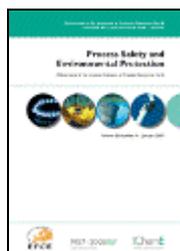


Process Safety and Environmental Protection

rok 2008, ročník 86

Číslo 6 (November 2008)



G.R. Astbury. *A review of the properties and hazards of some alternative fuels.* S. 397-414.

Abstract: The drive to find alternative fuels to replace such hydrocarbons as diesel and petrol has resulted in a plethora of different fuels—few of which are commercially available in significant quantities. As fuels, by their very nature, must be flammable, the fire, explosion and ignition properties will need to be known. Types of alternative fuels available are described and their ignition and explosion hazards with reference to existing commonly used fuels are discussed. The properties of 13 alternative fuels are given. Of all these alternative fuels, almost all have properties which are similar to those of existing types of fuels, and therefore the technology required to handle them is already well known and available. Hydrogen is the one exception—its ignition and combustion properties are quite different from those of conventional fuels, and hence the specific difficulties and hazards associated with the use of hydrogen are highlighted. Much existing technology is not applicable to hydrogen and there are many areas where adequate knowledge or data is not available. The area of most concern is that hydrogen appears to be prone to ignite spontaneously when released from high pressure, but there is as yet no rigorous scientific explanation for this. Further work is required to obtain greater knowledge of the properties, behaviour and safe use of hydrogen, as this is most likely to be “fuel of the future”.

- **Keywords:** Alternative fuels; Ignition; Combustion; Explosion; Hydrogen

J.M. Tseng, C.Y. Kuo, M.Y. Liu, C.M. Shu. *Emergency response plan for boiler explosion with toxic chemical releases at Nan-Kung industrial park in central Taiwan.* S. 415-420.

Abstract: A large amount of hazardous materials and equipment has been extensively employed to produce useful chemicals for our daily lives, but many serious accidents, such as fires, explosions, toxic releases, and so on, that harm human beings and impact the environment have occurred during preparation, operation, and transportation of these chemicals. On 17 May 2007, a toxic release from a boiler explosion in a chemical firm triggered a large amount of xylene (7 ton), isopropanol (8 ton), phosphorus trichloride (44.7 ton), and dimethyl formamide (DMF) (1.37 ton) to be released to the

atmosphere with total damages of 2000 m² level ground. Through concerted efforts from the Yunlin Emergency Response Information Center (YERIC), sponsored by the Environmental Protection Administration (EPA) of Taiwan and other government sectors, this accident was eventually well controlled after 37 h with 107 people being involved in the rescue action. This study could be applied to lessen the degree of hazard for relevant accidents with an emergency response plan (ERP), and, via Fourier transform infrared (FTIR) spectroscopy and photo ionization detector (PID) the toxic concentrations of airborne chemicals that occurred in the industrial area could be analyzed.

- **Keywords:** Explosions; Toxic releases; Emergency response plan (ERP); Fourier transform infrared (FTIR)

M.Y. Gunasekera, A.A.P. de Alwis. *Process industry accidents in Sri Lanka : analysis and basic lessons learnt. S. 421-426.*

Abstract: Accidents in the process industry could be prevented or reduced by having good safety management measures. Such preventive measures could be further improved through the experiences and lessons learnt from past accidents. Therefore, analysis results of past accidents are valuable sources of information for determining root causes and as case material to prevent and reduce the adverse consequences of accidents in the process industry. This paper looks at accidents in the process industry that have occurred in the past 10 years from 1997 to 2006 in Sri Lanka to gain an understanding of the nature and consequences of accidents. Lessons and main areas of concern to improve safety in the Sri Lanka process industry are discussed. The analysis is done for different event types based on specific operating process stage during which the accident occurred such as processing, loading and unloading, repair and maintenance and storage, the immediate effect types such as fire, explosion, chemical releases and emissions and the consequences of each accident. Fire incidents were observed in 38 accidents analyzed. The results show that the highest number of accidents has occurred during processing operations followed by accidents during maintenance and repair work. The cause analysis shows that many accidents have occurred due to technical and human failures. The accidents are then classified according to the severity of the consequences in order to compare the nature of accidents experienced in Sri Lanka with respect to accidents in other countries in the world.

- **Keywords:** Accident; Sri Lanka; Process industry; Database

A.L. Stephenson, J.S. Dennis, S.A. Scott. *Improving the sustainability of the production of biodiesel from oilseed rape in the UK. S. 427-440.*

Abstract: Owing to concerns about energy security and because of increased environmental awareness, the biofuel industry is expanding worldwide. It is therefore extremely important to be able to quantify the sustainability of biofuels in order to determine their benefits over using conventional fossil fuel derived transport fuels. This study investigates the total energy requirement and global warming potential (GWP) of the production of biodiesel from oilseed rape in the UK, using life cycle analyses. Large- and small-scale productions are compared and the sensitivity of these environmental impacts to production variables investigated. Possible changes to the processes are considered, with a view to reduce the energy requirement and global warming potential. This research shows that the scale of the production of biodiesel from oilseed rape in the UK, and the transport involved in the various stages of manufacture, has little effect on its global warming potential. It is also shown that if the rape meal and glycerol were combusted in combined heat and power plants, and the rate of application of nitrogenous fertiliser were reduced from 211 kg/ha to 100 kg/ha, the energy requirement and global warming potential savings from using biodiesel rather than ultra low sulphur diesel would increase dramatically, to 170% and 120%, respectively, on a basis of equivalent net energy content.

- **Keywords:** Life cycle analysis; Biodiesel; Oilseed rape; Rapeseed oil; Sustainability

Bao-Xiang Peng, Qing Shu, Jin-Fu Wang, Guang-Run Wang, De-Zheng Wang, Ming-Han Han. *Biodiesel production from waste oil feedstocks by solid acid catalysis. S. 441-447.*

Abstract: Biodiesel is a non-toxic and biodegradable substitute for petroleum-based diesel. However, it is impractical to use refined edible oils to produce biodiesel due to its high cost and priority for food products, especially in China, while waste oils with high free fatty acids (FFAs) can be considered as the raw materials. In the present work, a solid acid catalyst comprising $\text{SO}_4^{2-}/\text{TiO}_2\text{-SiO}_2$ was prepared, characterized and studied for its activity for the production of biodiesel from several low cost feedstocks with high FFAs. The solid acid catalyst can be recycled, easily removed and can simultaneously catalyze esterification and transesterification. The influence of reaction parameters was studied, and the optimized reaction parameters are reaction temperature 200 °C, molar ratio of methanol to oil 9:1 and catalyst concentration 3 wt.%. The catalyst showed good stability. A continuous process for biodiesel production from cheap raw feedstocks was proposed, and a 10,000-tonnes/year biodiesel production demonstration plant has been built.

- **Keywords:** Biodiesel; Solid acid; Esterification; Transesterification; Waste oil feedstock

Hai Zhao, Dexiang Zhang, Fangfang Wang, Tingting Wu, Jinsheng Gao. *Modification of ferrite–manganese oxide sorbent by doping with cerium oxide. S. 448-454.*

Abstract: Fe–Mn oxide and Ce-doped Fe–Mn oxide sorbents were studied on the structural and desulfurization behavior in COS removal from syngas. The effects of cerium oxide on the Fe–Mn oxides have been investigated by XRD, BET, TPR, XPS and TEM methods. Analysis data show that the Ce-doped sorbent has larger specific surface area and better particles' dispersion compared with non-modified Fe–Mn sorbent. The addition of Ce improves the reduction performance of Fe–Mn species. The desulfurization experiments show that the desulfurization activity of sorbent can be increased because of the promotion of the structural and redox properties by ceria doped. The Ce-doped sorbent can reduce COS from 15,000 ppmv to less than 0.1 ppmv at 325 °C and a space velocity of 1000 h⁻¹.

- **Keywords:** COS removal; Syngas; Ce-doped; Fe–Mn–Ce sorbent

Özer Çınar, Semra Yaşar, Metin Kertmen, Kevser Demiröz, Nevzat Özgü Yigit, Mehmet Kitis. *Effect of cycle time on biodegradation of azo dye in sequencing batch reactor. S. 455-460.*

Abstract: The effects of cycle time on the biodegradation of the azo dye remazol brilliant violet 5R (RBV-5R) were investigated in an anaerobic–aerobic sequencing batch reactor (SBR). System performance was determined by monitoring chemical oxygen demand (COD), color, anaerobic enzyme (azo reductase) and aerobic enzyme (catechol 2,3-dioxygenase), and aromatic amine concentration. SBR was operated in three different total cycle times (48 h, 24 h and 12 h), fed with a synthetic textile wastewater. In this study, the anaerobic period of SBR was found to allow the reductive decolorization of azo dye and the aerobic period was found to be effective on further COD removal after the anaerobic period. The percentage reductions in color by the anaerobic stage of the SBR were at 72%, 89% and 86% for the 24-h, 12-h and 6-h cycle times, respectively. Total COD removal efficiencies were over 75% for all operational conditions and about 70% of

the COD removal was achieved in the first 3 h of anaerobic stages. During the decolorization of RBV-5R, two sulfonated aromatic amines (benzene-based and naphthalene-based) were formed and detected by HPLC. Aerobic phases of SBR with total cycle times of 48 h, 24 h and 12 h were able to remove benzene-based aromatic amines with removal efficiency of 64%, 92% and 89%, respectively. The results indicated that the best SBR performance in terms of color removal and aromatic amine degradation was achieved from total cycle time of 24 h.

- **Keywords:** Anaerobic–aerobic treatment; Azo dyes; Biodegradation; Remazol brilliant violet 5R; Sequencing batch reactor; Textile wastewater