030. For these goals to be achieved there must be strategies in place designed to fix the food wastage problem in every affected country. Putting the focus on nations with registered high waste levels can result in beneficial outcomes. Among other countries, the UN has categorized The KSA as a country with high income and still under development. In countries that are still developing, wastage of food often falls on top because of the problems attached to the preservation and transportation of food. In countries with high income, a considerable percentage of wasted food occurs on the side of consumers and retailers. This is evident in the Kingdom of Saudi Arabia because the distinctive food chain of the country is pinpointed on consumption and distribution instead of the income level and production.

There is a new development policy of vision 2030 in the KSA which is designed to support the conversion of disposed of wastes to facilities that recover energy or materials the end results being the generation of energy that is recyclable, clean and products that are friendly to the environment. A considerable portion of waste in KSA cities are organic-rich solid waste which adds up to 40 to 50 percent of the total collected waste while the plastic waste averages 16 to 20 percent of the total waste. Thus, the best solution to reduce waste and generate energy from recovered waste is to develop biorefineries. Waste recycling plant will have both environmental and economic benefits to KSA. Lack of proper recycling waste products have over time led to several environmental issues. Therefore, the implementation of waste management systems will benefit both the economic and environmental sectors.

In this paper, we are proposing a novel approach to design a low cost and low power consuming Smart Recycle Bin (SRB) for domestic use. This SRB will have three different compartments for the recyclable item, green waste and garbage (non-recyclable) items with a different color code for each different type (e.g., plastic coding system). This SRB will be equipped with three different sensors in three different components and a camera to determine which compartment is suitable for any specific item. If the user is not sure any the which bin to use, they can put the item in front of the camera of the SRB. The SRB will be able to determine where the waste should go and will light up the color of the specific compartment. Details of the database that will be used in this SRB, how the SRB will update the database, how the SRB will communicate with specific smart fridge or other relevant smart kitchen appliances will be given in the full paper. This proposed SRB will assist the homeowner to help the council and waste collector to collect waste in a manner so that the maximum benefit can be found while processing the waste in a different manner.

Thermal Insulating Characteristics of Wasted Materials Made of Apple of Sodom and Palm Tree Surface Fibers as New Insulation Materials for Buildings

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Abstract :

The international trend nowadays is to use natural insulating materials in buildings to be safe for human beings and to lower the environmental impact. Fibers extracted from the pods of the Apple of Sodom (AOS) plant are confirmed to have lower thermal conductivity compared to those extracted from synthetic fibers and close to the ASME standard. The native range of this plant covers south west of Asia and Africa. Apple of Sodom is an environmental invasive and it is considered as a weed and it usually controlled by several herbicides to be effective as foliar spray, cut stump, or basal bark methods of control. This presentation shows the other promising good side of such plant, since the fibers extracted from its seed pods can be used as a thermal insulating and absorbing sound materials in building. Thermal analysis, acoustic characteristics and the microstructure of the Apple of Sodom fibers will be presented. Sample specimens are developed from the fibers of such plants in the lab scale using cornstarch as a binder to determine its thermal conductivity and its applicability to be used as insulating material for buildings. Other specimens are made as hybrid between the Apple of Sodom fibers and other wasted materials such as palm tree surface fibers (PTSF). Thermogravimetric analysis (TGA and DTGA) are obtained showing the stability of both fibers. The differential scanning calorimetry (DSC) analysis is also reported for all fibers and shows a broad endothermic transition indicating the melting point of the fibers. Sound absorption coefficients are obtained for the hybrid samples and indicate the potential of using these samples for sound absorption. Results also show that the average thermal conductivity at temperature range 10oC to 60oC of the developed specimens has average values of 0.0418 - 0.0568 W/m K.

Keywords :

Wasted palm tree surface fibers, Apple of Sodom fibers, Insulation building materials, Hybrid insulating materials.

Environmental and Financial Analyses for Waste Management Options in Madinah- KSA

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Abstract :

Solid waste management options require the integration of economic and environmental principles in order to select the best management method. This study analysed municipal solid waste (MSW) generation, composition and collection of Madinah region, as one of largest cities in KSA with the aim of finding a management method with minimum cost. The study aimed to provide an overview of current state of MSW management and recommendations for improving the waste treatment and management system in this area based on the significance of environmental and financial aspects. These recommendations would be not specific to Madinah region, but also would be applied to other cities in KSA or any other regions with similar features. The analysis results showed that the trend of waste generation would be increased as much as two to three folds in 2030. Approximately 30% of total generated waste is disposed to a sanitary landfill, while 70% is sent to normal dumpsites. The results of environmental and finical analyses recommended the recycling and energy recovery managements options for this type of wastes in this area. The results revealed that the worst scenario for solid waste management is just landfilling whereas the money-back is zero and the best scenario is implementation the composting process for the organic portion of the waste and recycling the other items.

Keywords :

Solid, Waste, Management, Environment, Financial.

Age-Dependent Mechanical Properties of Recycled Aggregate Concrete Containing Industrial Wastes – A Clean and Sustainable Solution

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Abstract :

Concrete has become the most consumable materials after water due to its vast use in construction industry. Globally, it is estimated that about 25 billion tons of concrete is used annually in construction. Only India generates 165175-millions of demolition waste in a year. Most of this waste goes to landfills and creates disposal problems. The utilization of recycled aggregate and industrial wastes in concrete construction does not only resolve the disposal problems but also solve associated environmental issues. The use of recycled aggregate in concrete construction can also save natural (i.e. natural river sand as fine aggregate and crushed rock as coarse aggregate) and financial resources. This paper addresses the age-dependent mechanical properties of recycled aggregate concrete. The recycled coarse aggregate (RCA) was prepared from concrete boulders procured from a 27 years old demolished concrete building. The RCA was used as the partial replacement of natural crushed coarse aggregate to prepare RCA concrete. The other industrial waste, i.e., thermal power plant bottom ash (BA), is also used as a replacement of fine aggregate in RCA concrete. Firstly, the concrete boulders were crushed and the required size of RCA was prepared through sieve analysis as per the recommended standards. Then, the mix design of RCA and BA concrete of M25 grade was prepared based on the method of trials. The mechanical properties of RCA and BA concrete were compared with the properties of conventional concrete and found in close agreement. The empirical relationships between compressive strength and elastic modulus, compressive and splitting tensile strength of RCA and BA concrete are proposed. The experimental data and the proposed empirical relations will be directly helpful in the design of concrete structures made with RCA, BA and their combinations and also contributes to sustainable development.

Keywords :

Recycled coarse aggregate, Bottom ash, Management, Mechanical properties, Empirical relations, Sustainability.

Recycling waste as a necessity for a shift towards a green economy - With reference to the case of Algeria

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Abstract :

This research aims to highlight the importance of waste recycling as a solution to a fundamental environmental problem that hinders a major obstacle to the transition to a green economy by highlighting the problem of waste and the economic and environmental benefits of recycling. Ensuring the need to rely on this solution to achieve progress towards a green economy and sustainable development

It has been shown that the results of the process of recycling waste does not stop at reducing the size and control of the problem, but beyond to achieve economic benefits and valuable opportunities for the economy, such as contributing to the creation of green jobs, saving energy in addition to the conservation of natural resources and the protection of the environment from the pollution of waste. Although at the same time it represents losses for a country such as Algeria where the waste recycling sector is marginal. In this situation, it is necessary to emphasize the need to pay more attention to the valuation and recycling of waste as a path to the green economy.

Keywords :

recycling, waste, green economy.

Economic Efficiency Evaluation of Canadian Solid Waste Management Systems

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Abstract :

Sustainable and integrated solid waste management has become a critical issue in communities worldwide because of the rapid urbanization and population growth. The aim of this study is to evaluate the performance of non-hazardous waste diversion systems of five Canadian provinces: British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario using entropy coefficient method and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. In this study, the economic outputs, expenditure and profits, and business sizes for both public and private waste services are considered. The performance of five Canadian provinces are assessed based on the diversion– gross domestic product (GDP) ratio, diversion– expenditure ratio, current expenditure per tonne handled, and GDP Sector 562 per tonne handled indicators. The entropy coefficient method is applied to determine the weight coefficient of each indicator while the TOPSIS method is used to rank the waste management systems with the consideration of the indicators. The result indicates that solid waste system of British Columbia (BC) is performing well compared to the other four provinces.

Keywords :

Solid waste management systems; Diversion rate; Entropy coefficient method; TOPSIS; GDP.

Integrated Solid Waste Management and Sustainability

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Abstract :

The municipal solid waste (MSW) generation are increasing day by day, as cities grow and as people prosper, affecting public health and the environment. In Asia, the proper management of MSW is one of the most neglected areas. Managing high volumes of MSW is a challenge in many cities. The drawbacks include poor collection and handling, inadequate disposal infrastructure, technical skills and guideline. There are significant consequences for human health and environmental sustainability if the solid waste is not managed properly. The study covers MSW generation and composition; handling, separation, storage and processing at source (recovery, reuse & recycling); collection; separation, processing and transformation of wastes at transfer station; transfer and transport; and disposal. It also includes energy-from-waste, biological treatment of organic waste, composting and anaerobic digestion. In integrated solid waste management (ISWM) hierarchy, there are 4 major components, e.g. source reduction, recycling, waste transformation and landfilling. The environmental impacts of waste management on the sustainable development are discussed. The challenges and role of MSW management in various initiatives of government, NGOs and CBOs are described. Waste minimization should be the key component of the ISWM. Information and education campaigns, especially for students in academic institutes, can promote lasting behavioral change in Asian cities. In Asia, many landfills operate as open dumps. However, the landfill should be designed to a standard that is environmentally sustainable and economically feasible. To better utilize the budget, control landfills can be adopted in a city rather than fully engineered facilities, if not necessary. In Asia, the Bukit Tagar Sanitary Landfill (BTSL), Hulu Selangor in Malaysia is an example of best sanitary landfill of fully engineered facilities with zero discharge, which received many international awards. The Ministry wants to show the BTSL as a model for other cities. For the next 65 years, it could meet MSW dumping requirements in Kuala Lumpur and Selangor areas. In 2014, it receives 2,500 tons of MSW daily. It is unlike the dumpsites that have been utilized in most parts of Asia. The by-product, e.g. methane gas is carefully managed for 4 MW electricity productions and toxic leachate is treated properly to produce clear water, which is dispersed through sprinklers in the trees and unused parts of landfill. A separate storm water collection system is installed to release it into the river. It is potential to use it as a solar farm as well by using flexible solar panels on top of the cells. In addition, it can be transformed into a playground or park once the dumping is completed in future. City authorities may express interest in converting waste to energy, e.g. refuse derived fuel (RDF) from combustible components of MSW. The RDF could be an economically feasible solution for significant percentage of MSW. The Asian Development Bank (ADB) provided technical support to 5 Asian cities to improve MSW management system for the long-term. The public-private partnerships (PPP) can play a vital role in ISWM. The PPP is the most useful way to improve collection system, separation, 3Rs, and landfill design, development and operation.

Keywords :

Municipal Solid Waste (MSW), Sanitary Landfill, Waste Transformation, Energy-from-waste, Public-private partnerships (PPP).

Obligatory Aspects of Sustainable Waste Management in the MENA Region

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Abstract :

Solid waste management (SWM) is one of the main challenges facing developing countries. The provision of adequate waste management services is critical because of the potential impact on public health and on the environment. Population growth in urban centers, lack of planning, lack of proper disposal, limited collection service, use of inappropriate technology and inadequate financing are considered the main obstacles facing municipal SWM in the Middle East and North Africa (MENA region).

SWM involves the activities associated with generation, storage, collection, transport, processing and disposal of solid waste, which is environmentally compatible adopting principles of economy, aesthetics, energy and conservation. It consists of planning, organization, administration, financial, legal and engineering aspects.

Suitable legislation and regulations provide an effective working system for taxation and its realization. The policy and legislative framework forms the backbone of any implementation system. A policy framework is necessary to guide the urban local bodies in the country for managing the solid waste scientifically and cost effectively. Economic aspect of solid waste closely connected with the overall economic efficiency of recycling and provides facilitate productivity by providing effective waste management. While considering SWM economically, the financial and monitoring aspects should not be forgotten. A waste management system comprising collection, operation, equipment, facility construction, etc. is a costly activity. Therefore, when introducing a new funding system, an improvement of the service should be noticeable. The improvement can only be achieved by a strong management that takes into consideration the application of 'Polluter Pays' or Extended Producer Responsibility (EPR) principle to all waste generators, especially in urban areas including governmental and non-governmental agencies, private sectors and commercial enterprises.

Keywords :

Solid Waste Management, Liability Laws, Technical Aspects, financial Aspects, Sustainability, MENA Region.

Solid Waste Characterization in Makkah, KSA

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Abstract :

Characterization of the existing municipal solid waste (MSW) in Makkah, KSA, has been performed to evaluate its suitability for various waste-processing technologies. The predominance of open dumping and the absence of reliable data regarding generation and characterization of waste has created a difficult situation for urban local bodies responsible for managing MSW generated in the city. In this study, MSW samples collected from the streets of different sites at different times throughout a year were analyzed for physical characteristics. Physical characterization of the city waste indicates that MSW is rich in biodegradables in the form of the average rates of organic matters of 47%, plastics 25%, Paper and card board of 20%, metals of 4%, glass of 2%, textiles of 1%, and wood 1%.

The waste characterization highlights the importance of waste segregation before sending the waste fractions for different waste-treatment technologies including composting, biomethanation, refuse-derived fuel, and landfilling.

The contouring of the sampling data performs a remarkable increase of the organic matters in the districts of Awaly (88.12%) and Azzizia (70.70%), and Shisha (54.69%); where the lowest rate of the organic matters at Mahbas Al-Genn (30.60%), and Reea Bakhsh (13.67%). While, there is a remarkable increase of plastics in the districts of central zone (Reea Bakhsh by a ratio of 60.31% and Mahbas Al-Genn by a ratio of 35.88%, that can be interpreted by the central zone of Makkah City is covered by hotels and housing of pilgrims and Umrah performers which depends mainly for their accommodations on the fast foods that needs extra plastic bags and plastic sheets for meals.

Data and information created in this study will be helpful for Municipality of Makkah city in the strategic planning of an upcoming integrated solid-waste management project in the city.

Keywords :

Solid Waste, Characterization, Generation, Makkah.

Study the characteristics of household waste in the city of Buraidah: the first entrance to good waste management

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Abstract :

Household solid waste varies in its characteristics and components according to many conditions, including the number of family members, the nature of consumption, the size of the house and the level of income. This study aims at identifying the characteristics of household waste in Buraydah city and the factors that affect it. The study follows the descriptive analytical and statistical approach based on analysis, extrapolation, conclusion and comparison. Where questionnaires are distributing and personal interviews are conducted to study the phenomenon. The objective is to demonstrate the importance of studying and quantifying the characteristics of household waste, and what are the benefits of identifying waste characteristics. It was found that the study of the characteristics of waste provides an opportunity to compare the rates of waste generation in the study area compared to other rates per capita waste. Waste characteristics provide an accurate description of the thermal and chemical contents and a review of the physical and biological characteristics related to household waste along with the quantitative and qualitative data of the waste.

The study of the characteristics of household waste in the city showed that the proportion of organic materials is 47%, while the proportion of inorganic substances was 53%, the average per capita production rate was 1.15 kg per day and the annual increase in the rate of waste production is about 5%. The study found that food residues accounted for 32% of the volume of household waste and provided a quantitative amount of all waste component categories. The study showed the percentage and volume of recyclable materials from household waste and its economic value and the opportunities to benefit from it if separated at the source, or dealt with to extract waste energy. It provided a way to calculate energy content of materials used in incineration and incineration processes for energy production.

The study recommended the preparation and construction of an integrated waste management system that includes the development of methods and ways in accordance with the best practices in the management of household waste at all stages in order to achieve good monitoring and follow-up and measure performance and achievement of all stages and enable the appropriate decision to manage these waste. It recommended that care to be given to the training of house workers who process the waste in the practice of sorting from the source and placing the waste in more than one container or basket to make the most of its multiple components. Finally Preparing the next generation to deal with a different vision and commitment to manage and conserve natural resources, supported by knowledge and practice to achieve sustainable development that meets the needs of present and future generation.

Keywords :

Solid Waste Management, Liability Laws, Technical Aspects, financial Aspects, Sustainability, MENA Region.

Assessing the Potential of Natural Zeolites and Biochar in the Bioconversion of Organic Fraction of Municipal Solid Waste to Organic Fertilizer

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Abstract :

Saudi Arabian natural zeolites and lawn litter wastes leaves biochar (10 and 15%) adding to food waste composting system was investigated to assess its potential as compost amendment. The study was initiated as no previous work has been conducted to explore the potential of local available natural zeolites and lawn wastes biochar derived as a result of slow pyrolysis (450 oC) for compost process improvement. Compost quality was evaluated in terms of typical stabilization indices like moisture contents, organic matters degradation, change in total carbon, and variation in nitrogen components. Results showed that both the amendments had a positive effect on food waste composting in term of all maturity parameters. The porous nature and water holding capacity of both the additives abet in achieving thermophillic temperature and it was noted that compost reactors blended with higher concentrations i.e. 15% entered to thermophillic stage in the first week of experiment. Likewise, wide range mineralogical composition, presence of reactive sites and porous structure enhanced decomposition process, nutritious value and retention of important components in the final product. High organic matters and carbon content was obtained in compost treated with biochar (10 and 15%) fallowed by zeolite. Nitrogen conservation by retaining ammonium and nitrate in compost was achieved due to the strong sorptive capacity of both the added zeolite and biochar. Stability parameters showed that compost maturity was achieved during 5060- days in runs amended with zeolite and biochar whereas control run was not mature even after 60 days.

Keywords :

Waste Management, Food Waste, Biochar, Natural Zeolite, Compost.

Evaluation of a Hybrid Thermal Solar and Biomass Energy System for Hot Water Supply

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According to the International Energy Agency (IEA) electrical energy consumption per capita in the Kingdom of Saudi Arabia (KSA) increased from 6.11 MWh in 2004 to 9.41 MWh in 2014. As per a report of Electricity & cogeneration regulatory authority, Saudi Arabian Government in 2014, this consumption was 9.137 MWh and in 2017 it reached to 9.333 MWh. This consumption is three times higher than the world average of 3.03 MWh/ capita as of 2014. The share of electricity consumption in a residential building in 2017 is 48.1%, which is also significantly higher than the global average of 27%. The share of electricity consumption is 10.3 % in residential homes for water heating in Qassim region of KSA. A view of the energy consumption data and trends in the KSA shows that there is an urgent need for the regular policy evaluation of energy consumption. This work is focused on a hybrid system using thermal solar energy where the heat was generated from the biomass energy reactor for water heating. The vacuum tube collector with heat pipes was used for the solar energy and the biomass reactor produced thermal energy from the household waste. Potential of generated biomass for waste-to-energy was evaluated. The waste resulted from the biomass reactor can be used as organic fertilizer. The use of solar energy and biomass energy together in a hybrid system helps to reduce the use of conventional energy and thus the CO2 emissions. The system produces energy and helps to solve the probalems associated to waste management. The main advantage of this system is that it can be used to supply hot water not only for domestic usage but also for any application at a lower temperature range, i.e., < 150°C.

Keywords :

hybrid system, thermal solar energy, biomass waste, hot water, CO2 emissions reduction.

Production of Sludge-Based Activated Carbon : Optimization, Characterization and Adsorption Study

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Abstract :

This study reports the utilization of municipal sewage sludge to produce activated carbon (AC) using the chemical activation method with different chemical agents that include, ZnCl2, KOH and H3PO4. The effect of the production parameters such as activation temperature (A), impregnation ratio (B) and activation time (C) on the product yield (Y1) and methylene blue removal efficiency (MB) (Y2) were investigated using statistical experimental design based on response surface methodology technique. Based on the results, quadratic models for yield (Y1) and MB removal efficiency (Y2) as functions of production parameters (A, B and C) and their interactions were developed. When ZnCl2 was used, the statistical analysis result revealed the yield model to be significant ($P < 0.05$), while the MB model was found to be insignificant based on its probability value ($P > 0.05$). Characterization of produced AC samples was limited to samples that presented higher values of yield and MB removal efficiency. The best AC realised, presented a surface area and pore size of 319.5 m2/g and 31.28 Å, respectively, which was achieved with ZnCl2 activation (impregnation ratio of 1:0.6, temperature of 700° C and time of 60 minutes). The FTIR analysis results showed the dominant functional groups present on the AC surfaces to be O-H, C-C, C-O and C=O. The adsorption performance of the produced AC for the removal of model organic (phenol) and inorganic contaminants (cadmium) from aqueous was investigated. A removal efficiency of 28 and 56 percent were achieved for Cd2+ and phenol, respectively, at the optimum conditions of pH value of 5.5, AC dosage of 0.15g per 50 ml and contact time of 120 and 720 minutes. Isotherm and kinetic modelling of the experimental data revealed the adsorption process was based on both physical and chemical interaction with the AC surface.

Keywords :

Sewage sludge, activated carbon, Adsorption, Isotherm, Kinetic, FTIR, BET.

Utilization of Municipal Organic Solid Waste in Production of Activated Carbon and its Application in Dye and Heavy Metals Adsorption

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Abstract :

In Saudi Arabia, considerable amounts of municipal solid waste (MSW) are generated annually. A total domestic solid waste of around 17 million metric tons per year is produced, which contains two major components; plastic and organic waste. The organic waste represents about 79 %, where food waste is the primary source of the organic portion. The common practice of municipal organic solid waste (MOSW) management is combustion or dumping in landfill sites causing many environmental problems. Therefore, conversion of MOSW into activated carbon (AC) could be a practical alternative approach. In this research, MOSW was utilized as an inexpensive, readily available source of AC. Chemical activation using orthophosphoric acid as a modifying agent was employed, where effects of activation conditions, including concentration, temperature, and time on the adsorption performance of the produced AC were studied. Physio-chemical properties of the produced AC including crystallinity, morphology, surface chemistry, and surface area were investigated using X-ray diffraction (XRD), scanning electron microscopy (SEM), Fourier transforms infrared spectroscopy (FTIR) and Brunauer–Emmett–Teller (BET), respectively. The results indicated that the concentration of orthophosphoric acid and temperature have significant effects, whereas activation time has an insignificant effect on the characteristics of the produced AC. Methylene Blue (MB) removal of 100%, BET surface area of 793 m2/g and yield of 32 % were reported for the AC produced at the best activation conditions, which were conducted using the orthophosphoric acid concentration of 30 % at a temperature of 700° C for 2hours. Moreover, adsorption experiments revealed that maximum removal efficiencies of Cd2+ and Pb2+ were found to be 78 and 94 %, respectively. The equilibrium isotherm study revealed that the maximum adsorption capacities of Cd2+ and Pb2+ were 61 and 90 mg/g, respectively, at the equilibrium time of 2 hours and a pH value of 5.

Keywords :

Waste Management, Activated Carbon, Chemical Activation, Characterization, Adsorption,.

Sustainable Approaches of Renewable Clean Energy Recovery from Solid Waste

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Abstract :

Integrated solid waste management is the need of today to reduce its harmful environmental burden and associated social and health risks. Reduction, recycling and recovery from waste are major component of integrated solid waste management. The progression in waste to energy WTE technology proves to be an ideal substitute of heat and power that helps in meeting the rising demand of energy. These technologies support in waste volume reduction and its environmental and health influences. Biogas, a by-product of anaerobic digestion of organic solid waste, proven to be a realistic solution for the over reliance on traditional use of fossil fuel. But these WTE conversion processes are little bit challenging for sustainable development due to various parameters including heterogenous composition, variable moisture contents and calorific values of waste and processes involved in conversion. Energy recovered from waste is a renewable clean source of energy only when processed through a sustainable approach. In this study, sustainable approach of high solid anaerobic digestion method was used for the efficient waste to energy WTE conversion. In result 6765.01E5 Joules (6.412E5 BTU) of biogas was produced with the value of 3.846 USD/ton. This study will help in ultimate reduction of greenhouse gas emissions and minimization of the impacts of climate change with special emphasis on various parameters and processes involved in conversion.

Keywords :

Waste to Energy Conversion, Sustainable Development, Anaerobic Digestion, Greenhouse gas emissions, Climate Change.

Treatment of Solid Wastes by Anaerobic Digestion for Compost and Biogas Production

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Abstract :

Municipal solid wastes as food wastes, cattle dung and sewage sludge require a proper and environmentally accepted management before final disposal, they are considered a major source of air and water pollution. We can invest the energy generated as biogas and production of high quality compost in addition to free pathogen soil fertilizer while achieving environmental and economic benefits. The objective of this study was to investigate the feasibility of biogas and methane production from food wastes and cattle dung in the first experiment. The second one is the production of biogas and methane from sludge and cattle dung by co-digestion system under mesophilic conditions. The experimet done in the bench scale batch anaerobic digester (vertical type) with 8.5 liter capacity, 6 liter digestion volume, stirrer 80 rpm/min and 85 days hydraulic retention time (HRT) under 36 °C mesophilic conditions and the mixing ratio 50:50%, with total solid (8% TS) after dilution for both experiment. The results showed that, the biogas and methane yield were 0.122 L biogas/g VS and 0.078 L CH4/g VS at 50% TS of in the mixture of food wastes and cattle dung, but this ratio receded in case of sludge and cattle dung where the biogas and methane yield were 0.093 L biogas/g VS and 0.062 L CH4/g VS at 50% TS. On the other hand, the produced biogas percentage was higher in case of sludge and cattle dung (66%) than food wastes and sludge which was (63.9%). The equilibrium between carbon dioxide and methane production was dependent on acetogenic, methanogenic bacteria, degradation percent and pH value. When the degradation ratio increased and pH value decreased; the percentages of CO2 increased and CH4% decreased. In addition, when the degradation% increased and pH value increased, the carbon dioxide decreased while methane content is increased. The methane percentage is influenced by the C:N ratio, which increased and in the same time the average CO2% is decreased. Recent research demonstrates that using co-substrates in anaerobic digestion systems improves biogas yields.

Keywords :

Anaerobic digestion; Solid wastes; Batch fermentation; Biogas; Methane content; Mesophilic.

Impact of Scrap Rubber Recycling on Sustainable Development and Environmental Improvement - A Review

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Abstract :

Waste management is a significant concern in environmental improvement and sustainable development for any country. However, critics of the waste management drive towards that the recycling may have little benefit to the environment, proposing that more energy may be used in attainment materials to the recycling facility than is saved by the recycling process. Although waste rubber particularly old (scrap) tires are just emerging in many waste streams, the available data shows reasonable environmental performance of recycling regarding energy demand, depletion of natural resources and economical point of view. The main problem of rubber is that it is not degradable or compostable easily. Nevertheless, the analysis pointed out that composting does not appear to be advantageous for energy demand and depletion of natural resources compared to the other alternatives. Several studies have been carried out to reuse or recycle scrap-tires in a variety of rubber and plastic products, incineration for production of electricity, or as fuel for cement kilns, as well as in asphalt concrete. The current paper is an overview of the scrap rubber showing the main applications of the recycled and reused material in real life. The study focuses on the recycling process of scrap tires and its uses and impact on sustainable development.

Keywords :

Waste management; Sustainable development, Scrap rubber; Recycling

A Geophysical Study on the Impact of Landfill Al-Maeesem on Groundwater to develop Available Options for the Construction of its Engineering cover

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Abstract :

In order to preserve the environment, protect groundwater, and manage waste, the Holy Capital Municipality intends to cover the old landfill in Al-Maeesem area and close it with an engineering cover that prevents rainwater from reaching the landfill, mixing with its components, and affecting the quality of groundwater in nearby valleys. In order to preserve the air environment, it intends to establish a gas collection network and consider the possibility of using it for energy production. Therefore, this research is concerned with studying the impact of landfill on the ground water in the region and to identify the range of the extent of pollution in the nearby valleys. It also aims to develop a program to monitor water quality and its impact. This research includes the results of field studies of geophysical work, the results of the examination of materials resulting from the drilling of wells to identify the layers of the earth, and the collection of data that form the basic basis in the design of the final cover. These geophysical works include measuring the electrical resistance of the different layers in the landfill to identify: The type of materials that make up the landfill layers of waste, dust and others. And determine the depth of the rock bottom layer of the landfill, and determine the depth of groundwater and distance from the surface of the earth. These measurements were used to estimate the amount of waste currently present in the landfill, to identify the locations of wells and test boreholes, the locations of the supporting structures of the landfill cover, such as internal roads, and the location of the landfill pool, as well as to determine the appropriate location of the landfill gas flame, or the treatment plant and energy recovery.

Keywords :

Waste, Landfill Al-Maeesem, Burn the landfill waste, landfill collection, environment.

Effective waste management by enhancing reusable packaging

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Abstract :

Waste is an old dilemma for the environment and societies. Dealing with waste packaging as a part of all waste is essential. This paper aims to propose an integrated method to reduce amount of waste packaging by enhancing reusable packaging in societies and industries. A conceptual framework was designed through an appropriate literature review. The paper consists of three phases. In the first phase, a System Dynamic (SD) method will be used for determining the interaction between the social aspects and reusable behaviour. The second phase of the paper will devote to exploring reusable packaging attributes by using Normal Average and Codes and Coding approaches. The last phase of the paper will conduct of a case study of a real company which needs to reduce waste packaging and increase the amount of reusable packaging it uses. All methods used in this paper have both a quantitative and a qualitative nature. Data was collected by evaluation of consumers› responses and experts› experiences as provided in the questionnaires. The results shown that a Social Behaviour Aspect Model (SBAM) demonstrated the importance of spreading the awareness of environmental behaviour to develop personal, social values and norms within communities. Moreover, a Reusable Packaging Attributes Model (RPAM) proved that the existence environmental packaging can help consumer to behave environmentally and reduce waste packaging. In conclusion, this paper can help government to investigate the most suitable approach for reduce the environmental impact of waste packaging by enhancing the use of reusable packaging within societies and industries.

Keywords :

Solid Waste, Environment, Packaging, Sustainability.

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