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Refaul Ferdous, Faisal Khan, Rehan Sadiq, Paul Amyotte, Brian Veitch. *Handling data uncertainties in event tree analysis*. Pages 283-292.

Event tree analysis (ETA) is an established risk analysis technique to assess *likelihood* (in a probabilistic context) of an accident. The objective data available to estimate the *likelihood* is often missing (or sparse), and even if available, is subject to incompleteness (partial ignorance) and imprecision (vagueness). Without addressing incompleteness and imprecision in the available data, ETA and subsequent risk analysis give a false impression of precision and correctness that undermines the overall credibility of the process. This paper explores two approaches to address data uncertainties, namely, fuzzy sets and evidence theory, and compares the results with Monte Carlo simulations. A fuzzy-based approach is used for handling imprecision and subjectivity, whereas evidence theory is used for handling inconsistent, incomplete and conflicting data. Application of these approaches in ETA is demonstrated using the example of an LPG release near a processing facility.

- **Keywords:** Data uncertainties; Fuzzy-based approach; Evidence theory; Event tree analysis; Monte Carlo simulations

Saad A. El-Sayed. *Ignition characteristics, conditions of criticality and disappearance of criticality of cumene hydroperoxide reaction by modeling approach*. Pages 293-299.

The thermal explosion problem of cumene hydroperoxide exothermic reaction which is used in chemical industries for production of some chemical materials is investigated. The analytical solutions of the problem to determine the margin between ignition and non-ignition systems are presented. The solution offers different analytical expressions which relate between the critical parameters for both steady and unsteady-states in different planes of solutions for different cases. The numerical solutions in different planes offer different trajectories of solution as sub-critical (non-ignition) and supercritical (ignition). Also from the numerical solution the relations between the critical parameters are presented. The critical behaviors from both analytical and numerical solutions are concise and pertained the same results.

- **Keywords:** Thermal explosion; Ignition characteristics; Critical and transition conditions; Hazard materials

Tsung Wen Chien, Hsin Ta Hsueh, Bo Yu Chu, Hsin Chu. *Absorption kinetics of NO from simulated flue gas using Fe(II)EDTA solutions.* Pages 300-306.

The absorption of NO encountering flue gases in aqueous solutions of Fe(II)EDTA was determined using a semi-batch stirred tank with a plane gas-liquid interface at 50 °C. The concentrations of NO, SO₂ and O₂ in the feeding stream were 300–800 ppm, 500–2200 ppm and 0–20%, respectively. The pH value of the Fe(II)EDTA solutions varied from 3 to 11. The concentrations of Fe(II)EDTA were maintained between 0.01 and 0.05 M. Experiments were performed to evaluate the effect of operating parameters on the NO absorption rate, the reaction kinetics of the reactants in gas and liquid phases, and the effect of competition between various reactants on the mass transfer rate in the NO removal system. Results indicate that the average reaction rate constant is $3.70 \times 10^7 \text{ M}^{-1} \text{ s}^{-1}$. Adding NaOH does not increase the absorption capability of Fe(II)EDTA. The presence of O₂ decreases the NO absorption rate with Fe(II)EDTA. The absorption rate of NO with Fe(II)EDTA decreases at low concentrations of SO₂, but increases at high concentrations.

- **Keywords:** Flue gas; Wet scrubbing; NO_x removal; Fe(II)EDTA

Tao Bai, Hengyi Lei, Guangwei Yu, Qiang Yu, Zhong Li, Hualiang Li. *High nitrite accumulation and strengthening denitrification for old-age landfill leachate treatment using an autocontrol two-stage hybrid process.* Pages 307-314.

An autocontrol two-stage hybrid process was developed to treat landfill leachate. Biological nitrogen removal with nitrification and denitrification via nitrite pathway was split into two stages. The first stage was designed for the high nitrite accumulation and was composed of two hybrid bed reactors (Hybrid I and Hybrid II) and a coagulation-flocculation reactor having effective volumes of 120 L and 80 L, respectively. The second stage was designed for strengthening denitrification and included a single 80 L reactor. The carriers of the hybrid bed reactors were composed of fixed multiple flexible carriers and suspended particle carriers. Dissolved oxygen (DO), pH value, oxidation-reduction potential (ORP) and temperature were used as online fuzzy control parameters of the automatic control system. The concentration of nitrite in Hybrid I and Hybrid II could reach 411 mg L⁻¹ and 604 mg L⁻¹, respectively. Ammonia removal has reached maximal rates of 0.061 kgNH₄⁺-N (m³ h)⁻¹ and 0.041 kgNH₄⁺-N (m³ h)⁻¹, respectively. A maximum nitrite removal rate of 0.211 kgNO₂⁻-N (m³ h)⁻¹ was observed during the strengthening denitrification. The running time of one cycle was not fixed and was actually controlled by the system. The results indicated that the running period was more closely related to influent ammonia concentration than influent COD concentration. The aeration times could be shortened and the energy could be saved. The autocontrol two-stage hybrid process is therefore an economical and effective way for landfill leachate treatment.

- **Keywords:** A two-stage hybrid bed reactor; Landfill leachate; Shortcut nitrification and denitrification; Automatic control

Daniela Meyer Fernandes, Cynthia Fraga Scofield, Arnaldo Alcover Neto, Mauri José Baldini Cardoso, Fatima Maria Zanon Zotin. *The influence of temperature on the deactivation of commercial Pd/Rh automotive catalysts.* Pages 315-322.

Automotive catalyst deactivation can be promoted by thermal and poisoning mechanisms. Catalyst efficiency is reduced by thermal degradation resulting in the agglomeration of precious metals and the reduction of the washcoat surface area. In this

paper, the temperature influence on the commercial Pd/Rh-based automotive catalyst performance was studied. Textural and physicochemical characterisation techniques were employed, such as X-ray fluorescence (XRF), atomic absorption spectrometry (AAS), N₂ physisorption, X-ray diffraction (XRD), temperature programmed reduction (TPR) and scanning electron microscopy coupled with energy-dispersive X-ray analysis (SEM-EDX). The catalysts were evaluated for CO and propane oxidation with a stoichiometric gas mixture similar to engine exhaust gas. The results indicated the transformation of alumina into high temperature phases and the formation of new mixed oxide phases. Evidence of sintered particles and several spots of palladium agglomerates was seen by SEM-EDX analysis. The activity results showed the effects of thermal deactivation on the conversion of the pollutants. In spite of exposure to extreme temperature conditions (72 h at 1200 °C), significant activity was still observed for carbon monoxide and propane oxidation reactions.

- **Keywords:** Automotive catalyst; Thermal deactivation; Propane oxidation; Carbon monoxide oxidation

Youqing Wu, Shiyong Wu, Jing Gu, Jinsheng Gao. *Differences in physical properties and CO₂ gasification reactivity between coal char and petroleum coke.* Pages 323-330.

This paper mainly investigated the physical properties and gasification reactivity of coal char and petroleum coke, separately at the high temperature pyrolysis (950–1400 °C) with slow heating rate and pyrolysis pressure of the atmospheric pressure and at the pressurized pyrolysis (the atmospheric pressure to 3 MPa) with rapid heating rate and the pyrolysis temperature of 950 °C. Some significant differences in those between coal chars and petroleum coke were found. The high temperature pyrolysis caused more easily the graphitization of petroleum coke than that of coal char, especially in the higher temperature range. The increasing pyrolysis temperature resulted in the decrease of surface areas of coal char and the increase of surface areas of petroleum coke. As the pyrolysis pressure was elevated from the atmospheric pressure to 3 MPa, surface areas of petroleum coke initially increased and then decreased, while those of coal chars presented an opposite tendency. The increasing pyrolysis temperature was adverse to the gasification activity of coal chars and was favorable for the gasification activity of petroleum coke. Also, the effects of the pyrolysis pressure on the gasification activity of coal char and petroleum coke were significantly different. The gasification activity of petroleum coke was obviously lower than that of coal chars, and even lower than that of the natural graphite.

- **Keywords:** Coal char; Petroleum coke; Physical property; Gasification reactivity; Pressurized pyrolysis

K. Walha, R. Ben Amar, P. Bourseau, P. Jaouen. *Nanofiltration of concentrated and salted tuna cooking juices.* Pages 331-335.

Tuna cooking juice from a Tunisian tuna-processing unit has a high level of polluting load: chemical oxygen demand (COD) is comprised between 4 and 20 g L⁻¹, nitrogen kjedahl (NK) between 0.6 and 3 g L⁻¹ and dry matter between 120 and 160 g L⁻¹. The juice has thus to be treated before being rejected into the environment. This paper considers the nanofiltration (NF) of these concentrated organic/inorganic mixtures using an AFC 30 (NF) membrane. The work focusses on the effect of organic and inorganic matters on the permeate flux and rejections of these matters. For this purpose, mixtures of salt and organic pollution (COD), used as model solutions, were prepared by the dilution of a typical industrial tuna cooking juice. The permeate flux was found to decrease when salt and organic matter concentrations increase. The recovery rate in organic matter decreases with increasing salt or organic matter content and the recovery rate of salt decreases when the COD concentration increases.

- **Keywords:** Nanofiltration; Tuna cooking juice; Organic/inorganic matters retention

K.W. Pi, L.X. Gao, M.X. Fan, W.Q. Gong, D.J. Wan. *Two-stage biodegradation coupled with ultrafiltration for treatment of municipal landfill leachate. Pages 336-342.*

The municipal landfill leachate was treated in a hydrolysis–acidification reactor (HAR)/aerobic bio-contact oxidation reactor (ABOR) following a pretreatment with ultrafiltration (UF) membrane. Experiments were conducted continuously for 44 days at a constant flow rate of 20 l d^{-1} and organic loading rates (OLRs) from 0.75 to 1.5 kgCOD m^{-3} per day. The results showed that COD of the leachate steadily decreased from $20,015 \text{ mg l}^{-1}$ to less than 3000 mg l^{-1} , and $\text{NH}_4\text{-N}$ decreased from 368.6 mg l^{-1} to 259.3 mg l^{-1} in the UF process. The COD and $\text{NH}_4\text{-N}$ removal efficiency of HAR was 56.7% and 27.7%, and that of ABOR was 94.6% and 86.7%, respectively. The total COD and $\text{NH}_4\text{-N}$ removal efficiency reached 99.6% and 93.2%, respectively. UF and HAR played a critical role in raising the biodegradability of the landfill leachate, while ABOR had an important function on removing the dissolved $\text{NH}_4\text{-N}$ in leachate.

- **Keywords:** Ultrafiltration; Hydrolysis–acidification reactor (HAR); Aerobic bio-contact oxidation reactor (ABOR); Municipal landfill leachate; Biogas production; Biodegradability

Shenghui Guo, Wei Li, Libo Zhang, Jinhui Peng, Hongying Xia, Shiming Zhang. *Kinetics and equilibrium adsorption study of lead(II) onto the low cost adsorbent—*Eupatorium adenophorum spreng*. Pages 343-351.*

Adsorption of Pb(II) ions from aqueous solution onto a low cost adsorbent—the *Eupatorium adenophorum spreng* has been investigated to evaluate the effects of initial lead ion concentration, contact time, pH and temperature on the removal of Pb(II) systematically. The optimal pH value for Pb(II) adsorption onto the *E. adenophorum spreng* was found to be 5.0. Thermodynamic parameters such as standard Gibbs free energy (ΔG°), standard enthalpy (ΔH°), and standard entropy (ΔS°) were evaluated by applying the van't Hoff equation, which describes the dependence of equilibrium constant on temperature. The thermodynamics of Pb(II) adsorption onto the *E. adenophorum spreng* indicated that the adsorption was spontaneous and endothermic. Langmuir and Freundlich isotherms were used to analyze the equilibrium data at different temperatures and the equilibrium data were found to fit Freundlich isotherm equation better than Langmuir isotherm. The adsorption was analyzed using pseudo-second-order kinetic models.

- **Keywords:** *Eupatorium adenophorum spreng*; Adsorption; Pb(II) ; Isotherm; Kinetics