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Friday O. Ochedi, Yangxian Liu, Yusuf G. Adewuyi. *State-of-the-art review on capture of CO2 using adsorbents prepared from waste materials*. Pages 1-25.

As a result of energy-related anthropogenic emissions to the atmosphere, greenhouse gases (GHG) like CO2 observed to be the most abundant continue to accumulate in the atmosphere at an alarming rate, with concomitant rise in its environmental impact; and hence, spurring research in technologies to mitigate climate change. This comprehensive review provides the state-of-the-art of CO2 capture using adsorbents prepared from various waste materials, which are categorized on the basis of their generation processes such as pyrolysis, combustion, smelting, and petroleum-related upgrading. These include biomass waste, sludge, polymer wastes, by-product of fuel and waste combustion processes such as fly ash and other biomass-based ashes, and byproducts of smelting and petroleum processes such as red mud, steel and iron slag, carbide slag, and petroleum and coal residues. In general, biomass waste derived adsorbents (up to 21mmol/g and 3900 m2/g), and petroleum and coal-based sorbents (160–900mg/g and 850 to 3800 m2/g) exhibited the highest CO2 adsorption capacities and the highest surface areas. The technological and economic feasibilities of these waste-derived sorbents for the simultaneous removal of multicomponent pollutants (SOx, NOx, Hg and CO2) need to be further assessed in future studies, focusing on the development of more resistant and kinetically stable adsorbents using adsorption capacity, temperature and pressure as a design metrics; and techno-economic and life-cycle assessments to aid in the scale-up of adsorbents with outstanding laboratory-scale performances to industrial applications.

- **Keywords:** Carbon dioxide; Carbon capture; Adsorbent; Waste materials; Post-combustion capture; Greenhouse gases

Zengguo Dou, Ligang Zheng, Kai Zheng, Rongkun Pan, Wen Yang, Yuanpeng Fu. *Effect of film thickness and methane fraction on explosion characteristics of biogas/air mixture in a duct*. Pages 26-35.

In order to evaluate the explosion characteristics of biogas (i.e., the mixture of CH4 and CO2), experiments were conducted in a duct with a length-to-width ratio of 10. The ignition was activated at the closed end while the opposite end was sealed by a PVC film of varying thickness. The effect of PVC film thickness and methane fraction in biogas was studied. The results show that there were three possible pressure peaks (Pb, Pmfa, Pext), due to the film failure, the attainment of maximum flame area and the external

explosion, respectively. The pressure profile pattern was dependent on the combination of film thickness and methane fraction. Two pressure peaks Pb and Pmfa were observed for the PVC film thickness δ ≤ 0.033 mm. However, the pressure peak Pmfa was absent for the film thickness δ ≥ 0.055 mm because the PVC film did not rupture in these cases when the flame had touched the sidewall. In other words, the maximum flame area was achieved prior to the moment of venting. It signifies that in the absence of explosion venting, the flame quenching due to the sidewalls alone was insufficient to induce an individual pressure peak Pmfa. The third pressure peak Pext was low for the biogas explosion in the current configuration. The film thickness exerted a greater impact on bursting pressure Pb than did the methane fraction, at least for the range of film thicknesses and methane concentrations considered. Additionally, the individual effect of the film thickness or the methane fraction was less influenced by each other. The existing theories were accurate to predict the characteristic times of the flame propagation for δ = 0.011 mm but not for δ ≥ 0.033 mm. The PVC film thickness affected the explosion overpressure more, whereas the CH4 fraction in biogas affected the flame front velocity more remarkably.

- **Keywords:** Flame propagation; Tulip flame; Bursting pressure; Explosion venting

Michel Keisuke Sato, Herdjania Veras de Lima, Aline Noronha Costa, Sueli Rodrigues, Sacha J. Mooney, Michèle Clarke, Augusto José Silva Pedroso, Claudia Maria Branco de Freitas Maia. *Biochar as a sustainable alternative to açaí waste disposal in Amazon, Brazil*. Pages 36-46.

The açaí palm (Euterpe oleracea Mart) is native to the floodplains of central and South America and is cultivated in Brazil for its berries, which are considered to be a 'superfood'. The waste açaí fiber and seeds obtained after fruit processing pose a challenge since they remain unutilised despite being an abundant waste by-product of açaí processing.This leads to a build-up of waste, regular dumping and environmental management challenges. Here we examine the potential use of açaí seed biochar as a soil conditioner. The biochar was produced from waste seeds in a handmade kiln, incorporated into two soils of different textures and then compacted in volumetric rings with a hydraulic press. The samples were kept in a greenhouse for a 270-day incubation period. After this, the samples were evaluated for their soil physical and chemical attributes. Nine months after the application of the açaí seed biochar, soil physical properties were not affected, except for the soil aggregate size distribution, for which the highest dosage resulted in a larger weighted average diameter. However, biochar increased phosphorus, potassium and magnesium contents, and reduced the aluminum content, which was reflected in an increase of the base saturation and a reduction in aluminum saturation. Therefore, within a relatively short time period, the biochar was found to improve soil chemical quality more so than soil physical properties, thus offering potential as a sustainable solution to manage açaí waste in the Amazon region.

- **Keywords:** Biochar; Euterpe oleracea Mart.; Soil physical properties; Soil Fertility

Larissa Renata Santos Andrade, Ianny Andrade Cruz, Luciano de Melo, Débora da Silva Vilar, Lucas Tadeu Fuess, Gabriel Reis e Silva, Victor Matheus Silva Manhães, Nádia Hortense Torres, Renato Nery Soriano, Ram Naresh Bharagava, Luiz Fernando Romanholo Ferreira, Renan Tavares Figueiredo. *Oyster shell-based alkalinization and photocatalytic removal of cyanide as low-cost stabilization approaches for enhanced biogas production from cassava starch wastewater*. Pages 47-59.

Cassava starch wastewater (CSW) poses a high polluting potential due to its high organic loading and cyanide (CN−) concentration, but this residue can be pretreated and reused. The present work proposes stabilizing the CSW pH and degrading CN- to optimize biogas

production. To control the acidity of the CSW we used natural oyster shells as source of CaCO3, and the photocatalytic degradation of CN− was achieved with Degussa P25 TiO2. Natural oyster shells raised pH from 4.5 to 6.2 over 6 h of reaction, efficiently controlling the effluent acidity. After pH stabilization, the TiO2 photocatalyst tested in a degradation process under visible light was able to reduce CN− concentration by 73.02 %. After these pretreatments (pH stabilization and CN- degradation), the CSW was inoculated with sewage sludge (SS) to produce biogas. The pretreatments were proved to be efficient at favoring biogas production as this was heightened by 27.6 %. In addition, the pretreated CSW and digestate (anaerobic digestion) significantly reduced the toxicity of the effluent, assessed by investigating lettuce seeds (L. sativa) germination and root growth. Thus, pretreatments and reuse of residues may potentially provide socio-environmental and economic benefits.

- **Keywords:** pH stabilization; Shell recycling; Calcium carbonate; Cyanide; Photocatalysis; Anaerobic biodigestion

Fabricio Motteran, Dagoberto Yukio Okada, Tiago Palladino Delforno, Maria Bernadete Amancio Varesche. *Influence of cosubstrates for linear anionic sulfonated alkylbenzene degradation and methane production in anaerobic batch reactors*. Pages 60-68.

This study evaluated the influence of cosubstrates, acetate, formate, and fumarate on the anionic surfactant degradation (linear alkylbenzene sulfonated - LAS), using anaerobic batch reactors at 30 °C, 50 rpm at 25.8 ± 0.2 mgLAS/L. Cosubstrates were tested separately for LAS degradation and methane production. Organic matter removal efficiency were 23 ± 1.2 %, 65 ± 2.8 %, 60 ± 5.6 %, 59 ± 0.8 % and 75 ± 2.7 %, for control without LAS (67 ± 11.9 mg/L), control with LAS (129 ± 27.2 mg/L), reactors with acetate (172 ± 19.8 mg/L), formate (126 ± 13.7 mg/L) and fumarate (332 ± 16.3 mg/L). Methane production for the experimental series was 0.072 ± 0.002 μmol, 0.6 ± 0.07 μmol, 1.69 ± 0.11 μmol, 1.51 ± 0.15 μmol and 2.18 ± 0.24 μmol in control reactors in the absence and presence of LAS and with the acetate, formate and fumarate, respectively. Under the nutritional conditions with cosubstrates, there was a higher LAS degradation in both dissolved and adsorbed fraction in anaerobic biomass. These cosubstrates can directly assist the metabolic pathways of microorganisms for energy generation and toxic removal. Among the cosubstrates tested, fumarate favored greater LAS degradation reaching a removal efficiency of 98.3 ± 0.8 % for 26 ± 1.13 mg/L of surfactant and also provided higher methane production in anaerobic batch systems.

- **Keywords:** Anionic surfactant; Acetate; Formate; Fumarate; Methanogenesis; Recalcitrant compound degradation

José Luiz Francisco Alves, Valdemar Francisco da Silva Filho, Ricardo Antonio Francisco Machado, Cintia Marangoni. *Ethanol enrichment from an aqueous stream using an innovative multi-tube falling film distillation column equipped with a biphasic thermosiphon*. Pages 69-75.

This paper aims to offer a new compact, safer, less energy-intensive technological alternative for ethanol-water separation, based on the intensified multi-tube falling film distillation technology. A pilot-scale investigation (with a processing capacity close to 250 kg h−1) proved the practical feasibility of a multi-tube falling film distillation column coupled with a biphasic thermosiphon for the distillation of ethanol and water in obtaining concentrated ethanol (64 wt.% - acceptable for medical applications) from aqueous ethanol (12 wt.%). Notable findings were achieved by using the intensified multi-tube falling film distillation to produce hydrated ethanol with adequate ethanol recovery (~ 50 %), acceptable energy savings (~ 15 %) and significant space savings (~ 63 %) as compared with a conventional tray column, thus justifying its relevance for sugarcane

ethanol distilleries. Finally, new research prospects for further improving the separation efficiency of this novel distillation concept are also mentioned in this study, purporting to make such novel intensified distillation process more competitive with conventional distillation columns in the future.

- **Keywords:** Falling film distillation; Process intensification; Ethanol distillation; Reduced dimensions; Energy savings

Wen-Jun Liang, Di Liu, Si-Da Ren, Qing-Lei Li. *Comparison of experimental and simulation results for optimization of a catalytic reactor for volatile organic compound abatement.* Pages 76-88.

In order to address the uneven flow velocity of catalytic reactors and to solve problems such as wear and soaring temperatures in catalysts, a three-dimensional mathematical model of a catalytic reactor was established. A comparison of the physical model and the simulation results revealed that the experimental results were a good fit to the mathematic model. The optimization results revealed the following: advantageous placement of the catalyst was 12.5–17.5 mm from the optimization site; the cross plate + porous plate was preferential; and the area-weighted uniformity index reached 0.93. When the catalyst was placed 25–30 mm from the optimization site, the cross plate + strip plate + hole or cross + grid + plate was preferential and the area-weighted uniformity index reached 0.93.

- **Keywords:** CFD simulation; Structure optimization; Model validation; Catalytic reactor

Jinlong Zhao, Jianping Zhang, Changkun Chen, Hong Huang, Rui Yang. *Experimental investigation on the burning behaviors of thin-layer transformer oil on a water layer*. Pages 89-97.

This paper examines experimentally the burning behaviors of thin-layer transformer oil on a water layer. A series of transformer oil pool fire experiments with different initial fuel thicknesses was performed. The burning process, burning rate, liquid temperature and radiative heat flux were measured. The experimental results show that the whole process can be divided into five typical phases: (1) rapid growth burning, (2) steady burning, (3) short boilover burning, (4) continuous boilover and (5) fire decay. The appearance of the middle three phases (2-4) depends on initial fuel thickness. The steady burning rate is found to be independent of the fuel thickness but slightly higher than that of burning without a water layer, because of the decrease in the boiling point of the fuel-water mixture. A critical fuel thickness was found to determine whether continuous boilover or short boilover will occur. The results also show the intensity of the initial boilover increases with increasing fuel thickness but the intensity of subsequent boilover of thin-layer burning can surpass that of thick-layer burning for some cases. A linear correlation was found between the time to boilover and fuel initial thickness in agreement with literature findings. The present results are of practical importance in situ-burning and thermal hazard analysis for fire accidents due to leakage of liquid fuels on water.

- **Keywords:** thin-layer burning; boilover intensity; burning rate; critical thickness

Fariba Abbasi, Hasan Pasalari, Juana Maria Delgado-Saborit, Ata Rafiee, Alireza Abbasi, Mohammad Hoseini. *Characterization and risk assessment of BTEX in ambient air of a Middle Eastern City*. Pages 98-105.

The present study aimed to assess BTEX (benzene, toluene, ethylbenzene, and xylenes) concentrations, their sources and health risk estimates in Shiraz, the fifth-most populous city in Iran. Air samples were collected from 19 sampling stations across Shiraz using passive samplers. Identification and quantification of BTEX were conducted by a Gas Chromatography–Mass Spectrometry (GC–MS). Spatial distribution of BTEX compounds were mapped by inverse distance weighting (IDW) procedure. Monte Carlo simulation was employed to assess the corresponding carcinogenic and non-carcinogenic risks of BTEX concentrations. BTEX concentrations were higher than current levels in Western countries but lower than concentrations measured in East Asia. Analysis of individual BTEX ratios and their strong correlation indicated that fresh traffic emissions were the main contributor to these compounds in Shiraz, with additional sources contributing to toluene (e.g. industrial solvent use) and benzene (e.g. evaporative emissions). The incremental lifetime cancer risk (ILCR) for benzene and ethylbenzene were estimated to be 6.49 × 10−7- 1.27 × 10-5 and 1.21 × 10−7- 2.37 × 10-6, respectively, exceeding the WHO and EPA recommendations. The current evaluation of BTEX sources and associated health risks will assist policymakers to define action plans to minimize BTEX exposure in Shiraz and similar cities in the Middle East.

- **Keywords:** BTEX; Air quality; Diffusive sampler; Spatial distribution; Source identification; Risk assessment

Wang Zhan, Zhaozhan Gu, Juncheng Jiang, Le Chen. *Influences of surface area of graphene on fire protection of waterborne intumescent fire resistive coating*. Pages 106-113.

In this study, three kinds of graphene were used as fire retardant fillers to improve the properties of waterborne intumescent fire resistive coatings. The surface area of graphene was measured by nitrogen adsorption-desorption method. The influences of surface area of graphene on fire resistance, thermal stability, smoke suppression and water resistance of the coatings were studied. SEM, FTIR, XRD and XPS were used to investigated the structure and composition of the inorganic expansion layer. The spectra of FTIR and XRD demonstrated the inorganic expansion layer had the same chemical composition. The XPS result proved that graphene could enhance anti-oxidation of the inorganic expansion layer. The SEM images showed that the number of holes and cracks decreased with the addition of graphene. The results demonstrated that the graphene with surface area of 212 m2/g significantly enhanced the fire resistance, thermal stability, smoke suppression, water resistance of the fire resistive coatings effectively.

- **Keywords:** Surface area; Graphene; Fire resistive; Intumescent coating

R.S. Chakrovorty, Rupesh Roy, H.M. Forhad, Robiul Alam, Muhammad Ali Zinnah, Mohammad Moniruzzaman, Badhan Saha. *Modification of conventional rice parboiling boiler to enhance efficiency and achieve sustainability in the rice parboiling industries of Bangladesh*. Pages 114-123.

South Asia is said to be the home of parboiled rice as it produces and consumes over 90 percent of the world's parboiled rice. Bangladesh, one of the world's top rice-consuming countries, has a large number of rice parboiling industries. Local rice parboiling industries, known as 'Chatal mills', are responsible for huge energy consumption in the rice processing sector because rice parboiling step ingests 95% of total energy and water in local rice processing industries. However, these local rice parboiling industries use an ancient parboiling system with low efficiency and little safeguards against mishaps. In most of the local rice parboiling industries, the parboiling step has an efficiency of around 15-20%, which results in enormous harmful emissions, huge wastage of energy and high cost of operation. In this study, a safer and more efficient rice parboiling boiler (improved

boiler) has been designed as well as trialed successfully in a local rice parboiling factory. Water and energy requirement is significantly less in the improved boiler compared to the conventional ones. The improved boiler saves fuel and water up to 43% and 38% respectively compared to the traditional boiler. The increasing energy efficiency subsequently reduces the stack emission such as the particular matter (PM) by 24.8%, carbon monoxide (CO) by 71.0% and sulfur dioxide (SO2) by 44.7%. Moreover, adopting the improved boiler also could save up to 705,600 Ton of greenhouse gas (CO2 equivalent) each year in Bangladesh. Hence, improved fuel economy and eco-friendliness of the improved boiler make it a sustainable choice for local rice parboiling industry.

- **Keywords:** Cleaner Production; Energy efficiency; Fuel saving; Water saving; GHG saving; Rice parboiling boiler

Jiafeng Ouyang, Zhirong Liu, Lu Zhang, Yun Wang, Limin Zhou. *Analysis of influencing factors of heavy metals pollution in farmland-rice system around a uranium tailings dam*. Pages 124-132.

Due to the limitation of special regions, few studies have combined the environmental pollution around uranium tailings dams and heavy metal pollution in farmland. The study aimed to analyze the pollution status and causes of U, Cd, Cr, Pb, Cu, Zn, As, and Hg in the farmland-rice system around a uranium tailings dam. It was found that Cr, Pb, Cu, and Zn exceeded the standards. The principal component analysis method was used to determine that there were three sources of heavy metals in the region: road transportation, human intervention, and natural background. The results of chemical speciation analysis showed that the pollution of Pb, Cu, and Zn needed to be vigilant. pH and SOM had a greater impact on them. A regression model was established to investigate the cause of heavy metal accumulation in rice, and it was found that various parts of rice were greatly affected by pH. The main reason for the current status of the study area was not the pollution input of the uranium tailings dam itself, but human activities. Improving the local soil acidity was of great significance for controlling local pollution problems and protecting residents' health.

- **Keywords:** Uranium tailings dam; Farmland-rice system; Speciation analysis; Space distribution; Pollution source analysis

Binbin Mao, Haodong Chen, Lin Jiang, Chunpeng Zhao, Jinhua Sun, Qingsong Wang*. Refined study on lithium ion battery combustion in open space and a combustion chambre*. Pages 133-146.

More refined combustion tests on 18,650-type lithium ion batteries (LIBs) are conducted both in open space (OS test) and a combustion chamber (CC test). High-speed camera is used to capture the fast rupture and ignition of LIB. In OS tests, jet-flame height increases with the state of charge (SOC), ranging from 0.095 to 0.217m for 70–100% SOC cell. The ejecting velocity of fragments reaches 30m s−1. In CC tests, the electrolyte solvent and flammable gas products are ignited by the ignition rods leading to deflagration and more complete combustion than that in open space. The predicted mass loss ratio of LIB is 14.36% agreeing with experiments. As SOC increases, more lithium metal is available in anode to react with electrolyte to generate more flammable gases. Higher SOC leads to higher specific combustion heat of the mixed gas products, thus increases the severity of thermal runaway and combustion. The total heat release of a LIB fire can be predicted by adding the contribution of all organics' combustion heats based on thermodynamic data.

- **Keywords:** Lithium ion battery safety; Jet flame; Flame height; Combustion chamber; Heat release rate

Mimi Zhou, Wei Jiang, Weidong Gao, Baohua Zhou, Xianchun Liao. *A high spatiotemporal resolution anthropogenic VOC emission inventory for Qingdao City in 2016 and its ozone formation potential analysis*. Pages 147-160.

Accurate and gridded emission inventories are crucial for better air quality modeling and air pollution policy making. As the economic center of the Shandong province and part of the first batch of open coastal cities in China, Qingdao has been frequently plagued by volatile organic compound (VOC) pollution along with its rapid economic development and urbanization in recent years. In this study, a high spatiotemporal resolution VOC emission inventory for Qingdao was established for the year 2016 using updated source-specific emission factors and the latest activity data for different sources. The anthropogenic sources considered in this study are classified into seven major sources and 46 subcategories. The results indicated that a total of 151.5 kt of VOCs were emitted in Qingdao in 2016. The three largest emission sources, industrial process, on-road mobile, and solvent use sources accounted for 49.9% 20.1%, and 14.1% of the total VOC emissions, respectively. Spatially, the Huangdao District (57.9 kt), the Chengyang District (15.4 kt), and Pingdu City (15.1 kt) were the top three emitters of VOCs. The high concentration of VOCs was mainly distributed in the central areas of Qingdao city and the emissions distribution was highly consistent with its road network. The maximum monthly VOC emissions occurred in June (14.4 kt) and the minimum monthly VOC emissions occurred mainly in February (9.5 kt). The uncertainties in the emission inventory were quantified using a Monte Carlo simulation provided by the Oracle Crystal Ball software. There exist relatively high uncertainties in the on-road mobile (-84.79%, 252.07%), biomass burning (-65.38%, 134.77%) and industrial process (-36.08%, 133.62%) sources. For the complicated species and different reaction rates of ozone formation, the control of the amount of VOCs emitted and the highly reactive VOCs are equally important. Based on the emissions of individual VOC species and the corresponding maximum incremental reactivity (MIR), the ozone formation potential (OFP) profiles of Qingdao City were constructed. The results indicated that alkenes/alkynes and aromatics contributed the most to the OFP and that m/p-xylene, ethylene, propylene, formaldehyde, toluene, trans-2-butene, cis-2-butene, 1-butene, o-xylene, and 1-pentene were the top 10 individual VOC species contributing to the OFP. The contribution of industrial process and on-road mobile sources accounted for 37.5% and 24.5% of the total OFP in Qingdao City, respectively. Both the large VOC emission and OFP indicate that the focus of VOC emission control should be on industrial process and on-road mobile sources in Qingdao City.

- **Keywords:** VOC emission inventory; Spatial and temporal allocation; Ozone; formation potential; Qingdao City

Jianlu Zhu, Yixiang Zhang, Shengnan Liu, Youmei Peng, Yuxing Li. *Experimental research on natural gas leakage underwater and burning flame on the water surface*. Pages 161-170.

This paper presents an experimental investigation into the flow rate of natural gas released underwater from a pipe orifice and the associated combustion behavior on the water surface in an aerodynamic channel. A stainless-steel pipeline with a diameter of 25 mm was placed in a water tank of 1 m (height) ×0.5 m (width) ×0.5 m (length). Methane gas was released from a cylinder controlled by a flow meter and pressure gauge. Ten k-type thermocouples, fixed in two directions, were used to measure the temperature profile. The variation parameters of orifice diameter (1 mm, 3 mm, 5 mm), pressure range (0.02 to 0.55 MPa) and gas release depth (0.4 m, 0.6 m, and 0.8 m) were varied to study the flame geometry and temperature profile. A digital CCD camera and an infrared camera are employed to record the visible and temperature distribution, respectively. Results show that flame temperature decreases vertically; an initially high

temperature region in the core flame quickly decreases in the plume region. Flame oscillation behavior is due to gas diffusion and flame turbulence. The stability of a burning flame is dependent on an increase in leakage pressure and large orifice diameter; shallow water depths provide greater flame stability. A new correlation is proposed to characterize the flame height to diameter ratio and the dimensionless heat release rate Q*.

- **Keywords:** Natural gas; Leakage underwater; Flow rate; Flame geometry; Flame temperature

Sang Yeob Kim, Hector A. Garcia, Carlos M. Lopez-Vazquez, Chris Milligan, Aridai Herrera, Marin Matosic, Josip Curko, Damir Brdjanovic. *Oxygen transfer performance of a supersaturated oxygen aeration system (SDOX) evaluated at high biomass concentrations*. Pages 171-181.

Oxygen transfer in wastewater treatment is significantly influenced by the mixed liquor suspended solids (MLSS). The effect is more pronounced at MLSS concentrations higher than 20g L−1 when supplying air by conventional diffused aeration systems. The oxygen transfer performance of a supersaturated oxygenation technology (i.e., the supersaturated dissolved oxygen (SDOX) system) was evaluated in clean water and in activated sludge with MLSS concentrations from 4 to 40gL−1 as a promising technology for uncapping such limitation. The evaluation was carried out at the laboratory facilities of the faculty of food technology and biotechnology at the University of Zagreb. The sludge was collected from a full-scale conventional activated sludge (CAS) wastewater treatment plant (WWTP) operated at a solid retention time (SRT) of approximately 5 days. The evaluation was carried out using a laboratory-scale setup consisting of a bench-scale SDOX system (2.75L) supplying pure oxygen to a 5L biological reactor. The SDOX exhibited oxygen mass transfer rate coefficient (KLa) values (2.6h−1) in clean water lower than for fine bubble diffusers (11h−1). However, higher oxygen transfer rate (OTR) values and alpha factors (mass transfer ratio of process-water to clean-water) as a function of the MLSS concentration were observed. A standard oxygen transfer efficiency (SOTE) of approximately 100 % in clean water was reported. The SDOX technology can be presented as a promising alternative for supplying dissolved oxygen (DO) into mixed liquor solutions; particularly, at the high MLSS concentrations required by high-loaded membrane bioreactor (HL-MBR) systems and aerobic digesters.

- **Keywords:** Oxygen transfer; Mixed liquor suspended solids; Conventional diffused aeration; SDOX; Activated sludge; High-loaded membrane bioreactor

Zhiyang Zhang, Ruowen Zong, Changfa Tao, Jie Ren, Shouxiang Lu. *Experimental study on flame height of two oil tank fires under different lip heights and distances*. Pages 182-190.

The combustion behavior of two oil tank fires will be influenced by the interaction of their respective flames. This paper presents the experiments to investigate the evolution of the visible flame height of two oil tank fires under different diameters, lip heights and distances. The results show that when the tank spacing is small, the vortex structure plays an important role in the flame behavior showing an enhancement of the flame height. The flame height increases with the increase in lip height and reaches a local maximum value. The flame merging characteristic is influenced by the burner size and shape. A dimensionless model of the visible flame height of two oil tanks fire has been proposed, taking the tank diameter, lip height, and tank spacing into consideration. The correlation is validated using the experimental data.

- **Keywords:** Two oil tank fires; Lip height; Tank spacing; Flame height; Flame merging

Amir Aghaei, Shahrokh Shahhosseini, Mohammad Amin Sobati. *Regeneration of different extractive solvents for the oxidative desulfurization process: An experimental investigation*. Pages 191-200.

In this study, gasoil with sulfur content of 1550ppm was oxidized employing an ultrasound-assisted oxidative desulfurization system followed by an extraction stage. The results indicated that desulfurization efficiency of the oxidation stage was 20 %. Then, the oxidized gasoil was extracted by either DMF or acetonitrile or 50–50vol.% solution of DMF – acetonitrile or 50–50vol.% solution of DMF – n-propanol. Fresh DMF was found to be the best solvent in terms of desulfurization efficiency (92 %), though acetonitrile resulted in the best fuel recovery (95 %). In addition, 50–50vol.% solution of DMF – acetonitrile and 50–50vol.% solution of DMF – n-propanol showed better performance to extract the sulfur compounds compared to pure acetonitrile. Regeneration of the solvents was investigated in various aspects such as regeneration efficiency, solvent ability to extract the sulfone compounds by once, twice and three times regenerated solvents as well as in a multistage extraction procedure. The results indicated that acetonitrile had the highest regeneration efficiency (85 %) since its boiling point is not close to the boiling points of the sulfur containing compounds. In addition, the results showed the desulfurization efficiency of DMF, 50–50vol. % solution of DMF – acetonitrile, and 50–50vol.% solution of DMF – n-propanol decreased from 92 %, 84 %, and 83 % in the fresh solvents to 63 %, 78 %, and 75 %, respectively, after three times regeneration. However, the desulfurization efficiency of acetonitrile was almost constant even after three times regeneration. Desulfurization efficiency using the regenerated acetonitrile in a three stage extraction was almost equal to the fresh DMF in a single stage extraction. Finally, the oxidized gasoil, desulfurized gasoil, and separated sulfur compounds were studied in detail using FTIR. The FTIR spectra results indicated that ODS was successful in removing the heavy sulfur compounds such as thiophenes.

- **Keywords:** Oxidative desulfurization; Extraction; Regeneration; Distillation; FTIR; Sulfone

Hua Long, Xing-zhong Huang, Ya-jie Zheng, Ying-lin Peng, Han-bing He. *Purification of crude As2O3 recovered from antimony smelting arsenic-alkali residue*. Pages 201-209.

In this study, a combined process of acidic oxidation leaching and SO2 reduction was proposed to purify crude As2O3 recovered from antimony smelting arsenic-alkali residue. The effects of various process factors on crude As2O3 leaching were investigated based on the thermodynamic analysis. The results showed that the leaching efficiency of arsenic was 95.5% when crude As2O3 was leached with the mixed solution of H2SO4 and H2O2 under the conditions: the H2O2/As(III) molar ratio (n(H2O2): n(As(III))) of 0.93, leaching temperature of 75 ℃, leaching time of 90min and liquid-solid ratio of 4:1. The kinetic study of As(V) reduction with SO2 gas showed that the reduction process conformed to the first-order gas/liquid reaction kinetics, and was controlled by both diffusion and chemical reaction with an apparent activation energy of 16.69kJmol−1. Arsenic could be directly recovered in the form of As2O3 from leaching solution by SO2 reduction, and the obtained product reached the standard of As2O3-1 (GB 26721-2011) after further purification. The direct recovery of arsenic was 85.8% after twice purifications for crude As2O3. In addition, no arsenic-containing wastes were produced in the purification process. Overall, this process is efficient and clean for the purification of crude As2O3.

- **Keywords:** Crude As2O3; Purification; Oxidation leaching; SO2 reduction; High-purity As2O3

Yun Chul Woo, Young Soo Kim, Jeong Jun Lee, Youngkwon Choi, Han-Seung Kim. *Evaluation of the different integrated pre-treatment processes for the ceramic based microfiltration*. Pages 210-217.

In the present study, in order to enhance the performance of ceramic microfiltration (MF) water treatment process, several pre-treatment processes such as adsorption, coagulation, flocculation, and sedimentation were examined under harsh conditions (kaolin of 50 mg/L with a humic acid of 1000 mg/L). A jar-test of batch coagulation/flocculation (C/F) experiments showed that the optimum coagulant (A-PAC, 10.6 % as Al2O3) dosage was 5 mg/L. Moreover, batch adsorption experiments revealed that the powdered activated carbon dosage of 20 mg/L with stirring for 30 min was the optimum condition. When the ceramic MF process was operated at the flux of 5 m3/m2/d, the implication of integrated coagulation/flocculation/adsorption (C/F/A-Mem) could lead to a better improvement of the removal ratio (DOC, UV254, and turbidity) compared with other integrated procedures. In terms of the filtration resistances, the integrated pre-treatment and ceramic MF processes are mitigating fouling problems compared with the single ceramic MF process, which means that the single ceramic MF process was not effective to operate with a stable TMP and produce suitable water qualities of the permeate water. Based on the results, the integrated C/F/A followed by the ceramic MF process was the best approach to produce better qualities water with long-term stability.

- **Keywords:** Adsorption; Coagulation; Flocculation; Integrated pre-treatment; Ceramic based microfiltration

Shuqi Wang, Han Zhang, Haiyan Huang, Ran Xiao, Ronghua Li, Zengqiang Zhang. *Influence of temperature and residence time on characteristics of biochars derived from agricultural residues: A comprehensive evaluation*. Pages 218-229.

In this study, the influence of production conditions (i.e., pyrolysis temperature and residence time) on the fundamental properties and the nutritional traits of biochars derived from different feedstocks (corn stalk, rape straw, wheat stalk, and peanut shell) were investigated. The results showed that pyrolysis temperature was a critical parameter affecting biochar properties, whereas the influences of residence time and feedstock were comparatively weaker. Biochar properties, including the pH, ash content, electrical conductivity (EC), oxidation stability, and the ability to retain nutrients, were positively related with increasing temperature and prolonged residence time. However, the water-extractable organic matter and available nutrients were negatively related with temperature and residence time. There was a minimal release of NH4+-N, NO3−-N, and PO43−-P from the generated biochars, and their concentrations were reduced through carbonization. By comparison, the water-soluble K+ content steadily increased with pyrolysis. Generally, the biochars showed a limited capacity for sorbing PO43− and NO3−, although the removal efficiencies were enhanced by pyrolysis. By comparison, higher NH4+ removal was achieved by biochars, and particularly for biochars with a higher pH. These findings suggest that the application of agricultural residue-derived biochars might not provide plants with sufficient nutrients (except for K). Additionally, the biochars generated at 500°C for a duration of 1h demonstrated higher potential for carbon sequestration.

- **Keywords:** Biochars; Temperature; Residence time; Feedstock; Fertility; Sorption

Meina Han, Xiaoguang Duan, Guoliang Cao, Shishu Zhu, Shih-Hsin Ho. *Graphitic nitride-catalyzed advanced oxidation processes (AOPs) for landfill leachate treatment: A mini review*. Pages 230-240.

Landfill leachate poses significant risks to public health via the release of high-toxicity contaminants, including refractory organic compounds, ammonia-nitrogen compounds, and heavy metals. Significant efforts have been made to develop useful methods for leachate disposition and treatment. Advanced oxidation processes (AOPs) are one of the most promising methods, because they can rapidly degrade diverse pollutants and significantly improve the biodegradability of leachate. Graphitic carbon nitride (g-C3N4), a fascinating conjugated polymer, has become a hot topic in AOP research due to its metal-free benefits and high photosensitivity. Thus, combining AOPs with g-C3N4 achieves excellent degradation of refractory pollutants in leachate. Since the composition of leachate is complex in the practical conditions, the information reported by current studies of using g-C3N4 as a remediator is still incomplete and fragmented. Thus, in this review, the recent status of leachate treatment and approaches for its disposal has been summarized and some conclusions have been drawn. In addition, a brief introduction to g-C3N4 and its application in AOPs for leachate treatment have been critically discussed and with its future outlook assessed. Although the development of g-C3N4 in AOPs for leachate treatment is highly efficient and practical, comprehensive study about its application and technology expansion is urgently needed, based on the complex operating conditions. Perspectives on the treatment of leachate using g-C3N4-AOPs are also included. The information and perspectives provided in this review will provide guidance and novel understanding to accelerate the development of g-C3N4-based AOPs for leachate treatment.

- **Keywords:** Graphitic carbon nitride; Advanced oxidation processes; Leachate; Photocatalysis; Pollutant degradation

Estel Rueda, María Jesús García-Galán, Antonio Ortiz, Enrica Uggetti, Javier Carretero, Joan García, Rubén Díez-Montero. *Bioremediation of agricultural runoff and biopolymers production from cyanobacteria cultured in demonstrative full-scale photobioreactors*. Pages 241-250.

The present work evaluated polyhydroxybutyrate (PHB) and carbohydrates production by wastewater borne cyanobacteria at demonstrative-scale (three photobioreactors (PBR) of 11.7 m3 each), using agricultural runoff as feedstock. Agricultural runoff was fed to PBR1, which was devoted to cyanobacteria selection and biomass growth. In PBR2, inorganic carbon was added in a feast and famine regime to favour PHB-accumulating microorganisms. Finally, inorganic carbon was continuously added in PBR3 to boost PHB accumulation. A high removal efficiency of 95% and 99% for total nitrogen and phosphorus was obtained, respectively. Cyanobacteria were successfully selected and outcompeted green microalgae. Results suggested that a minimum inorganic carbon concentration was needed to accumulate PHB while carbohydrates were accumulated only with CO2 additions. Maximum concentrations of 4.5%VSS and 69%VSS for PHB and carbohydrates were obtained. Overall, this study shows at demonstrative-scale the potential of cyanobacteria to produce PHB within a wastewater biorefinery concept. And it gives insight on the strategies needed to produce PHB with cyanobacteria at massive scale.

- **Keywords:** Microalgae; PHB; Carbohydrates; Wastewater; Biorefinery; Feast-framine

Aitao Zhou, Meng Zhang, Kai Wang, Xiang Zhang, Tianfei Feng. *Quantitative study on gas dynamic characteristics of two-phase gas-solid flow in coal and gas outbursts*. Pages 251-261.

The dynamic effect of coal and gas outburst seriously threatens the safety of underground equipment and workers in mines. In this paper, the models for outbursts are established, and according to the energy transformation during gas expansion

process, three parameters of the release of gas pressure potential energy are defined and the gas dynamic characteristics of two-phase flow in the initiation stage are quantitatively studied under the four factors: initial gas pressure, particle volume fraction, particle size and outburst hole size. The gas dynamic characteristics in numerical simulations are verified by experiments. The results show that for the influence of the factors on the gas dynamic characteristics of two-phase flow, initial gas pressure >outburst hole size >particle volume fraction ≈particle size. The solid particles block the pressure potential energy release from chamber, so does the caliber. However, the maximum of pressure drop occurs when the caliber is 80% of the chamber, which explains the outbursts in mines are so violent due to the caliber smaller than the internal space. This paper provides a novel quantitative research method of gas dynamic characteristics of coal and gas outburst, which is of guiding significance to the design of outburst prevention facilities and emergency rescue measure.

- **Keywords:** coal and gas outburst; gas dynamic characteristics; pressure potential energy; energy release; quantitative study

Yi Lu, Yilun Liu, Shiliang Shi, Geoff G.X. Wang, He Li, Tao Wang. *Micro-particles stabilized aqueous foam for coal spontaneous combustion control and its flow characteristics*. Pages 262-272.

The goaf is the location where coal mines are most prone to coal spontaneous combustion, 60 % of the spontaneous combustion fire occur in the goaf. The coal has a greater crushing degree at the top of the goaf, where the heat accumulation is not easy to dissipate and mine fires are more likely to occur. In order to prevent coal spontaneous combustion in goaf efficiently and comprehensively, the uniform and dense micro-particles stabilized aqueous foams with the bubble diameter of 350–400 micrometers are prepared in batch mode using a home-made foam generating column with an internal hollow tube. The micro-particles can disperse well in surfactant diluents with the concentration of 0.25 wt.% and have strong wettability with the contact angle of 82.2°. Similar simulation experiments for flow characteristics indicated that the foam fluid does not appear to flow as low as ordinary cement paste, the diffusions in the Y direction and Z direction occur simultaneously, and the whole high fracture of loose gangue heap can be fully accumulated and seeped by foam fluid. Based on the micro-element force analysis of foam fluid in highly inclined fractures, the relationship equations between pressure difference, time, shear force and dynamic viscosity under different fracture dip angles and azimuth angles are derived and amended. The error was compared with the residual measurement points, and the error value is 0.05 %–9.72 %, indicating the amended fitting formula has universal applicability.

- **Keywords:** Coal spontaneous combustion; Micro-particles; Foam; Flow characteristics; High inclined fracture

K.Y.U. Vershinina, V.V. Dorokhov, D.S. Romanov, P.A. Strizhak. *Comparing the ignition parameters of promising coal fuels*. Pages 273-282.

Here we compare the ignition and burnout parameters of lignite, bituminous coal, and anthracite particles, as well as slurry droplets. We also study the fire hazard of traditional fossil fuels and promising fuel types (coal-water slurry, coal processing waste, and waste-derived slurry). The micro-explosion of multi-component droplets is considered in terms of safety at an energy enterprise, i.e., under the actual furnace conditions. Dimensionless integral fire hazard indexes of fuels are calculated and compared with those of lignite as the most reactive fuel. Coal processing wastes are found to be the safest. The relative fire hazard indexes of bituminous coal particles and coal-water slurry are comparable. Adding used turbine oil to the waste-derived fuel mixture makes it more

fire-hazardous. Finally, we explore the micro-explosive dispersion of waste-derived slurry droplets before and during combustion in terms of the risk of their spontaneous ignition.

- **Keywords:** Coal; Slurry fuel; Ignition; Micro-explosion; Fire hazard; Relative indexes

James R. Stewart. *CFD modelling of underexpanded hydrogen jets exiting rectangular shaped openings*. Pages 283-296.

Underexpanded jet releases from circular nozzles have been studied extensively both experimentally and numerically. However, jet releases from rectangular openings have received much less attention and information on their dispersion behaviour is not as widely available. In this paper, Computational Fluid Dynamics (CFD) is used to assess the suitability of using a pseudo-source approach to model jet releases from rectangular openings. A comparative study is performed to evaluate the effect of nozzle shape on jet structure and dispersion characteristics for underexpanded hydrogen jet releases. Jet releases issuing from a circular nozzle and rectangular nozzles with aspect ratios ranging from two to eight are modelled, including resolution of the near-field behaviour. The experimental work of Ruggles and Ekoto (2012, 2014) is used as a basis for validating the modelling approach used and an additional case study, in which jets with a stagnation-to-ambient pressure ratio of 300:1 are modelled, is also performed. The CFD results show that for the 10:1 pressure ratio release the hazard volume and hazard distance remain largely unaffected by nozzle shape. For the higher pressure release, the hazard volume is larger for the rectangular nozzle releases than the equivalent release through a circular orifice, though the distance to lower flammability limit is comparable across the range of nozzle shapes considered. For both of the release pressures simulated the CFD results illustrate that a pseudo-source approach produces conservative results for all nozzle shapes considered. This finding has useful practical implications for consequence analysis in industrial applications, such as the assessment of leaks from flanges and connections in pipework.

- **Keywords:** Underexpanded jet; CFD; Modelling; Pseudo-source; Hydrogen; Dispersion

Azam Jamsaz, Elaheh K. Goharshadi. *An environmentally friendly superhydrophobic modified polyurethane sponge by seashell for the efficient oil/water separation*. Pages 297-304.

Seeking eco-friendly, highly-efficient, low-cost, and robust adsorbents to remove oil from water resources are very much in demand. In this work, an environmentally friendly, recyclable, superhydrophobic, and superoleophilic seashell/epoxy resin/polyurethane (EP/SPU) sponge with contact angle of 174.10±0.47° was prepared. EP/SPU sponge demonstrated high adsorption capacity in the range of 28.03–42.17g/g times more than of its own weight for five oils and four organic solvents. The EP/SPU sponge was used 10 times for the adsorption of the oils and organic solvents with no significant loss in its adsorption capacity. The mechanical test suggested that the lightweight EP/SPU sponge is not compressible compared with neat polyurethane (PU) sponge. The volume of neat PU sponge decreased from 2.28 to 1.14 cm3 while the EP/SPU sponge volume (2.28cm3) did not change. As a result, EP/SPU sponge is expected to be a promising sorbent for potential applications in the cleanup of oil spills from water.

- **Keywords:** Oil/water separation; Seashell; Epoxy resin; Polyurethane sponge

Lin Li, Tao Jiang, Bojian Chen, Mi Zhou, Chao Chen. *Overall utilization of vanadium–titanium magnetite tailings to prepare lightweight foam ceramics*. Pages 305-314.

Vanadium–titanium magnetite tailings (VTMT) are a common industrial waste in China, which are harmful to the environment and economic development. The efficient utilization of this industrial waste is urgently needed. Herein, foam ceramics were successfully prepared as partition materials using VTMT as the main raw material. In this work, the effects of VTMT and SiC content on the properties and microstructure of foam ceramics were investigated. Properties like rate of linear expansion, bulk density, water absorption and average pore size were analyzed. Furthermore, the foaming mechanism was further explained. Results showed that the rate of linear expansion of the samples first increased from 35.0% to 53.3% and then decreased with increasing VTMT content. Bulk density decreased, and the average pore size gradually increased from approximately 0.86mm to 2.56mm with increasing SiC content. Finally, the optimum foam ceramics were formed with 55wt.% VTMT and 0.10wt.% SiC sintered at 1130°C. Such samples had a bulk density of 0.78g/cm3, a water absorption of 14.3%, and a uniform pore size distribution. More importantly, this potential recycling process shows benefits to the environmental management and sustainable development of enterprises.

- **Keywords:** Vanadium–titanium magnetite tailings; Foam ceramics; Formulation optimization; Environmental management; SiC

J.M. Soto, M.A. Martín-Lara, G. Blázquez, V. Godoy, L. Quesada, M. Calero. *Novel pre-treatment of dirty post-consumer polyethylene film for its mechanical recycling*. Pages 315-324.

The excessive consumption of plastic films in many applications due to their lightness and versatility and the low recycling rate of this type of material is a very significant matter that increases the problem of plastic film pollution. Plastic recycling has been a popular topic in conferences and technical journals during the past few years, but studies on the washing process are rarely published. Washing is an essential step in the mechanical recycling of these materials. This work provides an assessment on the feasibility of the washing procedure to clean post-consumer polyethylene film, presented in municipal solid waste, which had not been collected selectively, to increase mechanical recycling of post-consumer plastic films. Particularly, the study analyses (1) the characteristics of the washing water after cleaning procedure at room temperature, at 60 °C and at 60 °C with addition of NaOH chemical; (2) benefits of a drying stage before washing on the cleaning efficiency and characteristics of residual water and (3) benefits of physical or physical-chemical treatment of water by using a single step of settling or a two-step process that includes flocculation-coagulation and later settling, in the possibility of wastewater recycling for its use again in the washing process. Results showed very low differences between washing procedures at room temperature and at 60 °C. However, with the addition of NaOH chemical best cleaning was achieved although a more difficult wastewater treatment was found, due to high COD, BOD5, chlorides, nitrogen and phosphorous content. Results also showed that drying before washing significantly improved decontamination of post-consumer polyethylene film decreasing the consumption of fresh water and the requirement of depuration of it. Finally, the stage of physical-chemical treatment of wastewater by means of the use of coagulants and flocculants showed the possibility of increasing the reuse of water in the process for cleaning of plastic with relatively low cost.

- **Keywords:** Cleaning; Film; Polyethylene; Drying; Water reuse; Wastewater

Zhi Wang, Jian Wang. *A comprehensive study on the flame propagation of the horizontal laboratory wires and flame-retardant cables at different thermal circumstances*. Pages 325-333.

Experiments were performed to carefully characterize the influence of ambient temperature and incident heat flux on the horizontal flame spread over wires and cables. Results show that the flame spreads evenly along the wire, and the flame spread rate

slightly increases with the ambient temperature increasing with a maximum increase of 16 %. However, the change of the flame front position with time for the cable presents a piecewise linear function, and an accelerating process exists. As the incident heat flux increases, the flame spread rate increases significantly with a maximum increase of 110 % and 113 % for both single and double cable. There is no spreading flame over the cable below a lower limit of the incident heat flux. The fastest flame spread along the cable occurs when the incident heat flux causes the flame to extend to the end of the fuel instantly. Compared to the single cable, the flame spread rate of double cable is increased by 13.6%–16.2% due to the enhanced heat feedback by the flame interaction effect. The difference in flame spread behavior in this work may be ascribed to different physical configurations, chemical compositions, reaction mechanisms, and heat transfer mechanisms.

- **Keywords:** Laboratory wire; Flame retardant cable; Ambient temperature; Incident heat flux; Flame spread

Ye Chen, Yi Li, Ziting Li, Chao Ji, Xuanya Liu. *Experimental studies on external pressures during vented lean hydrogen deflagrations in a 27 m3 chamber*. Pages 334-340.

A series of experiments were carried out in a 27m3 cubic chamber with different vent areas to study the external pressure during vented lean hydrogen deflagrations. Uniform hydrogen-air mixtures with concentrations ranging from 15 % to 21 % and stratified mixtures with maximum concentrations equalled to average values of uniform mixtures were tested. Different layouts of obstructions were used in the experiments to achieve different volumetric blockage ratios. Experimental data from vented deflagration tests were presented, and the effect of hydrogen concentration, vent area, non-homogeneous mixtures and obstacles on the external pressure during vented deflagrations was investigated. The results show that the external explosion has an effective influence on the internal pressure by several ways. The external pressure increases with the hydrogen concentration inside the chamber, and the maximum external overpressure with back ignition is higher than that with center ignition. Larger vent area leads to a higher external pressure measured at the position far from the vent, but an opposite trend is found at the position close to the vent due to the higher velocity of jet flame corresponded to the smaller vent. As the volumetric blockage ratio increases, the external overpressure increases accordingly, and the difference in magnitude between back ignition and center ignition becomes more pronounced. However, for the non-homogenous hydrogen deflagration, whose external pressure is mainly governed by the maximum hydrogen concentration inside the chamber, only when the volumetric blockage ratio inside the chamber is large enough, the obstruction can have a significant influence on the external pressures, but its effect is much stronger for the homogenous deflagration.

- **Keywords:** Vented deflagration; External pressure; Hydrogen stratification; Obstruction

Almat Kabyl, Ming Yang, Rouzbeh Abbassi, Shihan Li. *A risk-based approach to produced water management in offshore oil and gas operations*. Pages 341-361.

Produced water is a waste of significant concern due to its high volume being produced every day and complex chemical composition. In order to meet environmental regulations and standards, different techniques can be used to treat produced water. This paper first summarizes produced water composition, its related environmental impact, regulations, and standards, as well as a possible combination of different treatment techniques. This paper aims to develop a generic framework for a risk-based approach to produced water management. The proposed methodology considers the integration of

environmental, technical, and economic risks in the decision-making process for produced water management. Environmental risk assessment is conducted by DREAM, Failure Mode and Effects Analysis is used to estimate technical risk, and cost-benefit analysis is performed to calculate economic risk. To integrate all the risk values, acceptable risk levels are set and compared to the calculated risk values. Experts assign weighting factors by using pair-wise comparison. The sum of the multiplied weighting factors to the ratio of calculated-acceptable risk values gives the final integrated risk. This framework can help to examine and select the most suitable treatment or reuse technique or identify potential areas for improvement in a specific site. The estimated risk can be used to justify the selection process. A case study on the produced water treatment in Thunder Horse Oil Field is presented to demonstrate the application of the proposed framework.

- **Keywords:** Produced Water; Risk Assessment; Risk-based Decision-Making; Water Treatment

M. Toledo, M.C. Gutiérrez, A. Peña, J.A. Siles, M.A. Martín. *Co-composting of chicken manure, alperujo, olive leaves/pruning and cereal straw at full-scale: Compost quality assessment and odour emission*. Pages 362-370.

Co-composting is a simple and inexpensive alternative for stabilizing and reducing jointly different biodegradable waste. In this study, the feasibility of co-composting chicken manure (CM), alperujo (AL), olive leaves/pruning (OL) and cereal straw (CS) was evaluated at full-scale. The different areas of a composting plant such as fermentation area, composting area and leachate lagoon, were evaluated from physico-chemical, respirometric and olfactometric points of view. The compostable mixture was previously subjected to anaerobic fermentative pretreatment to hydrolyse the non-easy biodegradable organic matter and favour the subsequent composting process. The physico-chemical, respirometric and olfactometric characterization of the composted mixture showed a high-quality final product characterized by a 57 % average organic matter content, an adequate metal content (Compost type A) and a suitable microbiological stability (SOURmax value of 14mmol O2/kg VSh), complying with current national legislation for use as fertilizer in agriculture. Furthermore, the average global odour emission rate of the composting plant was 5.16 ouE/kg, considering the total mass of the compostable mixture and the time required to be treated. Finally, the leachate collected from different treatments of the compostable mixture was found to be a stabilized organic liquid waste with a high nutrient content, useful for wetting composting piles.

- **Keywords:** Co-composting; Compost quality; Odour emission; Olfactometry; Physico-chemical characteristics; Respirometry

Juliano Souza dos Passos, Marianne Glasius, Patrick Biller. *Screening of common synthetic polymers for depolymerization by subcritical hydrothermal liquefaction*. Pages 371-379.

Hydrothermal liquefaction could potentially utilize mixed plastic wastes for sustainable biocrude production, however the fate of plastics under HTL is largely unexplored for the same reaction conditions. In this study, we evaluate how synthetic waste polymers can be depolymerized to bio-crude or platform chemicals using HTL at typical conditions expected in future commercial applications with and without alkali catalyst (potassium hydroxide). We evaluate different characteristics for HTL processing of poly-acrylonitrile-butadiene-styrene (ABS), Bisphenol-A Epoxy-resin, high-density polyethylene (HDPE), low density PE (LDPE), polyamide 6 (PA6), polyamide 66 (PA66), polyethylene terephthalate (PET), polycarbonate (PC), polypropylene (PP), polystyrene (PS) and

polyurethane (PUR) at 350 °C and 20 min residence time. Polyolefins and PS showed little depolymerization due to lack of reactive sites for hydrolysis. HTL of PC and Epoxy yielded predominantly bisphenol-A in oil fraction and phenols in aqueous phase. PA6 and PA66 yielded one of its monomers caprolactam and a range of platform chemicals in the aqueous phase. PET produces both original monomers. PUR yields a complex oil containing similar molecules to its monomers and longer hydrocarbons. Our results show how HTL can depolymerize several different synthetic polymers and highlights which of those are the most attractive or are unsuitable for subcritical processing.

- **Keywords:** Hydrothermal liquefaction; Chemical recycling; Depolymerization; Circular economy; Polymers; Plastic