Poster Presentations

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Total recycling of valuable metals from spent auto-catalyst

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The cordierite ($2MgO{\cdot}2Al_2O_3{\cdot}5SiO_2$), the substrate of auto-catalysts is generally coated with the thin layer of γ- Al_2O_3, which also contains the PGMs (Pt, Pd and Rh) as active material and a mixture of additives (oxides of Ce, Zr, La, Ni, Fe and alkaline-earth). The recycling of PGMs from the spent auto-catalysts is becoming extremely attractive as compared to the primary resources due to the higher contents of PGMs, with several advantages such as simpler process, lower cost, and lesser environmental pollution. For decades the pyrometallurgical recycling processes have been employed to extract PGMs from the spent auto-catalyst. Though the pyrometallurgical processes are highly efficient to recover PGMs, but they can't recover other metal components. In view of the depletion of primary resources and climate changes associated with the gaseous emissions, new strategies are required particularly to recycling all valuable components. The hydrometallurgical routes may offer such possibilities ensuring the recovery of almost all the metals from the spent auto-catalyst, but require aggressive acidic conditions and oxidants in high concentrations. In order to develop an efficient and environmentally friendly approach, we have investigated a new hydrometallurgical process for the total recycling of other metal components as well as PGMs from the spent auto-catalyst. The cordierite substrate of the auto-catalysts was decomposed to dissolve aluminum and magnesium using NaOH roasting and H_2SO_4 leaching, leaving PGMs and cerium oxide in the residue. PGMs were recovered to the extent of 99% by cementation with Al whereas cerium oxide was recovered up to 90% by hot digestion using H_2SO_4. The hydrometallurgical process described in this study has a potential for sustainable utilization of wastes to recycle all the metals.

Speaker Biography

Jae-chun Lee is currently Distinguished Principal Researcher in the Mineral Resources Research Division at the Korea Institute of Geo science and Mineral Resources (KIGAM) and a campus representative professor in the Department of Resources Recycling at the Korea University of Science & Technology. Lee received his B.S. in metallurgical engineering, M.S. and Ph.D. in Hydro metallurgy from Hanyang University, Korea. His research deals with leaching, separation and purification of metals from primary and secondary resources and material preparation by aqueous processing. His current research focuses on the recycling of valuable metals from urban mine by hydro metallurgical routes. He has authored over 200 articles. He is currently an Associate Editor of Hydrometallurgy.

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Valorisation of industrial brines into value-added products (acids and bases) through selectrodialysis and bipolar membrane electrodialysis: A step towards circular economy approach

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High salinity waste water effluents originated from different industrial processes are normally considered as last-resort sources because their high contents of ions make necessary the use of complex and costly treatment systems. For this reason, generated brines have traditionally been discharged into natural water bodies, although this method is not environmentally friendly and represents a loss of potential resources (salts and water). Undoubtedly the selective recovery and revalorisation of salts contained in brines would permit their reusability as well as a reduction of the environmental impact caused by their disposal, contributing to the development of circular economy. Within this framework, the present study intended to treat an industrial brine rich in NaCl and Na_2SO_4 through a combination of membrane-based technologies to convert its ions into valuable chemical products. The involved technologies consisted in 1) electrodialysis (SED) to separate NaCl from Na_2SO_4, and 2) electrodyalisis with bipolar membranes (EDBM) to produce HCl and NaOH from NaCl, and H_2SO_4 and NaOH from Na_2SO_4. Experiments were performed under different Cl- and SO_4^{2-} concentrations in feed solution and carrier solutions to be enriched in Cl- and SO_4^{2-}. Results indicated that it was possible to separate Cl− and SO_4^{2-} by SED (purities up to 98%) and to produce pure NaOH and HCl and H_2SO_4 by EDBM. Optimal operation conditions were also determined with regard to energy consumption.

Speaker Biography

Oriol Gibert is an environmental chemist at Technical University of Catalonia (UPC) with more than 10 year's experience in the field of contaminated land and groundwater and of process separation (adsorption, membranes) applied to water treatment. He has 50 ISI-indexed publications and his publication H-index is 18.

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Composite material recycling by solvolysis - Energetic and thermal approach of the process

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Composite material production leads to wastes production and also leads to end-of-life wastes. Their management is a crucial problem to ensure the sustainability of the sector of the composite material made with organic matrix. Hence, since ten years, researchs on composite material recycling are carried out in our laboratories. Thus, three ph-D theses were defended referring to recycling by solvolysis. These works carried out news results on thermal mechanisms and on energy balance occurring during composites solvolysis process, with no equivalent in our bibliographic study. In this presentation, we will focus particularly, first, on the energetic approach of the solvolysis phenomenon. To this end, differential scanning calorimetric approach was used. The main result of this work is that the most important observed phenomenon is the condensation of the water vapor when pressure increase inside the reactor. In a second time, to be sure of these results, a reactor and samples were instrumented by thin thermo couples (diameter 100µm) to record the temperature evolution during the processes of solvolysis. These last experiments prove that the sample is the locus of exothermic reactions.

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Vegetable wastes for the preparation of activated carbons and their application in the treatment of waste water

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Industrial activities generate solid, liquid, and gaseous wastes which negatively impact the environment, and, as such, there is a worldwide concern about reducing the pollution of the ground, water, and air. Furthermore, during the preparation and the consumption of food, tons of solid vegetable residues are discarded. One way of minimizing the negative impact of human activities is found in the recycling of both industrial and vegetable residues by developing sustainable technologies that reduce the generation of solid wastes, producing new low-cost materials that can be used in the treatment of industrial waste water. There are diverse techniques used to treat industrial effluents such as coagulation-flocculation, advanced oxidation and electrochemical processes, membrane filtration, and adsorption, among others. Adsorption using activated carbon has proven effective in the elimination of industrial pollutants present both in waste water and air. The materials which are commonly used to produce activated carbon are wood, animal bones, coconut shell, and mineral carbon. The use of wood in the production of activated carbon generates unregulated logging of trees, and the extraction of mineral carbon originates devastation of the landscape leaving enormous holes, removed soil, and debris from exploitation in mines. Hence, the use of vegetable residues is a sustainable alternative in the preparation of activated carbons because, using waste materials such as prickly pear peels, broccoli stems, white and black sapote seeds, and avocado peels or seeds, as well as many others, it reduces the generation of solid residues. Furthermore, by carefully controlling the conditions of activation and carbonization, it is possible to prepare activated carbons with high specific surface areas which have proven highly efficient in the elimination of organic and inorganic compounds present in waste water such as dyes and heavy metals, respectively.

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New possibilities of microbial enzyme cocktails in paper recycling

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Paper is a composite consisting of cellulose, hemicellulose and lignin. The paper recycling process hence require the ligno-cellulosic enzymes like cellulase and xylanase for modification of paper pulp characteristics. A low molecular weight cellulase - xylanase complex (14 KDa) was co-produced using bacterial and fungal systems and compared for their efficiency in paper bleaching efficiency. Co-existence of these enzymes was found to be advantageous in paper pulp modification and in deinking applications. Defibrillations, crack formation and changes in functional groups was evident from the SEM and FT-IR analysis of paper pulp following the enzyme treatment. The enzyme facilitated a better reduction of Kappa number and Hexenuronic acid (Hex A) compared to earlier studies. A Δ brightness of approximately 10% was achieved in case of both cellulase and xylanase for different treatment time. The tear strength of recycled paper was also found to increase after the enzymatic treatment. The fungal enzymes were better in biobleaching applications compared to enzymes from bacterial systems. The enzyme mediated bio bleaching contributes to improved solid waste management efficiency and results in a eco-friendly and cleaner technology for paper and pulp industries.

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Life cycle assessment in the construction sector

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Every year in England more than 434 million tonnes of waste are generated. The construction and demolition sector is responsible for 30% of the total and also has a significant impact in terms of natural resource and energy consumption, as well as pollutant emissions into the atmosphere. As one of the most competitive sectors in the country, with continuously growing demand, we cannot just "stop building" but what we can do is apply more sustainable strategies by using waste as a resource and driving the concept of circular economy. With the aspiration of developing a circular and sharing economy for large infrastructure projects, Costain and Loop are collaborating to analyze the material flows on Costain's projects to define alternative solutions aimed at resource optimization and waste reduction. For instance, a program has been set up to manage demolition waste for the HS2 enabling works project in Euston to keep the residual materials in the loop, giving them a higher value uses. The environmental benefits associated with moving resources from waste streams back into use are identified and quantified by means of Life Cycle Assessment (LCA) with attributional and consequential approaches according to the different projects. The volume and quality of data in Costain's possession is of great value for the development of the LCAs because it comes directly from the constructors of, and suppliers to, the projects. With the use of this robust and science based tool the impacts of these alternative circular business models are measured and tested, helping to set priorities and giving a baseline for the product in question, so any improvements or deviations can be compared and progress can be monitored.

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Exploring new horizons and sustainable technologies for recycling and waste management

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The life cycle of recycling and waste management proceeds from arisings through separation, collection and transportation to recovery and treatment or disposal. Any such life cycle should be assessed as an aggregate, "a whole formed by combining several separate elements". Life Cycle Assessment (LCA) can be used to assess environmental impacts, and Cost-Benefit Analysis (CBA) to analyse economic costs, but these are both sums of separate values. Such sums of separate values are not the same as the value of the aggregated whole. There is currently no method to aggregate qualitative elements. Assessing aggregated qualities implies expressing their values in terms of the qualities of a whole frame, a basic structure. The frame enables all aggregated representations of scientific knowledge to be expressed, and the assessment of sustainable technology using "ecoputation", by maintaining the values of frame qualities at a given rate or level. The frame can include qualities, among others, that are variable, local, spatial and temporal; in waste management, in which local and variable transport is significant, assessing these aggregates has historically been a failure of decision support. An experimental methodology and trialing program is therefore proposed, to assess and manage sustainable household waste in agreement with several waste authorities in a country to be determined. Each authority will develop a (qualitative-and-quantitative) narrative to express local practice. The narrative may include both variable and fixed qualities, to be used with a prototypical frame to generate alternative representations with the same value. By repeated use, a sustainable technology will be attained. The frame and method will be fully evaluated within a participatory process to be carried out with authorities, local waste management contractors and a representative sample of members of the public. The report will be open, transparent and agreed in consultation with all parties involved.

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Application of internet of things for food waste reduction in food supply chain

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The food sector is increasingly under pressure to improve its resource efficiency, with particular areas of focus on reduction of food waste, energy and water consumption. In order to achieve this, it is vital for the Food Supply Chain (FSC) actors to share and exchange information in a timely manner. The technology and tools associated with the concept Internet of Things (IoT) is capable of supporting numerous tasks in real-time such as tracking, locating, monitoring, measuring, analyzing, planning and managing and enhancing efficiency and transparency within FSCs. In this context, the application of IoT for reduction of food waste is garnering lots of attention from researchers, politicians, and industrialists to achieve food security goals. But, the traditional methods of physically monitoring the food wastes in food supply chain is labour intensive, complex, and is often time consuming and costly. Therefore, there is a need to explore an innovative approach based on an automated real-time system to monitor and analyze the food waste and incorporate it in strategic planning of FSC which enables management to take better decisions and in turn make supply chain more sustainable and resilient.

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Recovery of value added products from post-consumer waste plastics through chemical recycling

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Post-consumer Plastic waste creates severe environmental issues in the eco system during their disposal, due to their inherent non-biodegradable nature. Currently in India nearly 15,500 TPD of waste plastic are generated and nearly 60% of them are collected and mechanically recycled while the remaining 40%, which could not be mechanically recycled, are uncollected and littered and enters in to MSW as land filling. In this aspect, Chemical or Feedstock recycling of waste polymer is particularly beneficial for it is environmentally safe and generates more useful chemicals. Thus development of value added recycling technologies is highly desirable as it would increase the economic incentive to recycle the waste plastics. This paper discusses the pyrolysis of mixed post-consumer waste plastics with various catalysts in a two stage process involving pyrolysis followed by catalytic cracking. The yields of resultant value added products like Diesel, Gasoline and Aromatics are evaluated under various process conditions. The resultant liquid fuels are characterized for BIS specifications and studied in internal combustion engine for their suitability as the transportation fuel. The gaseous products are analyzed for their chemical composition and energy content. Moreover, the by products like char are also characterized and their uses are also explored. The appropriateness of this process is also evaluated using the frame work of SWOT. Further recommendations and way forward for scale up studies also indicated

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Abstract on values of sawdust degraded diastic microbes (of *achatina fulica*) fed goats as part of formulated diets as an alternative municipal organic waste management

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Experiment was conducted to evaluate the utilization of sawdust degraded diastic microbes (SDDM) (of *Achatina fulica*) as feed component for Red Sokoto goats. Thirty six Red Sokoto goats of mixed sexes (18 females and 18 males), average body weight 4kg, between 4-5months of ages were used. Goats were randomized into 3 groups of 12 goats per group, consisting of 3 goats per replicate, which replicated 4 times. Groups were assigned to each of the 3 diets (T1 with 15% undegraded sawdust, T2 with 15% SDDM and T3 with 25% SDDM). Investigations revealed the chemical composition of the organic matter, ash, and the energy generally were low on the SDDM (P>0.05) when the sawdust was degraded with the diastic microbes. The SDDM protein, crude fibre, ether extract, nitrogen free extract as well as the nitrogen followed a different dive with great increment over the untreated sawdust. This could be due to the efficiency of the diastic microbes in the degradation of the sawdust to make the nutrients available for the efficient farm animals' utilization; which is an indication of quality sawdust produced (SDDM). The daily feed intake and weight gain values (435.87g) (79.37g) and (308.25g) (15.87g) differed (P<0.01) as against the values in T1. However the efficiency of feed utilization values (T3 and T2; 19.42, 5.49) differed (P<0.01) over T1. The cost of feed/kg and cost of production/goat showed better values on the T3 (P<0.05) over of T2 and T1; while the gross and net profits were generally better (P<0.01) in T2 followed by T3 and T1. Similar trends were observed on carcass values, wholesale cuts, lean/bone values and pelts, respectively. It was concluded that, the inclusion of SDDM at 15% and 25% as part of formulated concentrate diets for growing goats gave the best results, over the undegraded sawdust.

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Improvement of hazardous waste management at the University of Córdoba (Spain) through educational actions

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The teaching and research activity that takes place in the university generates a large amount of hazardous chemical and biological waste. This type of waste is characterized by a heterogeneous composition and a production in small and time varying quantities. This makes it necessary that the procedures for their control should pay special attention to educational strategies that may facilitate motivation and competence for the people involved.

Objective: To present the experience developed at the University of Cordoba (Spain) for controlling and improving the management of hazardous waste between 2008 and 2016.

Methodology: Describe the main training, information and awareness actions launched by the Environmental Protection Service of the University, e.g.: courses, newsletters, awareness tools aimed at producers and users. In our university there are about 90 producing units (research groups, departments, etc.).

Results: These actions have paid special attention to waste minimization, achieving, in the nine-year period, a decrease in consumption of packaging by 37% and waste production by 24% (getting a decrease in the percentage of mixtures of 64%).

Conclusions: Used in a coordinated way, education and management in the field of hazardous waste can complement and even strengthen between them. A good management is an excellent educational tool and, in the same way, a good education enriches and improves the effectiveness of management.

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Thermal degradation of dianhydride-modified polybenzoxazine

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Bisphenol-A/aniline based polybenzoxazine (abbreviated as poly(BA-a)) modified with different types of dianhydride, i.e. benzophenone-3,3',4,4'-tetracarboxylic dianhydride (BTDA) and pyromellitic dianhydride (PMDA) is attractive for the applications that require high thermal and mechanical properties with fire resistant characteristics. Therefore, thermal stability and thermal degradation kinetics may be significant to production and application. The purpose of the present work is to investigate the changes that take place during the thermal degradation of the poly(BA-a)/BTDA and the poly(BA-a)/PMDA copolymers. The activation energy and the reaction mechanism of the degradation processes of the copolymers presented by thermogravimetric analysis under argon atmosphere were estimated from non-isothermal kinetic results. The derivative thermogravimetric analysis (DTG) thermograms of the poly(BA-a)/BTDA copolymer exhibited five stages of thermal degradation reaction, while the four stages of thermal degradation reaction of the poly(BA-a)/PMDA copolymer were observed. The activation energy values obtained by composite kinetic method of five stages for the poly(BA-a)/BTDA copolymer and four stages for the poly(BA-a)/PMDA copolymer are 135-284 kJ/mol and 131-240 kJ/mol, respectively. Furthermore, the degradation reaction mechanism by integral master plot method of the stages of the poly(BA-a)/BTDA and the poly(BA-a)/PMDA copolymers was accounted by random nucleation model with one nucleus on the individual particle (F1)

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Can a monopoly increase the welfare of its consumers?

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Demand uncertainty may be a significant barrier for firms to enter the market. This study suggests that an establishment of a monopoly which absorbs demand uncertainty by commitment to determine a long-term stable price, may be efficient by reducing the uncertainty level. An economic model examines the social welfare consequences of establishing such a monopsony in the waste recycling market in Israel. The model provides a good description of many other markets with high entry cost and price volatility. The results show that an establishment of a monopsony in the waste recycling market could be an efficient process from a social welfare perspective (welfare increasing); this depends on the market's uncertainty level and the technological changes resulting from eliminating uncertainty. In the case study shown in Israel, creating a regulation that allows larger municipalities to sell the waste at competitive prices (international market prices) and allows small municipalities to recycle at a monopsony price, will lead to improved social welfare. The novelty of this study stems from the proof that a monopsony may increase the market size in markets with high levels of uncertainty, thus increasing the consumers benefit. A monopsony creates "certainty benefits" by reducing the risk premium arising from price fluctuations and the entrance of new players, and although it gains excessive profits, the benefit of reducing uncertainty may be greater than the loss of a monopolistic exploitation.

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Devulcanization of waste rubber tyre utilizing deep eutectic solvent and ultrasonic energy

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This particular study of interest aims to study the effect of coupling ultrasonic treatment with eutectic solvents in devulcanization process of waste rubber tyre. Specifically, three different types of DESs were utilized, namely ChCl:Urea (1:2), ChCl:ZnCl2 (1:2) and ZnCl2:urea (2:7) in which their physicochemical properties were analysed and proven to have permissible water content that is less than 3.0 wt%, degradation temperature below 200oC and freezing point below 60oC. The mass ratio of rubber to DES were varied from 1:20-1:40, sonicated for 1 hour at 37 kHz and heated at variable time of 5-30 min at 180oC. EDX results revealed that the first two DESs give the highest degree of sulphur removal at 74.44 and 76.69 % respectively with optimum heating time at 15 minutes whereby if prolonged, reformation of crosslink network would be experienced. Such is supported by the evidence shown by both FTIR and FESEM results where di-sulphide peak reappear at 30 minutes and morphological structures from 15 to 30 minutes change from smooth with high voidage to rigid with low voidage respectively. Furthermore, TGA curve reveals similar phenomena whereby at 15 minutes thermal decomposition temperature is at the lowest due to the decrease of molecular weight as a result of sulphur removal but increases back at 30 minutes. Type of bond change was also analysed whereby it was found that only di-sulphide bond was cleaved and such indicating partial-devulcanization. Overall, eutectic solvents indeed have a great potential to be used as devulcanizing solvent as proven.

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A new route for difficult-to-recycle plastics: Thermosets and composites

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Thermosets, elastomers, soft foams, rubbers, fiberglass and other polymeric matrix composites are generally considered difficult-to-recycle materials because of the network structure of organic macromolecules. In the best case, after grinding, particles and granules are used as fillers for new mixtures and blends. For example, end-of-life tires are ground to separate rubber, harmonic steel, and textiles. Rubber granules are used to produce parts by adding a polyurethane binder whereas rubber powders are used for rubberized asphalts. In other very rare cases, the organic matrix is evacuated to recover fibers and other fillers. Otherwise energy recovery seems to be the only possible convenient strategy for those materials after disposal. However, recent achievements have shown that a new recycling strategy is possible also for this class of difficult-to-recycle plastics. By setting the grinding process, it is possible to provide new reactivity to ground powder and granules. That has been shown in the European Project SMART (Sustainable Moulding of Articles from Recycled Tyres) where industrial products have been made by using 100% recycled rubber from tires without any additive or linking agent. The same concept has been extended to many other materials with similar network structure: fiberglass, polyurethane foams, MDF (medium density fiberboard), PCBs (printed circuit boards). From a recycling point of view, a primary route is not possible as recycled materials cannot be processed with the same machines of virgin ones. Nevertheless important engineering properties are obtained in those recycled products which can be effectively used in many industrial fields.

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Impacts of waste treatment management modes on products' prices by sector: A case study for china waste water treatment

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In this paper, a model to evaluate the change of prices of green products by sector compared with their traditional prices in 2 waste treatment management modes is established. The criterion is provided for the choice of the waste treatment management mode; this is accomplished by considering waste treatment costs as well as making full use of each product's price advantage all within the context of the macroeconomic system. The model is applied in wastewater treatment case in China. The changes in prices for 42 sectors in 4 scenarios are evaluated. The results reveal that the price for each sector's green product increases compared with that of its more traditional product. At the sector level, the price increases for Oil and gas extraction products, Metal products, machinery and equipment repair services, Petroleum, coking products and nuclear fuel processing products ranked in the top 3 in scenario 1. In the other scenarios, their ranks are different. The results further show that the price increases of 22 sectors are mainly caused by other sectors' added waste water treatment costs. The change of prices for green agricultural products would have a significant impact on their demands, in some cases, causing their annual demands to decrease. From the perspective of price advantage, the producers and administrative organizations are encouraged to consider the combination of two waste treatment management modes for 42 sectors. To limit the waste water discharged in China, one possible intervention would be to increase the fine imposed for unit waste water discharged, setting it at a higher level than the unit waste water discharge fee and its treatment cost. Furthermore, it is suggested that the waste water treatment cost needs to be reasonably incorporated in the products' prices, a suggestion that can be adopted in the model used in this paper.

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Mathematical modeling of radioactive waste transfer under the influence of wind

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This paper presents a mathematical model for describing heat and mass transfer processes and predicting the distribution of velocity, temperature, and concentration of radioactive contaminants propagating under the influence of wind. This model is based on the analysis of known experimental data on the radioactive waste repository in Kirghizia (Kara-Balta) and using concepts and methods of mechanics of reactive media, as well as approaches in existing models of environmental pollution. Dust, containing radioactive particles, can rise under the influence of air currents and is transported to considerable distances. It is assumed that 1) the flow has a developed turbulent nature, the molecular transfer is neglected, 2) the density of the gaseous phase does not depend on the pressure because of the low flow velocity in comparison with the speed of sound, 3) the subsidence of particles obeys the Stokes law. We consider the problem for two coordinates: a horizontal component perpendicular to the earth's surface. In addition, the assumption of a two-dimensional configuration can be justified, given that the length of contaminated sites can be quite large. To describe convective transport, we use the Reynolds equations for turbulent flow. The area from which the pollutants rise is modeled as a flat source of radioactive impurities.

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The clean recycling of waste printed circuit boards by pyrolysis technology

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Waste printed circuit board (PCB) is a typical electronic waste, which has dual characteristics of resource and danger. If it is not properly disposed, it will cause serious waste of resources and environmental pollution. In this study, a novel electric furnace was designed to manage waste PCB by pyrolysis technology. Typical electronic components, such as aluminum electrolytic capacitor and slot, in waste PCB were pyrolyzed at different temperature. The results showed that different electronic components had the similar pyrolysis technological conditions and hence the waste PCB could be pyrolyzed without electronic components demolition in advance. The waste PCB with electronic components pyrolyzed at 700^0C for 10 min. During the pyrolysis process, the organic part was decomposed to pyro-oils and pyro-gases: the solid residues of about 65-70 wt.%, liquid yields of 18-20 wt.%, and gas yields of 10–12 wt.%. The pyro-gas is rich in CO, CO_2, H_2 and CH_4, and it could be combusted for the pyrolysis self-sustain after being purged. On the other hand, the pyro-oil was rich in phenol and its homologue, which could be used as fuels or chemical materials. Dioxin concentration in the pyro-gas was 0.046 ngTEQ/m^3, which was lower than the emission standards. The tensile strength of the solid residues was significantly reduced after pyrolysis process, which was beneficial to subsequent crushing process and the separation of metal and glass fiber. Based on this study, a clean recycling of waste PCB by pyrolysis technology had been applied to industrial production in May, 2017.

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Study of effectiveness of cellulolytic bacteria from different sources in bio-activating of composting process

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Cellulolytic bacteria have a bio-activating role in the composting process. A study was carried out to isolate and identify cellulolytic bacteria from various sources. The isolates were cultured in the carboxymethyl cellulose(CMC) agar medium and incubated at 30°C for 3–7 days. Based on morphological characteristics of the isolates, maximum diameter of a clear zone around the colony and maximum cellulolytic activity, eight isolate were selected for further studies regarding composting experiments. Molecular tests based on PCR amplification and sequencing of 16S rRNA gene of isolates showed the closest phylogenetic similarity with the species of Stenotrophomonas rhizophila DSM14405 (99.8%), Brevibacterium halotolerans DSM8802 (99.6%), Achromobacter marplatensis B2 (99.8%), Bacillus methylotrophicus CBMB205 (100%), Pseudomonas azotoformans IAM 1603 (99.7%), Bacillus sonorensis NBRC 101234 (99.8%),Bacillus subtilis KCTC 13429 (100%) and Ochrobactrum thiophenivorans DSM 7216 (99.3%). The study of the isolates impact on the composting of palm wastes in a randomized complete block design with 11 treatments in 3 replications showed that strain IB (B. methylotrophicus) caused a significant decrease in C:N ratio (58%). The increasing of microbial respiration compared with control after 30 days incubation at 37°C showed that the B. methylotrophicus strain IB with cellulolytic characteristics can be applied to hydrolysis of cellulosic biomass in the composting processes.

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Investigation of solutions of cleaner production in paper making industry, case of the study, latif paper making industry

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The aim of this paper is to determine the solutions affecting water and energy consumption as well as environmental impact in a recycled paper manufacturing by using Analytic Hierarchy Process. The AHP enables one to consider all the elements of decision process in a model, and to compare criteria and sub criteria of the model to find the best alternative. Using a literature review and field study, the proposed model can provide a framework for cleaner production implementation in the industry. The results show that process change gives the highest priority between five main criteria and that industrial automation and its technology level gives the highest priority among sub-criteria. Regarding the alternatives, reduction of environmental pollutions is the most important solution for cleaner production in the industry . Also, product correction is the most sensitive criterion affecting the alternatives. The paper illustrates how the AHP method can help industrial management to overcome the energy usage and environmental impact in the manufacture.

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Exploring new horizons and sustainable technologies for recycling and waste management

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The intricate relationship between recycling and waste management is explored afresh and the clean technologies to propel these fundamentally important strategies forward, and render them sustainable, are introduced and given a new impetus. Despite the global strive towards a "zero waste" economy, the potential of many types of wastes as a valuable resource has yet to be fully realized but they will be addressed in this work. For examples, the reusing of waste heat to raise the temperature of process streams in a factory if need be; the use of gaseous carbon dioxide to be a raw material in commercial manufacturing; the extraction of useful metals from aqueous effluents into a form which can be fed into ore smelters and the related deliberations in the choice of treatment agents; refuse to fuel; and the redeployment of a country's stock of plutonium to produce electricity in civil nuclear power plants are all topics of dicscussion. The good management of reprocessing facilities is intrinsic to their success and salient features of plant operations are highlighted. Moreover, to mitigate or eliminate their carbon-footprint, their powering by renewable energy resources are encouraged. Traditionally, policies that guide environmental chemical engineering centre on technical feasibility, cost-benefit-risk analysis and ecological impact, all built upon the implicit bedrock of deontological ethics expressed explicitly under the glossy title "Duty of Care". Nonetheless, the advocation of recycling and improvements in waste management should not stop here. The authors envisage that a new dawn will witness an innovative pedagogy in an educational curriculum which encompasses the universal concept of "loss prevention" of energy and materials, environomics and a paradigm shift in industrial manufacturing methodologies which are known to cause prolonged depreciation of the health, functionality and aesthetics of this planet.

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Energy saving potential associated with recovering the waste heat of industrial plants in oman

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The power demand is facing a rapid increase and is starting to create a burden on Oman due to its unrenewable main sources of energy. Oman power production is mainly dependent on crude oil and natural gas (NG), while there is no much power produced by renewable sources as of yet. Waste heat recovery nowadays is considered to be an economic method to increase the overall efficiency of industrial plants and, thus, to lower fuel demand. The current study amid at evaluating the energy saving potential associated with recovering the waste heat by means of an Organic Rankine Cycle (ORC) in four industrial plants in Oman. Based on the average cooling water temperature and optimum dimensionless mass flow rate the maximum energy saving potential has been achieved at Al Ghubra Power & Desalination. In terms of fuel consumption's this equals to i) saving in crude oil consumption by 70.03 liters/day, and ii) saving in NG consumption by 68.56 m3/ day. Furthermore, the cost for the fuel purchased by the plant can be reduced down to 6.400/day Omani Rial (OR) (crude oil) and 1.600/ day OR (NG). In addition, the cost of the power consumed in the plant would be decreased by 13.00 OR/day. The lower energy savings potential occurred at Areej Vegetable Oils & Derivatives. It has been concluded that the ORC technology seems to be a practical solution for converting waste heat into power in Oman for industries of high values of waste heat temperature and flow rate.

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