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Ewa Adamek, Wojciech Baran, Andrzej Sobczak. *Photocatalytic degradation of veterinary antibiotics: Biodegradability and antimicrobial activity of intermediates*. Pages 1-9.

Residues of veterinary antibiotics in wastewater from breeding farms can be degraded effectively using the photocatalytic process. The aim of this study was to assess the changes in the biodegradability and antimicrobial activity of solutions containing ampicillin, doxycycline, tylosin or sulfathiazole after the photocatalytic process. The antimicrobial activities of the initial antibiotic solutions and the photocatalytic degradation products of these drugs were determined relative to eleven taxonomically diverse microbial species: Microbacterium spp, Brevundimonas diminuta, Citrobacter freundii, Comamonas testosterone, Enterococcus casseliflavus, Delftia acidovorans, Kurthia gibsonii, Staphylococcus warneri, Pseudomonas aurantiaca, Serratia rubidaea and Pichia anomalia. In contrast to the initial antibiotics, the photodegradation products were biodegradable. The important conclusion of this research is that partial photocatalytic mineralization of each of the studied antibiotic solutions resulted in the complete disappearance of their antimicrobial activity against the tested microorganisms.

- **Keywords:** Photocatalysis; Antibiotics; Antimicrobial activity; Biodegradability; Wastewater treatment; Ecotoxicity

Masood Hamadanian, Mohammad Hossein Keshavarz, Behzad Nazari, Mostafa Mohebbi. *Reliable method for safety assessment of melting points of energetic compounds*. Pages 10-22.

This work presents a widely applicable model for the prediction of melting points of energetic compounds including organic peroxides, organic azides, organic nitrates, polynitro arenes, polynitro heteroarenes, acyclic and cyclic nitramines, nitrate esters and nitroaliphatic compounds. This method is based on the elemental composition of an energetic compound and the contribution of some specific polar groups/structural moieties as additive and non-additive functions, respectively. The new model was applied for 288 different energetic compounds including complex molecular structures. The average and maximum deviations of the suggested method are 6.8 and 21.1, respectively, which are much lower than the predicted values of two well-known different methods.

- **Keywords:** Melting point; Energetic compound; Correlation; Safety; Prediction; Contribution

Mohammad Shirmardi, Nadali Alavi, Eder C. Lima, Afshin Takdastan, Amir Hossein Mahvi, Ali Akbar Babaei. *Removal of atrazine as an organic micro-pollutant from aqueous solutions: a comparative study*. Pages 23-35.

In the present study, different adsorbents were prepared: activated carbon (AC), MgO and ZnO nanoparticles, and the composite of AC/MgO/ZnO. The AC was prepared from oak charcoals, as low-cost and abundantly available materials in Iran, by chemical activation. MgO and ZnO nanoparticles were synthesized using a sol–gel method. The adsorbents were characterized using Powder X-ray diffraction (XRD), Field Emission-Scanning Electron Microscope (FESEM), and Energy Dispersive X-ray Spectroscopy (EDS). Then, the adsorption behavior of the adsorbents was tested for the removal of atrazine (ATZ) herbicide as a model of organic micro-pollutant. The average crystallite size of MgO and ZnO nanoparticles was calculated from their XRD data using the Scherrer equation. The results showed that the MgO and ZnO nanoparticles had a size in nano scale, which was supported by FESEM images. The experimental data showed that the pH of solution had no considerable effect on the adsorption of ATZ herbicide. The experimental data obtained for the AC and AC/MgO/ZnO composite were fitted to nonlinear pseudo first-order, pseudo-second order, and general order kinetic models. The general order kinetic model provided the best fit to experimental data compared with the other models. The adsorption isotherm data of these two adsorbents at different temperatures fitted well to the Langmuir and Liu models, but followed the Liu isotherm model most precisely, based on the lowest SD value provided by this model. The results of this study indicate that the chemically prepared AC has excellent adsorptive capacity and can be used as an effective adsorbent for the removal of ATZ from aqueous solutions. However, MgO and ZnO nanoparticles exhibited low adsorptive capacity for ATZ and could not be suitable adsorbents for the removal of this pollutant.

- **Keywords:** Organic micro-pollutants; Adsorption; Atrazine; MgO; ZnO; Composite

Sirikan Maneesuwannarat, Pattrarat Teamkao, Alisa S. Vangnai, Mitsuo Yamashita, Paitip Thiravetyan. *Possible mechanism of gallium bioleaching from gallium nitride (GAN) by Arthrobacter creatinolyticus: Role of amino acids/peptides/proteins bindings with galium*. Pages 36-45.

The objectives of this work were to screen and characterize heterotrophic bacteria for gallium nitride (GaN) leaching; and to study the involved mechanism of bacterial leaching of Ga from GaN. Ga in the form of GaN has been extensively used as a semiconductor substrate material. The advantage of bioleaching for gallium recovery is the fact that it is a safer, environmentally-friendly method and includes energy-saving processes, which can leach metals at relatively low concentrations. Three bacterial isolates were isolated from cadmium-, and arsenic-contaminated soil in the presence of GaN. NKS4 showed the highest efficiency in Ga leaching at approximately 18% after 15 days, and the system pH was 9. The analysis of 16S rDNA sequences indicated that strain NKS4 was characterized and identified as Arthrobacter creatinolyticus (A. creatinolyticus). Further investigation revealed that the ability of Ga leaching from GaN by this bacterium involved amino acids. Fourier transform infrared spectroscopy (FTIR) was used to investigate the interaction of Ga and amino acids/peptides/proteins which were secreted from this bacteria.

- **Keywords:** Arthrobacter creatinolyticus; Gallium nitride; Semiconductor; Bioleaching; Electronic waste

Kai Wang, Shuguang Jiang, Xiaoping Ma, Zhengyan Wu, Hao Shao, Weiqing Zhang, Chuanbo Cui. *Information fusion of plume control and*

***personnel escape during the emergency rescue of external-caused fire in a coal mine*. Pages 46-59.**

After a fire occurred in a coal mine, compared with putting out the fire, organizing the miners' safe escape was especially important. We established a local ventilation system model using TEPS (Thunderhead Engineering PyroSim) and set up control measures for fire smoke. The change rule of fire parameters, such as temperature, concentration of smoke, and visibility, was analyzed based on the results of FDS (Fire Dynamics Simulator). Without the control measures for fire smoke, the coal face and the intake airflow roadway were all polluted by smoke at 541 s after the fire broke out; at this time, personnel escape would be almost impossible in the coal face. Thus, the personnel escape conditions and routes are determined by the parameters of fire smoke flow. Evac was used to simulate the escape behavior of a miner who encounters an accident in a coal mine. After taking the fire smoke control measures into account, we performed simulation calculation to determine the best and fastest way for miners' escape. We exploited the hardware and software, and the belt fire emergency rescue system of the No. 1 plate in the Da Liu-ta coal mine was established. The emergency rescue system successfully fused fire plume control and personnel escape information into one platform. Through simulating a fire drill three times, the air quantity of the key branches changed to within reasonable limits while the air-door's opening area was 2 m2, field tests proved the reliability and feasibility of the system.

- **Keywords:** Fire plume control; Personnel escape; Information fusion; Emergency rescue; Numerical simulation

Bo Jin, Florian Zepf, Zhihui Bai, Baoyu Gao, Nanwen Zhu. *A biotech-systematic approach to select fungi for bioconversion of winery biomass wastes to nutrient-rich feed*. Pages 60-68.

Grape marc and lees are main waste biomass in wine industry, which contain substantial amount of carbohydrates and nutrients, but currently deliver considerable carbon emission through landfill in Australia. This study was aimed to develop a biotechnological systematic approach to select suitable fungi for bioconversion of the winery biomass wastes into animal feed. The biotech-systematic approach was developed through assessment of nutrient/carbon source accessibility of the fungi, understanding of their metabolic reactions in solid state fermentation, and nutritive value of the fungi-fermented grape marc. From 13 Aspergillus, Rhizopus, and Trichoderma fungal species, A. oryzae DAR 3699, A. oryzae RIB40 and T. reesei RUT C30 were determined as the best fungi due to their promising biochemical capabilities to enhance protein contents and in vitro digestibility of grape marc in mono- and co-cultivations. The mono-fungous-cultured SSF process used these selected fungi is able to convert grape marc to nutrient-rich feed by increasing the protein contents from ~5% to 26% and the digestibility from ~25% to over 50%. R. oligosporus 2710 with R. oryzae 6201 or T. viride 15719 showed promising protein enrichment to 18–23% and digestibility improvement by ~50% in their co-cultivations. This preliminary bioengineering strategy will be useful for selecting microorganisms for the bioconversion of organic wastes to high valuable products. This "green cycle" bioprocess will be useful to promote the old-fashioned waste treatment technologies for the cleaner production in food processing industries.

- **Keywords:** Bioconversion; Digestibility; Fungi; Protein enrichment; Winery biomass waste; Solid state fermentation

Francis Hassard, Jeremy Biddle, Elise Cartmell, Tom Stephenson. *Mesh rotating reactors for biofilm pre-treatment of wastewaters – Influence of media type on microbial activity, viability and performance*. Pages 69-75.

The impact of using different plastic mesh in rotating biofilm reactors (RBRs) on the treatment performance, biofilm activity and viability under varying organic loading rates (OLRs) was investigated. Laboratory-scale RBRs treating real wastewater were operated under OLR loading conditions typical of pre-treatment processes. A fully-crossed, three-factorial design series of experiments was undertaken with low and high surface area mesh made from polyvinyl chloride (PVC) and polypropylene (PP) operated at low, medium, high and very high OLR. The maximum volumetric removal rate of 2.4 kg sCOD m3 d−1 occurred at the high OLR, for low surface area mesh, irrespective of plastic used. The highest OLR at which nitrification could be attained was 35 g sCOD m−2 d−1. The biofilm growth decreased under medium compared to low OLR on all mesh. This coincided with a ~2 fold decrease in the microbial viability. Higher surface area mesh was important for high nitrification rates at medium OLR (p < 0.05). In contrast the low surface area PVC and PP mesh was best at very high OLR (160 g sCOD m−2 d−1 or ~320 g BOD5 m−2 d−1) for bulk organics removal (p < 0.05). Therefore, lower surface area mesh is recommended for wastewater pre-treatments at high OLR, whilst high surface area mesh was best for elevated nitrification rates at medium OLR. The microbial activity and viability had a strong positive correlation with OLR (R2 = 0.92, p < 0.001 and 0.81, p < 0.001 respectively). The microbial activity and viability also positively correlated (R2 = 0.4, p < 0.05 and 0.29, p < 0.01 respectively) to the sCOD removal performance but not the ammonia removal in mesh RBRs. This confirms the importance of maintaining biofilm activity and viability for bulk organics removal in biofilm processes in wastewater treatment.

- **Keywords:** Biofilm; Microbial activity; Nitrogen; Organic loading; Viability; Wastewater

Jon Alvarez, Gartzen Lopez, Maider Amutio, Javier Bilbao, Martin Olazar. *Preparation of adsorbents from sewage sludge pyrolytic char by carbon dioxide activation*. Pages 76-86.

This work focuses the valorization by CO2 activation of the sewage sludge char obtained in the fast pyrolysis in a conical spouted bed reactor at 500 °C. In order to improve the quality of the activated material for use as adsorbent, the sewage sludge char was subjected to two sequential steps of washing by using first a solution of HCl (in order to remove part of the ashes) and then a solution of Na2CO3 (to extract most of the silica remaining), thereby comparing the properties of the char washed with only HCl with that treated with both HCl and Na2CO3. The materials treated with one or two steps of washing were activated with CO2 in a fixed bed reactor at 800 °C, which allowed proving that the step of Na2CO3 washing contributes significantly to increasing the gasification rate. Furthermore, the properties of interest for use as adsorbents were greatly improved, attaining a BET surface area of 440 m2 g−1 with a notorious presence of meso and macropores for an activation time of 15 min and a burn-off value of 42%.

- **Keywords:** Adsorbent; Char; Sewage sludge; Carbon dioxide activation; Acid washing; Ash removal

Janardhan Reddy Koduru, Lakshmi Prasanna Lingamdinne, Jiwan Singh, Kwang-Ho Choo. *Effective removal of bisphenol A (BPA) from water using a goethite/activated carbon composite*. Pages 87-96.

The removal of bisphenol A (BPA) from aqueous solutions, where it can interact with natural organic matter (NOM), is of great concern for water safety. In this study, the preparation of goethite iron oxide particles impregnated activated carbon composite (GPAC) has been discussed. The goal of developing an advanced material was to remove BPA in the presence of NOM. Characterizations of the GPAC were carried out by X-ray diffractometer (XRD), the Fourier transfer infra-red (FTIR), and scanning electron microscope with energy dispersive X-ray spectroscopy (SEM-EDS), and their physical

characteristics were studied. The adsorption characteristics of GPAC were evaluated by batch adsorption studies. The adsorption kinetics of BPA on GPAC followed the pseudo-second-order kinetics. Freundlich and Langmuir isotherms models were applied to determine the BPA removal capacity by GPAC. The Freundlich adsorption isotherm was considered to be more suitable than the Langmuir isotherm for the adsorption of BPA. It was also noted that the adsorption capacity of BPA on GPAC increased with an increase in the iron oxide concentration in GPAC. The obtained results were also compared with those of goethite and bare PAC. The effects of NOM on the BPA removal characteristics were also studied, indicating that the BPA adsorption capacity was enhanced in the presence of NOM.

- **Keywords:** Bisphenol A; NOM; Goethite impregnated powder activated carbon; Iron oxides; Adsorption; Water treatment

Naseer Hussain, Tasneem Abbasi, S.A. Abbasi. *Vermicomposting-mediated conversion of the toxic and allelopathic weed ipomoea into a potent fertilizer*. Pages 97-106.

Characteristics of the highly pernicious weed ipomoea (Ipomoea carnea) were studied before and after its vermicomposting by the earthworm (Eisenia fetida). The studies, supported by UV–visible and Fourier transform infrared spectroscopy (FT-IR), thermogravimetric (TG) and differential scanning calorimetry (DSC), gas chromatography–mass spectrometry (GC–MS), and scanning electron microscopy (SEM) reveal a drastic change in the characteristics. There was a sharp reduction in the carbon-to-nitrogen ratio from 26.1 to 9.9, and in humification index from 7.7 to 1.9. By all accounts there was substantial mineralization of organic matter. Complex aromatics such as lignin and polyphenols were degraded into simpler carbohydrates and lipids. GC–MS analysis showed significant fragmentation, bio-oxidation and molecular rearrangements of chemical compounds in vermicompost in comparison to those in ipomoea. SEM micrographs of ipomoea vermicompost reflected strongly disaggregated material compared to ipomoea. The phenols and alkaloids which are specifically responsible for the toxicity and allelopathy of ipomoea, were significantly degraded in the course of the weed's vermicomposting, turning it into a plant-friendly organic fertilizer. These findings make it appear possible that millions of tons of ipomoea biomass, which is generated annually but goes to waste, can be transformed into organic fertilizer.

- **Keywords:** Ipomoea; Vermicomposting; Allelopathy; FT-IR; Humification; Mass spectroscopy

Chunfei Wu, Mohamad A. Nahil, Norbert Miskolczi, Jun Huang, Paul T. Williams. *Production and application of carbon nanotubes, as a co-product of hydrogen from the pyrolysis-catalytic reforming of waste plastic*. Pages 107-114.

Hydrogen production from waste plastics is an important alternative for managing waste plastics. This work addresses a promising technology for co-producing high value carbon nanotubes (CNTs) in addition to the production of hydrogen; thus significantly increasing the economic feasibility of the process. Catalyst design is a critical factor to control the production of hydrogen and CNTs. NiMnAl catalysts, prepared by a co-precipitation method, with different metal molar ratios were developed and investigated using a two-stage fixed-bed reactor. It was found that the NiMnAl catalyst with the higher Mn content produced a higher yield of carbon (57.7 wt.%). Analysis of the carbon on the NiMnAl catalysts showed it to consist of ~90 wt.% of carbon nanotubes. The CNTs were recovered from the catalyst and added at 2 wt.% to LDPE plastic to form a composite material. The tensile and flexural strength and the tensile and flexural modulus of the CNT composite material were significantly improved by the addition of the recovered

CNTs. Thus it is suggested that cost-effective CNTs could be produced from waste plastics as by-product of the production of hydrogen, enhancing the potential applications of CNTs in the composite industry.

- **Keywords:** Plastics; Waste; Hydrogen; Carbon nanotubes; Composite; Reforming

Tohid Nejad Ghaffar Borhani, Afsaneh Afzali, Mehdi Bagheri. *QSPR estimation of the auto-ignition temperature for pure hydrocarbons*. Pages 115-125.

Due to the combustible nature of hydrocarbons, accurate safety information for their safe utilization and transport is essential. The autoignition temperature (AIT) is an important safety parameter. In this study, a quantitative structure–property relationship (QSPR) approach was utilized to present a predictive model for the estimation of the AIT of 813 hydrocarbons from 69 different chemical families. A unified three-parameter model was constructed combining multivariate linear regression (MLR) and a genetic algorithm (GA). In order to investigate the complex performance of the selected molecular parameters an optimized artificial neural network (ANN) model was developed. The resulting models showed good prediction ability. Although the ANN prediction results are more accurate than the GA-MLR model, the application of the latter is more convenient.

- **Keywords:** AIT; QSPR; GA-MLR; ANN; Hydrocarbons

Wen Nie, Xiao Ma, Weimin Cheng, Yanghao Liu, Lin Xin, Huitian Peng, Wenle Wei. *A novel spraying/negative-pressure secondary dust suppression device used in fully mechanized mining face: A case study*. Pages 126-135.

Aiming at improving the spraying dust suppression performances between the coal cutter hydraulic supports, a novel spraying/negative-pressure secondary dust suppression device was developed. In this device, the nozzle's atomization performance including atomizing angle, spraying range and droplet diameter were measured so as to select the optimal nozzle. A nozzle with optimal overall atomization performance was selected among 4 kinds of nozzles with hollow and solid cone-shaped spraying fields. At the optimal spraying pressure of 8 MPa, the spraying field of the developed dust suppression device can almost cover all the space between coal walls and hydraulic support's columns, and effectively absorb the dusty airflow in the footway. Field measurements indicated that, compared with the original dedusting method, the dust suppression rates of total coal dust and respirable dust in the fully mechanized mining face by the developed novel spraying device can be enhanced by 26.2% and 27.3% respectively and reach efficiencies up to 82.0% and 80.9%, respectively. The dust suppression rates of total coal dust and respirable dust in the working area for supports moving workers can be enhanced to 81.5% and 80.1%, respectively.

- **Keywords:** Coal dust; Fully mechanized mining face; Hydraulic support; Nozzle; Spraying; Negative-pressure secondary dust suppression

Mesut Taskin, Serkan Ortucu, Yagmur Unver, Ozden Canli Tasar, Mustafa Ozdemir, Haluk Caglar Kaymak. *Invertase production and molasses decolourization by cold-adapted filamentous fungus Cladosporium herbarum ER-25 in non-sterile molasses medium*. Pages 136-143.

This study was undertaken to remove the coloring compounds of molasses as well as produce extracellular (exo) invertase in sterile and non-sterile molasses medium by using cold-adapted filamentous fungus Cladosporium herbarum ER-25. It was determined that a combination of low culture pH (5.5), temperature (20 °C) and high molasses

concentration (6%) could completely prevent undesired bacterial contamination during the cultivation of C. herbarum ER-25. Under the optimized non-sterile culture conditions, the maximum invertase activity (36.1 U/mL) was attained after 72 h. On the other hand, the fungus could remove toxical dark brown pigments (melanoidins) in non-sterilized molasses medium through biodegradation and bioadsorption mechanisms. A color removal rate of 64.8% in non-sterile medium could be achieved at the end of 144-h cultivation period. It was found that laccase and manganese peroxidase were responsible for biodegradation. No ligninase activity was detected for the fungus during the cultivation. Maximum laccase (4.6 U/mL) and manganese peroxidase (3.5 U/mL) activities could be reached after 120 h. Higher invertase activity and color removal rate were achieved in non-sterilized medium compared to sterilized one. This is the first report on invertase production from cold-adapted microorganisms under non-sterile culture conditions. As an additional contribution, use of cold-adapted fungi for molasses decolourization was investigated for the first time in the present study.

- **Keywords:** Cladosporium herbarum ER-25; Cold-adapted; Invertase; Non-sterile molasses; Decolourization; Optimisation

Seda Karayünlü Bozbaş, Yasemin Boz. *Low-cost biosorbent: Anadara inaequivalvis shells for removal of Pb(II) and Cu(II) from aqueous solution*. Pages 144-152.

his study used untreated Anadara inaequivalvis shells as a biosorbent for Cu(II) and Pb(II) ion removal from aqueous solutions. The biosorbent was characterized using SEM, XRD, BET, and FT-IR. Results showed that the main seashell structure was aragonite with a heterogenic surface. Batch experiments were performed to determine the effects of contact time, initial pH, and biosorbent amount on biosorption efficiency and the isotherms were examined. The biosorption thermodynamics and kinetics also were determined using equilibrium data. The maximum biosorption capacities of Cu(II) and Pb(II) were 330.2 and 621.1 mg/g, respectively (seashell particle size 250 μm, 100 mg/L metal ion solution, 2.5 mg biosorbent, 25 °C). Langmuir isotherm fitted the equilibrium data better than the Freundlich and Temkin isotherms; biosorption was spontaneous and exothermic. The kinetic parameters were pseudo-second-order. This low cost and natural biosorbent successfully removed heavy metal ions from water and could be used to treat wastewater.

- **Keywords:** Biosorbent; Heavy metal ions; Seashell; Water treatment

Mohsen Behbahani, Youngwoo Seo. *Investigation on haloacetic acid (HAA) degradation by iron powder: Application of response surface methodology*. Pages 153-162.

Response surface methodology (RSM) was applied to investigate the degradation of major haloacetic acids (HAAs) in aqueous solutions using iron powder. The individual and combined effects of initial pH, iron dosage, and reaction time were considered as three major controlling factors. For all HAAs, the decrease of initial pH value and the increase of iron dosage improve degradation efficiency. The increase of reaction time was found to be influential on all HAA degradation (except DCAA and TCAA). However, its effect was not as significant as that of the initial pH and iron dosage. Brominated HAAs show higher degradation rates than chlorinated ones in similar experimental conditions. According to the ANOVA (analysis of variance) test outcomes, all the developed regression models to predict HAA degradation presented high R2 values (0.95, 0.92, 0.93, 0.99, 0.97, and 0.97 for TCAA, DCAA, MCAA, TBAA, DBAA, and MBAA, respectively) which confirms the applicability of polynomial regression models for HAA removal estimation.

- **Keywords:** Disinfection by products; Haloacetic acid degradation; Iron powder; Response surface methodology; Analysis of variance; Polynomial regression models

Xinhong Li, Guoming Chen, Hongwei Zhu. *Quantitative risk analysis on leakage failure of submarine oil and gas pipelines using Bayesian network*. Pages 163-173.

Submarine pipeline is the major transportation way of subsea oil and gas production. Due to the internal and external factor, the failure probability of submarine pipeline is increasing, which could lead to the spill accidents of oil and gas. Efficient risk analysis is vital for preventing and mitigating such potential accident. This paper presents a risk-based accident model to conduct quantitative risk analysis (QRA) for leakage failure of submarine pipeline. Firstly, we employ bow-tie method to model the causal relationship between pipeline leakage and potential accident scenarios. Subsequently, in order to overcome the difficulties of bow-tie in modeling uncertainties and conditional dependency, a Bayesian network model for pipeline leakage is developed through mapping from the former bow-tie. Meanwhile, an object-oriented Bayesian network that has a smaller and more clarified structure is also constructed by modularizing the primary Bayesian network. Eventually, the probability updating is implemented in risk analysis using Bayesian network when a new evidence or observation occurs, and an experience learning from accident precursor data is also conducted through Bayesian approach. The proposed accident model based on Bayesian network can provide a more case-specific and realistic analysis consequence compared to bow-tie method, since it could consider the common cause failures and conditional dependency in accident evolution process of pipeline leakage.

- **Keywords:** Quantitative risk analysis; Leakage failure; Submarine oil and gas pipeline; Bow-tie model; Bayesian network; Accident precursor data

Jong-Chan Yoo, Yeon-Jun Shin, Eun-Jung Kim, Jung-Seok Yang, Kitae Baek. *Extraction mechanism of lead from shooting range soil by ferric salts*. Pages 174-182.

The conventional soil washing process uses inorganic acids to extract metal from contaminated soils; however, soil structure disturbance is a negative by-product of the process using the acids. To minimize the adverse effects of soil washing, the use of alternative extractants is needed. Ferric chloride has a low pKa value, and anionic chloride ligand can enhance the extraction of toxic cationic metals from soils. In this study, a soil washing process using ferric chloride and ferric nitrate was applied to a Pb-contaminated model and field shooting range soils, and the outcome was compared to the use of conventional inorganic acids. The extraction of Pb from both soils was mostly dependent on the equilibrium solution pH regardless of the extractants used, and chloride could not significantly enhance that. Ferric iron enhanced the extraction of Pb compared to the inorganic acid treatment because ferric could generate continuously hydrogen ions by the equilibrium reaction between ferric ions and ferric hydroxide. Ferric chloride may be an attractive alternative extractant for the soil washing of Pb-contaminated soils. However, although Pb concentration in soil was significantly decreased by washing process, soil enzyme activity and plant growth was inhibited by severe soil acidification. Additionally, ferric salt-based washing showed similar seed germination test using tomato (Solanum lycopersicum) with HCl-based washing. Therefore, ferric salt based soil washing could remove more Pb from the shooting range soil with similar quality of soil compared to inorganic-based washing.

- **Keywords:** Ferric chloride; Fractionation; Inorganic acid; Lead; Soil washing; Soil quality

Ruochen Liu, A. Rashid Hasan, Amar Ahluwalia, M. Sam Mannan. *Well specific oil discharge risk assessment by a dynamic blowout simulation tool*. Pages 183-191.

Despite the implementation of multiple sophisticated safety barriers, well blowout, the most undesired disaster for the petroleum industry, still happens as Macondo or Montara incidents show. The crush of crude price has pushed the operators toward cost-cutting plans. Such plans, in short terms, may significantly reduce the exploration and operation costs and relieve financial pressures. On the other hand, such measures may also compromise the balance among safety, reliability and cost in the long term and potentially lead to catastrophic accidents. The current regulation in the Gulf of Mexico region requires the operators to report a single value for the worst-case discharge (WCD) during a possible blowout. However, it does not provide any additional value to manage risk of uncontrolled wellbore flow event and the impact to the marine environment. In this paper, a practical and comprehensive oil spill risk assessment method is introduced. It couples the reservoir/wellbore models and distribution of uncertainties to depict the risk picture of uncontrolled wellbore flow events. Statistical design of experiments is conducted to determine important uncertainties to the blowout risk. As shown by sensitivity analysis, this method can guide the operators to allocate limited resources to the important barriers and make proper risk reduction plans, so that the blowout risks are effectively controlled.

- **Keywords:** Blowout; Oil spill; Oil discharge amount; Risk assessment; Prevention and mitigation; Risk management

Mohamad Ghalebizade, Bita Ayati. *Solar photoelectrocatalytic degradation of Acid Orange 7 with ZnO/TiO2 nanocomposite coated on stainless steel electrode*. Pages 192-202.

Dyes, especially azo dyes, are among the most applicable compounds in textile and dyeing industries. Using the photoelectrocatalytic method for degrading wastewaters has recently attracted researchers' attention. By using the potential difference between anode and cathode in these systems, the lifetime of electron–hole pairs formed by photocatalysts increases, and the possibility of their recombination decreases to the least possible extent. In this investigation, the photoelectrocatalytic process was used for removing synthetic wastewater under solar irradiation with graphite cathode and stainless steel anode coated by ZnO/TiO2 nanocomposite. A LC–Mass test was performed on wastewater to investigate its products; the energy consumption was also calculated and optimized. The results showed that the process' optimum condition of the effective parameters included current density = 1 mA/cm2, pH 6.5, without aeration, dye concentration = 100 mg/L and electrode area = 30 cm2. Under these conditions, the dye removal efficiency after 180 min and COD removal after 270 min were 97% and 99%, respectively, and the energy consumption was 0.19 kWh/kg. Based on the results, the photoelectrocatalytic method is a powerful method for removing organic compounds especially in wastewater degradation containing the dye and persistent pollutants because it enhances hydroxyl radical production.

- **Keywords:** pH; Energy consumption; Aeration rate; Current density; Carbon nanotube; Synthetic wastewater

Botao Qin, Lin Li, Dong Ma, Yi Lu, Xiaoxing Zhong, Yuwei Jia. *Control technology for the avoidance of the simultaneous occurrence of a methane explosion and spontaneous coal combustion in a coal mine: A case study*. Pages 203-211.

Methane gas explosions and spontaneous combustion of coal severely threaten mining production safety and efficiency. Methane drainage can reduce the risk of a methane explosion while it may intensify the self-ignition of coal. To understand the relationship between these two issues, a working face of the Xinji No.2 Coal Mine in China was studied. A model of high drill holes extraction (HDHE) is established and the methane concentration distribution and air leakage under four different drainage pressures (below atmospheric) were determined. The simulation results show that drainage pressures can control the methane concentration in the air, so as not to exceed a threshold value. However, these drainage pressures enlarged the size of the zone where spontaneous combustion could occur due to the increase in air leakage. The possibility of the coexistence of a methane explosion and spontaneous coal combustion was proposed. This is an important index for the selection of a reasonable methane drainage pressure. The monitoring data from the mine were used to validate the model.

- **Keywords:** Coexistence disasters; Methane drainage; Spontaneous combustion of coal; Simulation; Methane concentration; Methane explosion

Farzin Nekouei, Hanieh Kargarzadeh, Shahram Nekouei, Farzaneh Keshtpour, Abdel Salam Hamdy Makhlouf. *Novel, facile, and fast technique for synthesis of AgCl nanorods loaded on activated carbon for removal of methylene blue dye*. Pages 212-226.

This article introduces a novel, facile, and simple technique for synthesis of AgCl nanorods modified activated carbon (AgCl-NRs-AC) for the first time as a new sorbent for removal of hazardous methylene blue (MB) dye from aqueous solution. Different characterization methods including field emission scanning electron microscopy (FESEM), X-ray diffraction (XRD), and response surface methodology (RSM) were applied to examine the removal of MB by AgCl nanorods loaded on activated carbon as a new sorbent. A quadratic model was used to predict the variables. Central composite design (CCD) was used for the evaluation of adsorption parameters effect such as pH, adsorption dose, initial dye concentration, and contact time on the percentage removal of MB dye from aqueous solution. Analysis of variance (ANOVA) exhibited a high R2 value of 0.9900, high F-value (105.79), very low P-value, and non-significant lack of fit demonstrating good correlation between experimental and predicted values of the response. The optimum conditions were determined to be pH = 7, adsorbent dose = 15 mg, initial dye concentration 25 mg L−1, and contact time of 16 min. Under the optimum conditions, the maximum removal of MB dye was 96.01670% with satisfactory desirability of 0.978. The effect of variables were examined and discussed by depicting three dimensional (3D) and contour (2D) plots to analyze the changes and the predicted responses. Results revealed that Langmuir and pseudo-second-order models were the best models for describing the adsorption process. Antibacterial activity of the synthesized nanorods were also evaluated by testing against some Gram-negative and Gram-positive bacteria. The synthesized nanorods showed effective bactericidal activity.

- **Keywords:** Adsorption; AgCl nanorods; Methylene blue; Isotherm models; Antibacterial; Response surface methodology

Selva Çavuş, Gülşah Yaşar, Yasemin Kaya, Z. Beril Gönder, Gülten Gürdağ, İlda Vergili. *Synthesis and characterization of gel beads based on ethyleneglycol dimethacrylate and 2-acrylamido-2-methyl-1-propane sulfonic acid: Removal of Fe(II), Cu(II), Zn(II), and Ni(II) from metal finishing wastewater*. Pages 227-236.

The efficiency of gel beads containing sulfonic acid (–SO3H) group was investigated for use in the removal of Fe(II), Cu(II), Zn(II) and Ni(II) ions from a real wastewater, which was provided from a metal finishing factory. Poly(EGDMA-AMPS) gel beads were

synthesized by suspension polymerization method from 2-acrylamido-2-methyl-1-propane sulfonic acid (AMPS) and ethyleneglycol dimethacrylate (EGDMA) using benzoyl peroxide (BPO), N,N,N′,N′-tetramethylethylenediamine (TEMED) and polyvinylpyrrolidone (PVP) as the initiator, accelerator and stabilizer, respectively. Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), environmental scanning electron microscopy (ESEM) and zeta potential measurements were used in the characterization of the gel beads. The gel beads showed preference mainly towards Fe(II). Ninety-seven percent of Fe(II) sorption was completed in the first 5 min, which increased to 97.7% in 30 min. And also, the sorption kinetics of the metal ions on the gel bead was analyzed with two sorption models, which is the Lagergren pseudo-first order and the pseudo-second order equations. While the sorption mechanism of the metal ions was not in accordance with a first-order model, it well fits the second-order model. The order in the sorption capacity was as follows: Fe(II) > Cu(II) > Zn(II) > Ni(II).

- **Keywords:** Sulfonic acid; Gel bead; Sorption; Real wastewater; Heavy metal ions; Kinetics

M.F. Zawrah, R.A. Gado, N. Feltin, S. Ducourtieux, L. Devoille. *Recycling and utilization assessment of waste fired clay bricks (Grog) with granulated blast-furnace slag for geopolymer production*. Pages 237-251.

In the present study, the alkali-activation process potential of the industrial by-product called waste fired clay bricks (Grog) as well as the effects of the addition of another industrial by-product known as granulated blast-furnace slag (S) on the properties of the final products has been studied. Granulated blast-furnace slag has been employed as 20%, 40%, 60% and 80% replacement of waste fired clay bricks (Grog) in the production of geopolymers. At the same time, the effects of curing time on the properties of geopolymers were investigated. The study proved a successful method for the feasibility of recycling and valorization process of two industrial by-products and converts them into valuable geopolymer products. These potential recycling processes can generate significant benefits for environmental sector and many economic impacts to the construction materials sector by using it as alternative raw material resources for the production of the geopolymer.

- **Keywords:** Waste fired clay bricks (Grog); Granulated blast-furnace slag; Recycling and valorization; Geopolymer; Construction materials

Dilek Gümüş, Feryal Akbal. *Comparison of Fenton and electro-Fenton processes for oxidation of phenol*. Pages 252-258.

This study compares the performance of Fenton and electro-Fenton processes for phenol degradation. The effects of operational parameters such as initial pH, current density, concentration of phenol and hydrogen peroxide on phenol removal was investigated in electro-Fenton process. The degradation and mineralization efficiency increased with an increase in hydrogen peroxide concentration and current density and decreased with an increase in initial phenol concentration and initial pH. It was found that optimum pH, current density and H2O2 concentration were 3.0, 1 mA/cm2 and 500 mg/L, respectively. Under the optimized conditions, the phenol and chemical oxygen demand (COD) removal efficiency reached 93.32% and 87.5%, respectively. In conventional-Fenton process, the effect of hydrogen peroxide and Fe2+ concentrations on the degradation and mineralization of phenol removal were investigated. The results indicated that the conventional-Fenton process only yields 59% mineralization. An estimation of the operating costs of the processes investigated showed that electro-Fenton was the more economical system to treat the phenol containing wastewater.

- **Keywords:** Electro-Fenton process; Fenton process; Phenol; Iron electrodes; Economic evaluation; Oxidation

Pranati Sahoo, Abanti Sahoo. *Fluidized bed reactor for treatment of gaseous pollutant: Flourides a case study*. Pages 259-270.

Gaseous effluent from Aluminium industry is treated under different operating conditions. Air and industrial gaseous effluent are used as fluidizing medium and secondary gas in the FBR respectively. The fluoride component from the effluent gas reacts with different metallic groups present in the bed materials. The exit gas was allowed to circulate back to the fluidizer for certain time period to allow proper contact among gaseous effluent and bed materials. Different bed materials are used at high temperatures to check the maximum reduction of fluorides from industrial gaseous effluent. The phase composition and structural transition of bed materials at different temperatures are analysed. Characterisation of bed materials before and after the experiments are carried out by several types of analysis like FT-IR, ICP-MS, FESEM, EDX, PSA, BET and XRD analysis. After the experiments, the presence of fluoride was confirmed through all characterisation techniques. Presences of NaF, AlF3, FeF2, and FeF3 in the bed material were confirmed by above mentioned analysis techniques. From these analysis reports, it can be concluded that abatement of fluorides from industrial effluents by FBR is confirmed, thereby implying the fluidized bed technique to be the most efficient technique for abatement of fluorides from gaseous effluents.

- **Keywords:** Fluidized bed reactor; Industrial gaseous effluent; XRD analysis; ICP-MS analysis; EDX analysis; FT-IR analysis