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Fan Zhang, Mengmeng Chen, Xuewu Jia, Wei Xu, Ning Shi. *Research on the effect of resin on the thermal stability of hydrogen peroxide*. Pages 1-6.

Resin is widely used in hydrogen peroxide purification process, but it has a certain role in the decomposition of hydrogen peroxide. The effect of resin on decomposition characteristics of hydrogen peroxide was investigated in this study. Based on the Chinese national standard GB/T1616, hydrogen peroxide stability test was established, and the effect of resin on the stability of hydrogen peroxide was investigated. The thermal stability of hydrogen peroxide and the effect of resin on the samples were obtained by DSC calorimeter. The adiabatic simulation experiment was carried out by VSP2 calorimeter, and the thermal runaway reaction characteristics of hydrogen peroxide-resin system under adiabatic conditions were obtained. By fitting regression of the adiabatic calorimetric experimental data, the kinetic parameters of the experimental system were obtained, and the TMRad was calculated to be 5.9 h. The experimental results show that the stability of hydrogen peroxide decreases obviously with the addition of resin, and the uncontrolled decomposition of hydrogen peroxide easily occurs under adiabatic conditions, which has great potential safety hazards.

- **Keywords:** Hydrogen peroxide; Macroporous resin; Thermal stability

Senem Yazici Guvenc. *Optimization of COD removal from leachate nanofiltration concentrate using H2O2/Fe+2/heat – Activated persulfate oxidation processes*. Pages 7-17.

This study aimed to remove COD from leachate nanofiltration concentrate (LNFC) by oxidation of H2O2/Fe2+/Heat - activated persulfate (PS) and optimization and modelling of its removal using a Central Composite Design (CCD) by the Response Surface Methodology (RSM). In the results of ANOVA where the experimental data of the study were analyzed, high correlation coefficients ($R2 > 0.80$) were obtained from all three processes, and it was seen that models could be explained by these data. The COD removal efficiencies under the optimum conditions for the H2O2, Fe2+ and Heat - activated PS processes were 56.9%, 76.2% and 93.5%, respectively. About 64.3%, 78% and 93.2% removal efficiency values of inert COD were obtained after the H2O2-activated PS, Fe2+-activated PS and Heat-activated PS processes, respectively. Consequently, the heat-activated PS process may be an alternative technology for COD and inert COD removal from leachate nanofiltration concentrate.

- **Keywords:** Leachate nanofiltration concentrate; Persulfate oxidation; Response surface methodology; COD fractions

Xin Zhang, Mengjia Lu, Mohd Amzar Mohamed Idrus, Cameron Crombie, Veeriah Jegatheesan. *Performance of precipitation and electrocoagulation as pretreatment of silica removal in brackish water and seawater*. Pages 18-24.

Continuous increase in the world's population is posing serious threat to the fresh water reserves all over the world. Seawater desalination processes have been proven to be one of the most promising processes to supplement the increasing demand for fresh water, due to the limitless nature of seawater. One of the biggest problems related to the membrane desalination process is the fouling and scaling of reverse osmosis (RO) membrane. Among all the foulants, silica is considered to be one of the most difficult inorganic foulant to deal with in membrane desalination due to its chemical complexity. This study compares some of the most commonly used pretreatment techniques of silica removal, analyses the characteristics of dissolved silica in both brackish water and seawater bodies, along with silt density index (SDI) tests. It was found that silicate salts are difficult to be dissolved in brackish water and seawater, and the fouling propensity of membrane is not a function of silica concentration (from 15–200 mg/L) in the feed water. Also, Al3+ exhibited superior silica removal efficiency than Fe3+, and a removal efficiency of 90.2% was reported when using electrocoagulation on brackish water where the silica concentration was around 28 mg/L.

- **Keywords:** Desalination; Electrocoagulation; Membrane fouling; Precipitation; Pretreatment; Silica

Nashia Deepnarain, Mahmoud Nasr, Sheena Kumari, Thor A. Stenström, Poovendhree Reddy, Kriveshin Pillay, Faizal Bux. *Decision tree for identification and prediction of filamentous bulking at full-scale activated sludge wastewater treatment plant*. Pages 25-34.

This study attempted to model sludge bulking in a full-scale wastewater treatment plant operated as a 3-stage Phoredox process. Principal component analysis and a regression tree model were employed to describe the correlations between influent wastewater characteristics and operational conditions (as inputs) and sludge volume index (SVI) as an output. A classification tree model was used to determine the environmental factors that affected the proliferation of filamentous microorganisms. Fluorescent in situ hybridisation analysis identified filamentous species of Microthrix parvicella, Thiothrix I & II, and Eikelboom Types 0041, 0092, and 021 N. It was found that SVI increased with an increment in sludge retention time, but it negatively correlated with soluble chemical oxygen demand (sCOD) and ammonium-nitrogen. The dominance of Microthrix parvicella was observed with a decline in temperature below 15.5 °C, causing an increase in SVI during the winter and spring seasons. The overgrowth of Thiothrix could be linked to the unbalanced ratio between readily biodegradable COD and nutrient species. The filament Type 0092 contributed to high SVI, and it prevailed with a decrease in food-to-microorganisms ratio below 0.08 1/d. Based on the satisfactory training, validation, and generalization procedures, the proposed models could be applied for the prediction of sludge bulking episodes.

- **Keywords:** Classification and regression trees; Filamentous detection; Sludge volume index; Sludge bulking; Wastewater characteristics

Sikandar Azam, Devi Prasad Mishra. *Effects of particle size, dust concentration and dust-dispersion-air pressure on rock dust inertant*

***requirement for coal dust explosion suppression in underground coal mines*. Pages 35-43.**

Coal dust explosion constitutes an ever-present hazard in underground coal mines worldwide. This study examines the effects of important parameters, such as, dust particle size, dust concentration and dust-dispersion-air pressure on rock dust inertant requirement for suppressing coal dust explosion using a Godbert-Greenwald (GG) furnace. It also elucidates the underlying mechanism involved in the coal dust explosion and its propagation. The study revealed that the proportion of rock dust required to inert the coal dust explosion increases with the decrease in the coal dust size and increase in the rock dust size. The finest size coal dust (<38 μm) and the coarsest mine size coal dust (<850 μm) required 90% and 72% rock dust inertant respectively for suppressing the coal dust explosion. The optimal coal dust concentration that causes a violent explosion and requires maximum proportion of rock dust inertant for explosion suppression was determined to be 427 g/m3. The inertant requirement increased with the increase in dust-dispersion-air pressure up to 62 kPa.

- **Keywords:** Rock dust inertant; Coal dust explosion suppression; Particle size; Dust concentration; Dust-dispersion-air pressure

Jiaxi Jiang, David Inhyuk Kim, Pema Dorji, Sherub Phuntsho, Seungkwan Hong, Ho Kyong Shon. *Phosphorus removal mechanisms from domestic wastewater by membrane capacitive deionization and system optimization for enhanced phosphate removal*. Pages 44-52.

Membrane capacitive deionization (MCDI) is an emerging technology for effective removal of charged pollutants from the water sources including domestic wastewater. In this work, a lab-scale MCDI system was employed to investigate its feasibility for effective phosphorus removal from domestic wastewater. The effect of phosphate equilibrium reactions on the ion sorption behaviour was studied in sodium phosphate buffer solution at typical pH range maintained in a real domestic raw wastewater effluent (between 6.5 and 8.5). The results demonstrated that phosphate equilibrium system has positive impact on the degree of inorganic phosphorus (P) adsorption capacity in aqueous solution. In addition, the ion selectivity of P over other co-existing anions (Cl-, SO42-) were experimentally studied using a synthetic wastewater solution. And it was found that the preferential electrosorption sequence of the competitive anions is: Cl-> SO42- > P, while the initial ion concentration order in the synthetic feed solution is: Cl- 1.90 mM> P (0.40 mM) > SO42- (0.32 mM). The experiments with diverse operating conditions revealed that the optimal adsorption of inorganic phosphorus over chloride and sulphate can be achieved in some extent with slower flow rates and higher applied potentials (less than 1.23 V).

- **Keywords:** Membrane capacitive deionization; Phosphate removal; Phosphate equilibrium system; Electrosorption; Selectivity

Biplob Kumar Pramanik, Li Shu, Jega Jegatheesan, Kalpit Shah, Nawshad Haque, Muhammed A. Bhuiyan. *Rejection of rare earth elements from a simulated acid mine drainage using forward osmosis: The role of membrane orientation, solution pH, and temperature variation*. Pages 53-59.

The high demand for the rare earth elements (REEs) in the clean technological industries implies the increased demand to produce these elements from ores and REEs containing impaired water sources such as acid mine drainage (AMD). However, the presence of these elements in AMD has increased their toxic exposure to the water environment. Herein, we investigated the role of the orientation of the membrane (such as active layer

facing feed solution (AL-FS) or active layer facing draw solution (AL-DS) mode), solution pH, and temperature variation on the flux performance and rejection of three REEs (e.g., lanthanum, cerium, and dysprosium) from a simulated AMD solution using the forward osmosis (FO) process. It was found that there was a greater water flux at high pH, AL-DS mode of the FO system and high feed and draw solution temperature. FO could effectively reject all three REEs in both AL-FS and AL-DS membrane orientations mode due to steric hindrance. The rejection of these REEs in the AL-DS mode was slightly lower (82–88%) than that in the AL-FS mode (86–96%). The rejection of all REEs was noticeably influenced by solution pH in both mode. This was due to the changes in membrane surface with pH variation. The rejection of REEs increased when the temperature of the feed and draw solution was 20 and 40 °C, respectively. However, the rejection of all REEs decreased markedly when the temperature of the feed and draw solution was 40 and 20 °C, respectively. The lower rejection of these REEs was due to the enhancement of their diffusivity at a higher temperature in the feed side.

- **Keywords:** Acid mine drainage; Forward osmosis; Flux performance; Rare earth elements; Rejection

Sharf Ilahi Siddiqui, Mu. Naushad, Saif Ali Chaudhry. *Promising prospects of nanomaterials for arsenic water remediation: A comprehensive review*. Pages 60-97.

This review discusses the brief of health problem associated with the arsenic exposure found in drinking water. This review also discusses the shortcomings associated with the traditional methods, advantages with adsorption process and the new approaches towards the advance and effective techniques. The novelty of present study is a collection of latest literature and reports which comprises the latest advances made in the nanoparticles and nano-composites for the efficient removal of arsenic from aqueous medium. The mechanism of interaction of arsenic and nanomaterials surface is discussed in this novel review. The latest and novel approaches towards avoiding the preoxidation step for arsenite removal using oxidants is also highlighted, and the large numbers of nanomaterials having the photo catalytic properties and functionalities for simultaneous oxidation of arsenite to arsenate and adsorption of both forms, is also deliberated. No previous literatures have discussed the detail of oxidation of arsenite to arsenate using the nanomaterials having photocatalytic activities. Overall, this review highlights and provides an overview, advantages and features of the newly developed nanomaterials comprising virgin zero valent metallic nanoparticles, metal oxides, metal doped oxides, binary metal oxides, mixed metal oxides, functionalized metal oxides and organic-inorganic nanocomposites for arsenic removal. The comparative evaluation of cited nanomaterials and low-cost, and others micro/nano-sized adsorbent has also been also comprised. The disadvantages associated with the existing technology are deeply highlighted and future development and prospects have been discussed in depth. Therefore, this review article will definitely contribute a great role to the researches by developing the advanced materials to remove all shortcomings associated with the existing technologies.

- **Keywords:** Wastewater; Arsenic; Adsorption; Nanoparticles; Nanocomposites

Yan Tang, Shengnan Si, Xiaoxing Zhong. *Experimental investigation of the performance of an effective self-suctioning water mist generator for controlling underground coal fires*. Pages 98-105.

Coal fires represent a worldwide hazard, and water mist is used as an effective means in controlling the fires. In the present study a new self-suctioning water mist generator was developed that produces efficient atomization at a relatively low pressure without the need for compressed air and improving the applicability of water mist systems in coal fire areas. The effects of structural parameters of the generator and operational variable

(water supply pressure) on atomization performance were investigated. Both laboratory experiments and field tests were conducted to assess the fire suppression efficiency and cooling effects of this generator. The results show that the generator can attain a high degree of atomization after the optimization on the structural parameters and operational variable. The water mist produced by this device was also demonstrated to effectively suppress coal combustion. Compared with traditional water injection techniques, this new approach created more temperature decrease during a same period of application time while consuming an equal amount of water. This work therefore provides a practicable technique for the effective control of underground coal fires.

- **Keywords:** Coal fire; Water mist generator; Self-suctioning; Atomization; Fire control

N. Arul Manikandan, Kannan Pakshirajan, G. Pugazhenthi. *A novel ceramic membrane assembly for the separation of polyhydroxybutyrate (PHB) rich Ralstonia eutropha biomass from culture broth*. Pages 106-118.

This work investigated the separation of polyhydroxybutyrate (PHB) containing Ralstonia eutropha cells from the culture broth using a novel ceramic based tubular membrane assembly. The culture broth was fed into outer surface of the membrane (shell side) and permeate was drawn from the tube side. Further, the number of ceramic membranes in the assembly was raised from 1 to 4 and its performance was assessed by measuring the broth flux, biomass and PHB recovery as a function of applied pressure (49 kPa - 196 kPa). The present ceramic membrane is found to be highly efficient ($99.9 \pm 0.03\%$) in recovering the PHB from the culture broth. A maximum initial water flux of 444 L m^{-2} h^{-1} and a permeate broth flux of 52 L m^{-2} h^{-1} was observed at the maximum applied pressure (196 kPa) and with four number of ceramic membranes added to the membrane assembly. Both biomass and PHB recovery were observed to decrease with an increase in the applied pressure; on the contrary, a reduction in the applied pressure enhanced the biomass and PHB recovery, but at the cost of low broth flux. However, this relationship is overcome by increasing the number of membranes in the membrane assembly.

- **Keywords:** Ceramic membranes; Polyhydroxybutyrate; Ralstonia eutropha; Novel membrane assembly; Bioseparation

Mustapha Mohammed Bello, Abdul Aziz Abdul Raman, Anam Asghar. *A review on approaches for addressing the limitations of Fenton oxidation for recalcitrant wastewater treatment*. Pages 119-140.

Fenton oxidation is an effective technology for the degradation of recalcitrant organic pollutants. However, conventional Fenton oxidation possesses some drawbacks such as the requirement of acidic pH condition, production of iron sludge and requirement of high chemical inputs. Strategies such as heterogeneous Fenton, fluidized bed Fenton, use of chelating agents and in-situ production of Fenton's reagent have been studied as possible solutions to these limitations. Although there have been reviews on the fundamentals and applications of Fenton oxidation, a review with focus on the limitations of Fenton oxidation and their possible solutions is lacking. Here, we review the limitations of Fenton oxidation and the recent strategies toward addressing them. For each approach, fundamentals and applications in the removal of recalcitrant pollutants are reviewed. Heterogeneous Fenton process is the most widely investigated due to the progress in catalysis. Fluidized bed Fenton process could lower sludge generation and enhance process performance. Chelating agents are used to conduct homogeneous Fenton at circumneutral pH, though the potential detrimental effect of some chelating agents remains a source of concern. In situ production of Fenton's reagent through

bioelectrochemical technology (bioelectro-Fenton) is emerging as a possible strategy to reduce the cost associated with Fenton's reagent.

- **Keywords:** Advanced oxidation processes; Fenton oxidation; Fluidized-bed Fenton process; Heterogeneous Fenton process; Bioelectro-Fenton process; Electro-Fenton process

S.S. Makgato, R.M.S. Falcon, E.M.N. Chirwa. *The effect of recycling coke oven tar on environmental pollution, coke quality, personnel and process safety*. Pages 141-149.

Oven charging is an important operation stage in coke making process which is also where most of the coal dust is commonly generated. Coal dust is seen as a major hazard due to its tendency to ignite explosively causing coal losses, environmental pollution and plant equipment damages. In this study, the effect of recycling coke oven tar addition over a loading range of 2– 8 wt.% was evaluated as a probable partial substitute for expensive coking coals. Operation under an optimum coke oven tar loading of 6 wt.% resulted in a remarkable reduction of coal fines of 56.8%. By reducing coal fines, there is a considerable reduction in coal dust that personnel are exposed to and a reduction in acid mine drainage when storing the discarded coal fines as well as a decreased likelihood of spontaneous combustion. In addition, coal dust can cause pneumoconiosis and other health related conditions. Good coke qualities compared well to other international benchmarks were obtained. Vital factors for coking pressure such as maximum dilatation and maximum contraction increased within the acceptable range of <30 and < 20 respectively. High coking pressures cause operational problems such as stickers and heavy-pushes, which result in the deterioration of the brick lining of the coke oven walls. Therefore, it is desirable that coke oven tar increase coking pressure within the acceptable range so that the life span of the coke ovens is not shortened.

- **Keywords:** Coal dust; Oven charging; Coal fines; Coking pressure; Process safety

Taotao Zeng, Eldon R. Rene, Shiqi Zhang, Piet N.L. Lens. *Removal of selenate and cadmium by anaerobic granular sludge: EPS characterization and microbial community analysis*. Pages 150-159.

The main aim of this work was to evaluate the simultaneous removal of Se(VI) and Cd(II) by anaerobic granular sludge in batch tests. The anaerobic sludge completely removed 10 mg/L Se(VI) and 20 mM (1800 mg/L) lactate within 1.5 d of batch incubation. After 7 d of incubation, 90.7% and 87.7% of 5 mg/L Cd(II) were removed by the sludge in, respectively, the absence or presence of Se(VI). Compared to experiments with autoclaved biomass, Se(VI) and total Se removal 98% and 70 was mainly due to bioreduction instead of adsorption onto anaerobic granular sludge. The increase in the protein and polysaccharide content of the extracellular polymeric substances (EPS) contributed to the adsorption of total Se and Cd(II). The predominant bacterial composition of the samples from the different treatments was similar. However, the abundance of genera in the microbial community gradually changed over the treatment time depending on the Se and/or Cd exposure. Se, as an environmental factor, had a positive impact on the dominance of the Methanosaeta, Syntrophobacter and Methanobacterium genera, while Cd had a positive impact on the dominance of the Methanosaeta genus.

- **Keywords:** Selenate; Cadmium; Anaerobic granular sludge; Autoclaved biomass; Microbial community

Mohammad Rizwan Khan, Saikh Mohammad Wabaidur, Rosa Busquets, Moonis Ali Khan, Masoom Raza Siddiqui, Mohammad Azam.

***Identification of malachite green in industrial wastewater using lignocellulose biomass composite bio-sorbent and UPLC-MS/MS: a green environmental approach*. Pages 160-166.**

A method based on eco-friendly solid-phase extraction (SPE) and ultra-performance liquid chromatography/tandem mass spectrometry (UPLC-MS/MS) was validated for the trace analysis of malachite green (MG) in industrial wastewater samples. For the extraction of MG, a lignocellulose biomass composite material was prepared from moringa oleifera pods, which were modified with CuFe2O4, and used as solid phase extraction bio-sorbent. The chromatographic separation of MG was optimised using an Acquity® BEH C18 analytical column in isocratic separation conditions (65% water with formic acid (0.1%, v/v) and 35% methanol). The total separation time was <1 min with satisfactory resolution and symmetry. The proposed method offers suitable validation parameters in terms of linearity (r2 > 0.999), precision (run-to-run and day-to-day) <4%, and sensitivity with a limit of detection of 0.1 µg/L. The optimized method has been applied in the analysis of industrial wastewater samples (printing press, paper, textile and laundry), and the amounts obtained were in the range of 0.62 to 1.68 mg/L with recovery rates ranging from 99 to 103%. The achieved outcomes confirmed the applicability of the proposed analytical methodology as a novel advantageous approach for the routine analysis of MG in industrial effluents. In the future, this method could be comprehensively applied in the efficient removal of colored pollutants as well as for the quantification of the exposure to MG.

- **Keywords:** Malachite green; Moringa oleifera pods; Lignocellulose biomass composite; Wastewater; Solid phase extraction; Liquid chromatography-mass spectrometry

Paolo Mocellin, Chiara Vianello, Giuseppe Maschio. *A comprehensive multiphase CO2 release model for carbon sequestration QRA purposes. Modeling and conditions for simplifying assumptions and solid CO2 occurrence*. Pages 167-181.

In the framework of emerging Global Warming strategies, CO2 sequestration pipelines require attentive hazard studies to ensure a safe operability, but current risk assessment procedures applied to CO2 pipeline failures lack reliable and comprehensive source models. This work suggests a resolutive and robust multiphase discharge model suited for matching all expected CO2 discharge mechanisms. The application to real scale CO2 pipelines shows an essential incidence of the pipeline geometry (length and internal diameter) as well as of the orifice size on the release features. Wider thermal dynamics and enlarged solid contents are expected in short pipelines subjected to large ruptures. The resulting expansion transformations are characterized by increasing degrees of reversibility. Results show that expected solid content may amount up to 45% on a mass basis under usual carbon sequestration operative conditions. The latter, being linked to the initial CO2 aggregation state, play a key role in determining the whole discharge dynamics especially because of the effects of phase change mechanisms. A peculiar mass flow rate discharge profile is observed depending on the occurrence of liquid-vapor and solid-vapor mixtures. Specific set of geometric and operative conditions allow for the applicability of the isothermal bulk hypothesis and negligible wall effect in heat transfer mechanisms. Main governing parameters are the ratio between the pipeline length and internal diameter L/D and that between the orifice and the internal pipeline diameter d/D. Essential in driving the QRA procedure is the occurrence of the solid phase in rapid depressurizations that is expected only for pipeline shorter than 1500 m subjected to d/D > 0.30. Independently on the operative temperature, only pipelines carried at pressures above 55 barg lead to CO2 solid-vapor mixtures. Under these conditions, the solid CO2 cannot be neglected thus requiring a QRA modelling procedure considering additional scenarios involving sublimative dynamics of a dry ice bank.

- **Keywords:** CCS safety; Vessel depressurization; CO2; Source model; Dry-ice

Mohammad Reza Sabouri, Vahid Javanbakht, Davoud Jafarian Ghotbabadi, Mojtaba Mehravar. *Oily wastewater treatment by a magnetic superoleophilic nanocomposite foam*. Pages 182-192.

This study has been conducted to synthesize a superhydrophobic and superoleophilic magnetic nanocomposite based on polyurethane foam to remove the oily contaminants from water. The magnetic nanoparticles of magnetite were in-situ and ex-situ precipitated on a polyurethane foam and then the resulted magnetic nanocomposite modified by stearic acid. The synthesized nanocomposite was characterized by FTIR, XRD, FESEM, VSM, TGA/DTG and, CA analyzes. The results of various adsorption processes of oily compounds showed that the nanocomposite is in high separation properties for various oily compounds from water. The results showed that the surface modification of polyurethane foam has increased the capacity and efficiency of adsorption of light crude oil, gasoline, kerosene, and soybean oil as much as 79–86% and 108–147%, respectively. The regeneration of adsorbents through chemical regeneration by oil solvents has a positive effect on their capacity and adsorption efficiency. The equilibrium data adaptation of the light crude oil adsorption process by pure polyurethane foam, nanocomposite, and their regenerated forms through Langmuir, Freundlich, and Temkin isotherm models revealed that the Langmuir model could well describe the adsorption process. Superoleofilic, proper thermal stability, and suitable magnetic properties are other features of the synthesized nanocomposite.

- **Keywords:** Polyurethane foam; Adsorbent; Oily contaminants; Magnetic nanocomposite

Prasenjit Chakraborty, Sumona Show, Wasi Ur Rahman, Gopinath Halder. *Linearity and non-linearity analysis of isotherms and kinetics for ibuprofen remotion using superheated steam and acid modified biochar*. Pages 193-204.

Adsorption capabilities of physically activated Cocos nucifera shell biochar (CPBC) and chemically activated Cocos nucifera shell biochar (CCBC) were explored towards Ibuprofen (IBP) removal from simulated water in the present study. Impact of adsorbent dose (0.033–10 g L^{-1}), pH (1–7), initial ibuprofen concentration (1–50 mg L^{-1}), agitation speed (100–200 rpm), contact time (0.5–24 h) and temperature (15–40 °C) were conferred to designate the performance estimation of CPBC and CCBC towards IBP adsorption. Surface morphology and chemistry of CPBC and CCBC were studied using scanning electron microscopy (SEM) and FT-IR spectroscopy for better evaluation of sorbents characteristics on IBP removal. Assessment of linear and non-linear methods of isotherms and kinetics models were considered for validation of sorption study. The results were exposed from isotherm and kinetic model that non-linear methods evidenced to be an expressively better substitute for fitting the experimental data with more accuracy than linear form. While Langmuir isotherm and pseudo-first order kinetic were appeared to be the best-fitted models of IBP sorption study. Sorptive uptake of IBP by CPBC and CCBC were 9.69 mg g^{-1} and 12.16 mg g^{-1} respectively. The thermodynamic study revealed the exothermic, spontaneous and feasible nature of IBP sorption process by CPBC and CCBC. Reusability of both sorbents showed its efficacy of IBP adsorption to multiple cycles. Cost analysis of CPBC and CCBC production validates cost-effectiveness of both the sorbents. Consequently, the activated form of C. nucifera (coconut shell) derived biochar presented prospective candidature as a sorbent for ibuprofen adsorption.

- **Keywords:** Cocos nucifera; Ibuprofen; Isotherm; Non linear; Kinetics; Cost analysis

Chunfeng Song, Run Li, Yingxin Zhao, Ruying Li, Degang Ma, Yasuki Kansha. *Assessment of four sewage sludge treatment routes with efficient biogas utilization and heat integration*. Pages 205-213.

Sewage sludge treatment is a critical step of wastewater treatment plants (WWTP) to produce clean water, mineral matter and bio-energy. Techno-economic feasibility and performance of different process alternatives significantly depend on configuration and operating conditions. Thus, energy analysis of four sewage sludge treatment pathways is carried out in this work, including: i) high concentration digestion, dewatering and drying (HDDD); ii) thermal hydrolysis, high concentration digestion, dewatering and drying (THDDD); iii) low concentration digestion, dewatering and drying (LDDD); and iv) drying and incineration (DI). The energy and material balance of each pathway is simulated. Especially, the potential energy integration arrangement is put forward by efficient biogas utilization. The investigation results indicated that THDDD route has the optimal energy integration efficiency without additional natural gas input. Meanwhile, the surplus biogas of THDDD route is 4.7 ton/day, which is higher than that of HDDD (2.1 ton/day) and LDDD (0.3 ton/day). Techno-economic analysis results indicated that the total investment of HDDD process is the lowest (91.8 M$), and its operating cost (8.9 M$/year) is also lower than THDDD (9.0 M$/year), LDDD (9.9 M$/year) and DI (9.9 M$/year). From the viewpoint of waste reutilization, HDDD can be a promising alternative of energy efficient sewage sludge treatment route.

- **Keywords:** Sewage sludge; Energy; Biogas; Heat integration; Simulation

Abbas Hemmati, Reza Farahzad, A. Surendar, Behrad Aminahmadi. *Validation of mass transfer and liquid holdup correlations for CO2 absorption process with methyldiethanolamine Solvent and piperazine as an activator*. Pages 214-222.

In the present study, 24 data sets regarding CO2 absorption by the piperazine (PZ) activated aqueous methyldiethanolamine (MDEA) solution (30% wt) have been obtained from Khan et al.'s work and have been investigated using rate base model. Hence, mass transfer correlations such as Onda's, Bravo-Fair's, Billet-Schultes' correlations and liquid hold-up correlations of Billet-Schultes and Stichlmair have been studies in the current paper. In addition, important parameters like CO2 absorption (%), liquid temperature and rich solvent's loading have been compared in different mass transfer and liquid hold-up correlations. The results of using the rate-base model in the mass transfer and liquid hold-up correlations in 24 different experimental conditions indicate that the Bravo-Fair mass transfer correlations have higher accuracy compared to other mass transfer correlations. This comparison has been carried out based on CO2 absorption (%) and the rich solvent's loading. Moreover, studying mass transfer correlations give the following amounts for the average error of Onda's, Bravo-Fair's and Billet-Schultes' mass transfer correlations respectively for CO2 absorption (%) calculation in 16 different experimental conditions: 23.45, 14.63 and 38.59 (%). In the last part of the paper, rich solvent's loading is compared with real amounts in 12 different experimental conditions. The comparison shows that the average errors of Onda's, Bravo-Fair's and Billet-Schultes' mass transfer correlations are 14.80, 9.70 and 21.75 (%) respectively. Investigating liquid hold-up correlations indicates that Billet-Schultes' and Stichlmair's correlations give the same results regarding rich solvent's temperature, solvent's temperature profile along the absorption column, CO2 absorption (%) and rich solvent's loading.

- **Keywords:** Rate-base model; Post-combustion CO2 capture; Methyldiethanolamine (MDEA); Piperazine (PZ); Bravo and Fair mass transfer correlation

Jun Guo, Hu Wen, Xuezhao Zheng, Yin Liu, Xiaojiao Cheng. *A method for evaluating the spontaneous combustion of coal by monitoring various gases*. Pages 223-231.

Coal spontaneous combustion has always been a worldwide problem, which causes waste of coal resources, greenhouse gas emissions and other atmospheric environmental pollution problems. Although coal temperature monitoring is the most direct and accurate means of predicting the spontaneous combustion of coal, the coal temperature often cannot be directly measured owing to various physical restrictions. As an alternative, the present study assessed the qualitative and quantitative analysis of the CO and C2H4 formation rates, as well as various gas ratios such as the CO/CO2 ratio and fire coefficient R2 ($R2 = 100 \times \Delta CO/\Delta O2$), to predict spontaneous combustion. This method was established based on the temperature-programmed experiments of three different coal rank (including lignite, bituminous coal and anthracite), and was verified using data obtained from on-site monitoring at an actual mine. The results show that the method accuracy is as high as 97% when predicting the coal temperature to within 15 °C (allowable error range of the predicted value). This degree of accuracy should be sufficient for on-site fire prevention and control. This new technique is not only accurate and reliable but also has theoretical significance with regard to the identification of coal spontaneous combustion in goaf and for the development of fire prevention and suppression technologies.

- **Keywords:** Coal spontaneous combustion; Coal temperature; Evaluating method; Various index gases; Environmental pollution control

Pingju Zhao, Yuhua Bai, Baicang Liu, Haiqing Chang, Yongliang Cao, Jun Fang. *Process optimization for producing ultrapure water with high resistivity and low total organic carbon*. Pages 232-241.

In this work, we proposed a new combined process to produce high-purity water which can meet the requirement in many advanced high-tech applications. Here, we mainly focus on the rejection of ions and organic matters, which is characterized by conductivity/resistivity and total organic carbon (TOC), respectively. Ground water with TOC concentration of 373 μg/L and conductivity of 755 μS/cm was fed to the combined process. The effects of granular activated carbons (GACs) (Haycard and Calgon), ultraviolet (UV) sterilizers (single-wavelength and multiwavelength) and ion-exchange (IX) resins (SMT200L, SMT100L and UP6040) on TOC removal efficiency were systematically investigated. We found that a multiwavelength UV185/254, GAC (Calgon) and IX resin (SMT100L) had a higher TOC removal efficiency. We then optimized ultrapure water system and assembled units to the system, which consisted of double-pass reverse osmosis (RO) membranes, IX resin (SMT100L), multiwavelength UV185/254 sterilizer, GAC (Calgon) + IX resin (SMT100L) and a final filter. The optimized ultrapure water system produced water with a high resistivity (18.2 MΩ·cm) and low TOC concentration (2.37 μg/L). This research provides a new available combined process for ultrapure water production design.

- **Keywords:** Ultrapure water; Ultraviolet sterilizer; Reverse osmosis; Ion-exchange; Granular activated carbon

Moh Moh Thant Zin, Dong-Jin Kim. *Struvite production from food processing wastewater and incinerated sewage sludge ash as an alternative N and P source: Optimization of multiple resources recovery by response surface methodology*. Pages 242-249.

Nitrogen (N) and phosphorus (P) cause eutrophication in water body, but they also act as an essential and limiting nutrient in agriculture. In this study food wastewater (FW) and

incinerated sewage sludge ash (ISSA) were combined together as the alternative NH4+-N and PO43−-P sources to produce struvite. PO43−-P (67.0 g/kg SSA) was leached from the ISSA by acid and alkali treatment of ISSA. Multi-response surface methodology (RSM) has been applied to find the optimal condition for the maximal NH4+-N and PO43−-P recovery of 79.6% and 99.9%, respectively, from the mixed solution of ISSA leachate and centrifuged FW at pH 9.28, Mg/P 2, and N/P 0.6. Overall yields were 64.9% NH4+-N (27.1 g NH4+-N /L FW) and 72.7% PO43−-P (72.8 g T-P/kg ISSA) from the FW and ISSA, respectively. XRD, ICP-OES, and P-bioavailability analysis confirmed that the recovered precipitate had high struvite content (77.5%) and P-bioavailability (98.4%) with negligible heavy metals content. FW and ISSA were successfully combined together to produce struvite and it can be utilized as an effective fertilizer.

- **Keywords:** Food wastewater; Incinerated sewage sludge ash; Nutrient recovery; Response surface methodology; Struvite

Yi-Chun Chen, Chia-Hua Lin, Shih-Chun Candice Lung, Ku-Fan Chen, Wen-Cheng Vincent Wang, Cheng-Tai Chou, Chia-Hsiang Lai. *Environmental concentration of spray paint particulate matters causes pulmonary dysfunction in human normal bronchial epithelial BEAS-2B cell*. Pages 250-258.

In addition to airborne particulate matter (PM), exposure to spray paint PMs (SPPMs) may also be associated with pulmonary dysfunction. In this study, we employed human normal bronchial epithelial BEAS-2B cells to elucidate the association between pulmonary toxicity and different sizes of SPPMs (SPPM10-3.2, SPPM3.2-1 and SPPM1) under realistic environmental concentrations in a spray paint factory. Results indicated that all SPPMs (20–100μg/cm2) induced significant decreases in cell viability (> 70% compared to the control), except for low-dose SPPM10-3.2 (20 and 50μg/cm2). Almost all SPPMs (20μg/cm2 and 100μg/cm2) induced oxidative stress (2–4 times that of the control), which increased the production of proinflammatory cytokines (1.5–4.5 times that of the control) as well as increased α1-antitrypsin expression (3–4.5 times that of the control). Moreover, we found that almost all SPPMs induced pulmonary epithelial barrier dysfunction (0.77–0.11 times that of the control) through the depletion of zonula occludens proteins (0.8–0.65 times that of the control). In conclusion, smaller SPPMs induced more severe adverse pulmonary adverse effects. Exposure to SPPM1 was a potential major risk factor for pulmonary epithelial barrier dysfunction. Our evidence demonstrates that exposure to SPPMs, especially SPPM1, may increase the risk of pulmonary dysfunction.

- **Keywords:** Paint; Particulate matter; Inflammation; BEAS-2B; Chronic obstructive pulmonary disease

Gholamreza Moussavi, Eshrat Fathi, Mahsa Moradi. *Advanced disinfecting and post-treating the biologically treated hospital wastewater in the UVC/H2O2 and VUV/H2O2 processes: Performance comparison and detoxification efficiency*. Pages 259-268.

The present study compares the ultraviolet (UV)-based AOPs for the disinfection and the post-treatment of the biologically-treated hospital wastewater (BHW). It was found that the vacuum UV (VUV) photoreactor was much more efficient than the UVC photoreactor in inactivation of E. coli. A 6.4 and 3.7 log E. coli inactivation (from an initial concentration of 1.09 × 1010 CFU/mL) was achieved in the VUV and UVC photoreactors, respectively, operated under similar conditions at the neutral pH of water. In the case of continuous-flow operation, the complete inactivation of E. coli was achieved in the VUV photoreactor in hydraulic retention time (HRT) of 3 min. However, the UVC photoreactor could not attain the same performance even at the longer HRT of 10 min. Adding H2O2 to

the VUV photoreactor improved the removal of total organic carbon (TOC) from the BHW. The TOC removal in the recirculated VUV photoreactor improved from 10.8%–61.7% in the reaction time of 10 min at the presence of the optimum H2O2 amount of 3 mM whereas the TOC removal in the UVC/H2O2 operated at the similar conditions was only 13.1%. When operated under flow-through condition, 93.6% of TOC could be removed from the BHW in the VUV/H2O2 process at the HRT of 10 min where the complete bacterial inactivation and detergent removal was also achieved. The electrical energy consumption was 52.9, 12.2, and 6.5 kW h/m3 in the UVC/H2O2, VUV and VUV/H2O2 processes, respectively, when operated at the HRT of 10 min under identical conditions for TOC removal. The VUV/H2O2 process could also degrade most of the residual substances in the BHW thus efficiently detoxified the BHW to the level sufficient for discharging into the water environment. Accordingly, the VUV/H2O2 process is an efficient, energy-effective, and thus emerging method for the disinfection and the post-treatment of the hospital wastewater.

- **Keywords:** Advanced oxidation process; VUV process; Hydroxyl radical; TOC removal; Disinfection

Yiling Zhuang, Zhaoji Zhang, Zejun Zhou, Minquan Chen, Junjie Li, Shaohua Chen. *Co-treatment of shale-gas produced water and municipal wastewater: Removal of nitrogen in a moving-bed biofilm reactor*. Pages 269-277.

Co-treatment of hydraulic fracturing produced water (PW) with municipal wastewater is a cost-effective shale gas PW management option. However, little attention has been paid to the impact of PW on the reliability of bioprocess in municipal wastewater treatment plants. In this study, a mature chemical pretreatment method was used to remove a large proportion of organic matters in real PW. Then a laboratory-scale moving bed biofilm reactor (MBBR) was established for the co-treatment of pretreated PW and synthetic domestic wastewater. Results showed that CODCr removal rate reached above 90% and acute toxicity was lowered by 20% in the pretreatment of PW using consecutive Fenton–NaClO oxidation. After 68 days of slowly increasing the mixing ratio, complete nitrification–denitrification was established with a maximum mixing ratio of 50%. The mean total nitrogen (TN) removal rate reached above 60% when the MBBR operated under maximum mixing ratio for the following 38 days. Shotgun metagenomic analysis revealed high taxonomic structure similarity between suspended and attached growth biomass in the MBBR when the mixing ratio was maintained at 50%. The functional diversity of nitrite-oxidizing bacteria may be present in the saline biological nitrogen removal system and may strengthen nitrogen and other typical element cycles.

- **Keywords:** Hydraulic fracturing; Produced water; Co-treatment; Biological nitrogen removal; Parallel factor analysis; Microbial community

Guo-Qing Shi, Peng-xiang Ding, Zhixiong Guo, Yan-ming Wang. *Modeling temperature distribution upon liquid-nitrogen injection into a self heating coal mine goaf*. Pages 278-286.

Liquid N2 could be injected into goaf to decrease temperature and prevent spontaneous combustion during mining. A working face at Liangbaosi coal mine was adopted for study. Firstly, a mathematical model for calculating the temperature field in goaf was developed and field tests without injection of liquid N2 were conducted to validate the model. Comparable development trends and hot zones between the simulation and field measurements were found. The hot zones were located about 35–45 m behind the workface on the air-return and air-intake sides in the goaf. Then the model was employed to simulate the time development of temperature distribution in the goaf with injection of liquid N2 from different locations. It was observed that a low-temperature

cooling zone (<300K) due to injection of liquid N2 gradually grew and became relatively stable 90 min after continuous injection. The size of the cooling zone depends on the injection location and flow rate. The cooling zone was smaller when the N2 was injected from the air-intake side than from the air-return side. The largest cooling zone was found when the N2 was injected 35m behind the workface from the air-return side. The cooling zone increases with increasing N2 perfusion rate. This study provides a quantitative assessment for preventing coal oxidation and spontaneous combustion using the liquid N2 technology.

- **Keywords:** Temperature distribution; Liquid nitrogen; Numerical simulation; Goaf; Coal spontaneous combustion

Yee Cheng Lim, Shih-Kai Lin, Yun-Ru Ju, Chung-Hsin Wu, Yi-Li Lin, Chiu-Wen Chen, Cheng-Di Dong. *Reutilization of dredged harbor sediment and steel slag by sintering as lightweight aggregate*. Pages 287-296.

The purpose of this study was to evaluate the feasibility of lightweight aggregate (LWA) made from dredged harbor sediment and basic oxygen furnace (BOF) slag to increase their reutilization. The effects of preheating, sintering and raw materials proportion on the properties of LWA were discussed in term of particle density, water absorption, and compressive strength. Microscopic structure, water-soluble chloride and heavy metals leachability of the LWA were also examined. Results showed that the mixture of the dredged harbor sediment and BOF slag under the manufacturing process with preheating temperature at 500 °C for 10 min and sintering temperature at 1175 °C for 15 min was conducive to be a low water absorption and high strength LWA, which had as low as 1.73 g cm−3 and 3.45% for dry particle density and water absorption respectively. Its compressive strength reached 23.2 MPa when the addition of BOF slag was up to 27%. The LWA prepared in this study also have very low water-soluble chloride and heavy metals leachability, all compliant with Taiwan regulatory standards, thus would be suitable for further civil engineering application. The results of this study provide useful information on co-treating of wastes and recycled resources as LWA.

- **Keywords:** Harbor sediment; BOF slag; Lightweight aggregate; Preheating; Sintering

K.C. Ho, Y.H. teow, A.W. mohammad. *Optimization of nanocomposite conductive membrane formulation and operating parameters for electrically-enhanced palm oil mill effluent filtration using response surface methodology*. Pages 297-308.

Electrically-enhanced membrane filtration with the application of electric field across the conductive membrane was proved as an effective method in reducing membrane fouling through the enhancement of electrostatic repulsion between foulants and the membrane surface. In this study, nanocomposite conductive membranes were fabricated by blending graphene oxide (GO) and multi-walled carbon nanotubes (MWCNTs) into polyvinylidene fluoride (PVDF) membrane matrix via phase inversion method. Response surface methodology (RSM) was employed to establish the optimum nanocomposite conductive membrane formulation and operating parameters for the electrically-enhanced filtration process in palm oil mill effluent (POME) treatment. The optimum process variables for continuous mode study are the use of nanocomposite conductive membrane with carbon nanomaterials concentration of 4.22 wt% and electric field of 221.00 V/cm. Whereas, interval time of 32.00 min and application time of 6.00 min are suggested for intermittent mode study in achieving high normalized flux. The corresponded experimental normalized flux for optimum continuous study mode and intermittent study mode were 0.7778 and 0.7983, with low percentage of error 9.94% and 11.20%, respectively. Optimization with the use of RSM is satisfactory to improve

the performance of nanocomposite conductive membrane in electrically-enhanced filtration process through the reduction of membrane fouling propensity.

- **Keywords:** Nanocomposite conductive membrane; Electrically-enhanced membrane filtration; Membrane fouling reduction; Response surface methodology (RSM); Optimization

Philip Thomas, Ian Waddington. *Fallacies in criticisms of the J-value*. Pages 309-328.

Detailed examination of the criticisms of the J-value put forward by Jones-Lee and Chilton shows their points to be without merit. However, the exercise of refuting their critique has brought out a number of J-value implications of potential interest and value to engineering professionals seeking to find the objectively reasonable amount that ought to be spent on a safety system. The paper applies the J-value to the example of a long-term protection system on a notional major-hazard process plant, where a severe accident would otherwise pose a risk of death to the general public either immediately or in the short term. Equations are developed for the improvement in life expectancy produced by averting such an industrial hazard over a prolonged period. The opportunity is taken to review the developments in the J-value that have taken place over the 12 years since the first paper on the method appeared in Process Safety and Environmental Protection.

- **Keywords:** J-value; Risk; Immediate hazard; VPF; Safety; Safety fallacies

Sabrina Copelli, Marco Barozzi, Martina Silvia Scotton, Anna Fumagalli, Marco Derudi, Renato Rota. *A predictive model for the estimation of the deflagration index of organic dusts*. Pages 329-338.

Among all the powder handling operations, the hazard represented by organic dusts explosions is one of the most critical, as several industrial accidents occurred during the last centuries testify. Particularly, in order to estimate the magnitude of a dust explosion, the so-called deflagration index, KSt, plays a fundamental role because it is also used to design the emergency vents aimed to protect both vessels and silos from a collapse due to an internal explosion. Nowadays Kst values are obtained by means of experimental testing, e.g. using a standard 20 L sphere, but its determination is quite expensive and time consuming. This problem is even more severe when a target dust is processed into a plant giving rise to a wide range of particles sizes; in this case, an experimental investigation of all the different granulometries would be advisable but too expensive. In this context, the aim of this work was to develop a predictive model for the evaluation of the KSt, for whatever organic dust, as it would be estimated by a standard test in the 20 L sphere using only a single thermo-gravimetric test. In order to validate the aforementioned model, eight different organic dusts (Aspirin, Cork, Cornstarch, Niacin, Polyethylene, Polystyrene, Sugar, and Wheat Flour) were tested. Preliminary results showed a good agreement between literature KSt values and model predictions. Such an achievement, once further validated on a wider range of explosive organic dusts, could lead to an improvement in the risk assessment panorama for powder handling operations by making the risk evaluation process quicker and cheaper.

- **Keywords:** Organic dusts; Deflagration index estimation; Explosion severity; Dust explosion modeling; Powder handling operations safety

Jinhui Huang, Shuying Peng, Xumei Mao, Fei Li, Shiting Guo, Lixiu Shi, Yahui Shi, Hanbo Yu, Guang-ming Zeng. *Source apportionment and spatial and quantitative ecological risk assessment of heavy metals in soils from a typical Chinese agricultural county*. Pages 339-347.

This study collected topsoil samples from 330 sites of Shan County, a typical Chinese agricultural county, to analyze the causes and effects of heavy metal pollution. It was found that the average contents of all heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb and Zn) were lower than their screening values in China. However, average contents of As, Cd, Hg, Ni, and Zn exceeded their local background level. The enrichment factors suggested the moderate pollution of Cd and slight pollution of Hg, and they were also the two of the most toxic elements. Most importantly, a new combination of spatial analysis, ecological risk assessment and positive matrix factorization model was used to identify the sources and ecological risks of heavy metals from different sources quantitatively and spatially. The results showed that the risk contribution rates of the natural source, sewage irrigation and animal husbandry, atmospheric deposition and industrial emissions, and agricultural materials were 20.0%, 35.1%, 22.0% and 22.9%, respectively. It was worth noting that agricultural activities contributed nearly 60% of the risk. In general, a large part of the area was in moderate risk. Therefore, it was necessary to promote long-term control of major sources and take precautions.

- **Keywords:** Agricultural soil; Heavy metal; Source apportionment; Ecological risk assessment; Spatial analysis

Md Rokon Ud Dowla Biswas, Kwang Youn Cho, Chong-Hun Jung, Won-Chun Oh. Novel synthesis of LaNiSbWO4-G-PANI *Designed as Quaternary Type Composite for High Photocatalytic Performance of Anionic Dye and Trihydroxybenzoic acid under Visible-Light*. Pages 348-355.

In this study, we describe the special properties of LaNiSbWO4-G-PANI (LNSWGP) polymer composites with exploited interfacial coupling and their use as visible light photocatalysts. These quaternary composites are newly designed materials by easiest hydrothermal method. Thin graphene (G) sheets could completely cover LaNiSbWO4 (LNSW) with highly conductive polyaniline by means of an evaporation-induced hydrothermal process. The increased surface adsorption outcome of G, a huge improvement of the photoactivity of LNSW, has been proved by the degradation of anionic methylene orange (MO) and trihydroxybenzoic acid (a type of phenolic acid) upon the covering of polyaniline. The improved photocatalytic activity is recognized as developing from the well-defined LNSWGP interfaces, which considerably increase the charge-separation efficacy. The efficiency of degradation was obtained MO (85%) & trihydroxybenzoic acid (92%). Our study found that the photocatalytic performance of LNSWGP in the existence of polymer was better than that of any other composite in an aqueous medium. Considering its ease of preparation and excellent performance, LNSWGP could be a promising, competitive, and safe visible-light-driven photocatalyst in the field of battery separators, solar cells, and environmental remediation.

- **Keywords:** LaNiSbWO4; Quaternary composite; Nanocomposite; Environmental remediation; Polyaniline

Md. Tanjin Amin, Faisal Khan, Paul Amyotte. *A bibliometric review of process safety and risk analysis*. Pages 366-381.

Process safety and risk analysis have paramount significance in the modern process industries for preventing fatalities and asset and reputation loss due to an accident. Hence, this has been an active area of research for many decades around the world. In this paper, a bibliometric analysis-based review is presented to investigate the evolution of process safety and risk research. Specifically, the following basic questions are addressed: (i) Which countries are active in the research? (ii) What are the key areas? (iii) Who are the leading contributing authors? (iv) What are the potential sources of the publications? (v) What is the focus of most of the documents? (vi) What are the

dominant factors behind the citations? and (vii) What is the contribution of the industries? Additionally, the evolution and popularity of major tools used in this field are also analyzed. It is found that safety and risk analysis is a global topic. China, Malaysia, and Iran are the emerging countries with an impressive percentage increase in research volume in this decade (2009–2018). The USA is the leading contributor, and India is the most cost-effective country. Methodology development-related works cover the vast portion of this field, and journals focusing on these works are highly likely to be cited by peer researchers. Despite a healthy contribution from industry, unfortunately collaborative works between industry and academia are rare. It is also observed that the field of process safety and risk analysis is of great growth potential with an exponential increase in the number of annual publications.

- **Keywords:** Safety analysis; Risk analysis; Review; Bibliometric analysis; Process industries; Loss prevention

Mahdieh Keramati, Bita Ayati. *Petroleum wastewater treatment using a combination of electrocoagulation and photocatalytic process with immobilized ZnO nanoparticles on concrete surface*. Pages 356-365.

A large quantity of water is used at oil refineries; Consequently, high amounts of wastewater are produced. The main aim of this study is to evaluate COD removal rate using an electrocoagulation process as well as a photocatalytic process with ZnO nanoparticles. Subsequently, the combined treatment was also implemented to reach energy savings and higher performance. At the optimum condition of the EC process (COD concentration of 900 m/L, current density of 20 mA/cm2, pH of 8.5 and NaCl concentration of 0.5 g/L), COD removal rate was 94% after 60 min. For the photocatalytic process at optimum conditions (COD concentration of 600 mg/L, ZnO concentration of 80 g/m2, pH of 5 and irradiation power of 32 W), 76% of COD removal efficiency was obtained, after 300 min. Thereafter, the combined system was implemented, with initial COD concentration of 1000 mg/L at the optimum conditions; First, the COD removal efficiency was achieved to be 47% after 8.5 min using the EC process; after that, the effluent entered the concrete photoreactor for 120 min, which lead to 85% of COD reduction and final COD concentration reached to 75 mg/L. The GC-Mass analysis was also performed which approved the removal of oil compounds from the wastewater.

- **Keywords:** COD removal; Electrocoagulation; Energy consumption; Immobilized photocatalytic process; ZnO nanoparticles; Combined process

Hana Chaloupecká, Michala Jakubcová, Zbyněk Jaňour, Klára Jurčáková, Radka Kellnerová. *Equations of a new puff model for idealized urban canopy*. Pages 382-392.

During a leakage of hazardous materials, emergency services need to predict the evolution of the accident. In such situations, fast models are used. Such models can produce reasonable results for long-term leakages, but short-term leakage results can be underestimated by as much as a full order of magnitude (shown in the COST ES1006 project). Hence, the main aim of this paper is to present equations for recalculating the continuous source results to achieve results valid for the short-term source. The model would consist of a sub-model utilized for the continuous source in combination with the equations introduced in the paper. The outputs obtained are the probability density functions of the puff characteristics: dosage, maximum concentration, and 99th and 95th percentiles of concentrations. These functions can help to estimate the situation not only for the mean case, but also for the extreme cases.

- **Keywords:** Short-term gas leakage; Long-term gas leakage; Continuous release; Operational model