

Economic Ag/AgCl Electrodes Prepared from the Recovered Silver from Laboratory Waste for the Potentiometric Determination of Chloride

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In this work, we propose the idea to recover the metallic silver from laboratory waste via the cementation technique and employed it to prepare Ag/AgCl electrode. The purity of silver metal was 89.4-97.0%, as examined by the Volhard's titration. Silver was melted by torch with the temperature over 1,000°C, and then poured into a stationary mold to form a silver ingot. To make a silver wire, a manual swaging machine was employed for radial reduction of an ingot by replicatedly drawing it through a reducing die to be a wire with the size of 1 mm o.d. The wire was cut to 10 cm long, polished and cleaned before immersing it about 6.5-7.0 cm into a solution of 0.5M FeCl₃ for 12 h, to form a AgCl film on the silver wire. The electrode was then washed with water and used as a working electrode. For reference electrode preparation, a Ag/AgCl electrode was immersed in a 0.5 M KNO₃ contained in a glass tube (length 15 cm, diameter 0.5 cm) which was plugged the end of tube (2.0 cm) with agar to serve as a salt bridge. Both working and reference electrodes were assembled with a digital multimeter, operating as a voltmeter to set-up for potentiometric detection of chloride ion. Electrical potential was plotted versus logarithm of chloride concentration to obtain two linear calibration graphs, 5-20 ppm and 20-60 ppm, with the linear equation of $y = 0.0018x - 0.0347$ and $y = 0.0006x - 0.0121$, respectively. Moreover, the precision (%RSD) examined with 1 and 20 ppm of chloride solution was 0.9% and 2.7% (n=11), respectively. The prepared electrodes were used for determination of chloride in real samples comparing the results by t-test to those determined by the precipitation titration method. It was found that both methods have no significant difference at 95% confidence level.

Keywords Chloride; Ag/AgCl Electrode; Recovery; Silver; Laboratory Waste

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Recovery of Lead from E-Waste and Copper from Laboratory Waste for Self-Preparation of Economic Chemicals

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In this work, we proposed the recovery process of the metallic lead from printed circuit boards (PCB) and copper from laboratory waste with economic and simple procedure. The obtained lead and copper were further employed for preparation of economic chemicals; namely, $\text{Pb}(\text{NO}_3)_2$, $\text{Pb}(\text{CH}_3\text{COO})_2$, $\text{Cu}(\text{NO}_3)_2$ and CuSO_4 . To recover lead from PCB, the several influence parameters were examined by the analysis of lead in leach liquor using an AAS. The results shown that the maximum quantity of lead (20.23% w/v) could be obtained from ground PCB (14-25 mesh) 30 g dissolved to 100 mL of 0.3M HNO_3 at 75°C, stirring speed of 400 rpm for 2 hrs. Some leached metallic ions, especially copper and tin, can be removed by the cementation on lead wire. Lead ions were subsequently reduced by zinc strips under the studied conditions of temperature 55°C and stirred 400 rpm for 3 hrs. The metallic lead with the purity more than 84.0% was used to prepare $\text{Pb}(\text{NO}_3)_2$ and $\text{Pb}(\text{CH}_3\text{COO})_2$ by react to conc. HNO_3 and 5% CH_3COOH , respectively. The obtained $\text{Pb}(\text{NO}_3)_2$ and $\text{Pb}(\text{CH}_3\text{COO})_2$ shown the purity of 99.5% and 85.0%. For the copper recovery from laboratory waste, cementation technique was also employed using zinc as reductant. Next, the metallic copper reacted to 30% H_2O_2 and conc. H_2SO_4 with the studied suitable weight ratio of $\text{Cu}:\text{H}_2\text{O}_2:\text{H}_2\text{SO}_4$ at 3:10:3 to produce CuSO_4 , while $\text{Cu}(\text{NO}_3)_2$ was prepared from the reaction of copper and conc. HNO_3 at the weight ratio of 1:5. All processes were done at the ambient without any complicate and expensive apparatus. Both crystals occurred in a few days. Percent yields of CuSO_4 and $\text{Cu}(\text{NO}_3)_2$ were found to be 38.8 and 64.7%, respectively. From applying these chemicals as the reagent for both qualitative and quantitative analysis, there are no different results between them and commercially available chemicals.

Keywords Recovery; Lead; Copper; E-waste; Laboratory Waste

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The Sorption of CO₂ from the Hydrocarbon Mixture Gas by Silica Particles Modified with Polyethylenimine Adsorbent

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A high efficiency sorbent for CO₂ capture from the hydrocarbon mixture gas (80% CO₂, 15% CH₄, 3% C₂H₆ and 2% C₃H₈) was developed by loading 50 wt% polyethylenimine (PEI800) on silica particles. CO₂ capture was tested in a fixed-bed reactor. The effects of sorption temperature, the moisture, pressure and regeneration performance of the adsorbent was investigated. Sorption capacity of CO₂ capture from the hydrocarbon mixture gas was lower than CO₂ capture from 80% CO₂ balance in N₂. The sorption capacity was not increased significantly with the temperature 30°C to 80°C. However, the sorption capacity decreases when higher temperature at 80 °C due to the dominant desorption. Desorption of CO₂ was favored while the temperature increases to 90 °C which can desorb CO₂ up to 95% of volumetric adsorption. Therefore, the developed sorbent can be regenerated easily at 90 °C, and it exhibited stable adsorption-desorption behavior during 8 consecutive test cycles. Moisture was an importance component in the flue gas and other industrial gases. Therefore, the effect of the moisture on the sorption separation of CO₂ from the mixture gas was investigated. Moisture had a promoting effect on the sorption separation of CO₂. The CO₂ breakthrough time and CO₂ saturated sorption capacity increase 2 and 3 times, respectively when the moist was used. This is because one mole of amine groups reacts with one mole of CO₂ to form ammonium bicarbonate in the presence of water. Moreover, the sorption capacity increases with increasing pressure because higher driving force of CO₂ molecule can react easily with amine group inside the pore of adsorbent.

Keywords Carbon Dioxide; Adsorption; Fumed silica; Polyethylenimine

Estimation Density of Biodiesel Produced by Ethanolysis

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Density is an important physical property of a liquid fuel. A slight change in density can affect engine output power. In this work, an empirical approach for estimation density of pure fatty acid ethyl ester and biodiesel produced by ethanolysis based on free energy of molecular expansion with the Martin's rule of free energy additivity is proposed. The free energy of volumetric expansion is transformed to $\ln \rho = a + zb + c/T + dz/T + en_d + fn_d/T$, where a , b , c , d , e and f are thermodynamically related constants. T , z and n_d are absolute temperature, number of carbon atoms and number of double bond(s) of fatty acid, respectively. Data available in literatures are used to validate, and support the speculations derived from the proposed equation. The proposed equation is easy to use and the estimated densities at different temperatures agree well with the literature values. It is shown that it can estimated the densities of biodiesel with average deviations was 0.25%.

Keywords Biodiesel; Density; Estimation; Fatty Acid Ethyl Ester; Thermodynamic Parameters

Adsorption of Graphene Oxide for Removal of Alizarin Red S from Aqueous Solution

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Textile dyeing process is an important source of an environmental pollution. One of the most problems of textile wastewater in addition to both toxic and carcinogenic nature is color effluent. Particularly, alizarin red S (ARS) dye is widely used for dyeing textile materials. The removal of ARS is crucial process from both economical and environmental points of view. This research was aimed to study the adsorption of ARS using graphene oxide (GO) as an adsorbent compared with bare graphite powder (BGP). For optimum conditions, the effects of the initial concentration of ARS, solution pH, adsorbent dosage, and contact time were investigated in detail. The water-soluble dye was analyzed spectrophotometrically at 422 nm. The optimum conditions for ARS removal from aqueous solution were consisted of 350 mg/L initial concentration of ARS dye with 0.02 mg adsorbent at pH 2. The adsorption equilibrium was completely reached within 30 min. The maximum adsorption capacity of GO was 88.50 mg/g which was higher than that of BGP (34.13 mg/g). The adsorption isotherms for GO and BGP fit well with the Langmuir and Freundlich models, respectively. It is, therefore, evident that the as-prepared GO can be used as a high potential adsorbent for the anionic dye.

Keywords Graphene Oxide; Anionic Dye; Alizarin Red S, Adsorption Isotherm

Coconut Shell Activated Carbon Production: Comparing the Efficiency For Dye and Heavy Metal Removal

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This research was carried out in order to study the adsorption of Pb(II), Cd(II) and dye (Acridine orange) on activated carbon prepared from Coconut Shell. The treatment and preparation of coconut shell activated carbon are of importance and became a subject of study. Phosphoric acid was chosen as the chemical reagent for the carbon activated process concentrated at 20, 30, 40 and 50% (V/V). In order to know that the activated temperatures have affected by absorption performance of activated charcoal, the various temperatures were also conducted. The samples were carbonized at 600, 700 and 800 °C for 1hr. After comparing efficiency of absorbing of ARCH30% at different temperature, 800°C was selected to show the adsorption efficiency. For dye adsorption is high to 97.66%, 71.53%, 27.33% and 11.89% at concentration 50, 100, 500 and 1,000 ppm, respectively. The efficiency of absorption of Lead (II) is 96.50%, 93.50%, 63.12% and 67.05% and Cadmium (II) is 75.00%, 78.50%, 58.33% and 62.65% at concentration 5, 10, 15 and 20 ppm, respectively. Both Langmuir and Freundlich models could be used to represent the trends of adsorption on Acridine Orange. The adsorption process for metal ion followed Langmuir isotherm theory more than Freundlich isotherm.

Keywords Coconut shell; Dye; Lead ion; Cadmium ion; Adsorption isotherm

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Stable Hydrogen and Oxygen Isotope Compositions of Water used for Rice Cultivation

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Water samples used for rice cultivation collected from different locations in the northeast and south of Thailand were analyzed for their stable hydrogen ($^2\text{H}/^1\text{H}$) and oxygen ($^{18}\text{O}/^{16}\text{O}$) isotope compositions using liquid water isotope analyzer. All isotopic compositions are reported as $\delta^2\text{H}$ and $\delta^{18}\text{O}$ values, expressed in conventional δ -notation with the unit of per mil (‰). Analytical precisions for isotopic analyses of water were ± 2.0 ‰ and ± 0.3 ‰ for H and O isotope ratio measurements, respectively. The isotopic compositions of water samples from the northeast indicated that $\delta^2\text{H}$ varied from -47.92 ‰ to -18.99 ‰ and $\delta^{18}\text{O}$ varied from -5.52 ‰ to -1.08 ‰. The $\delta^2\text{H}$ and $\delta^{18}\text{O}$ ranged from -37.93 ‰ to -2.49 ‰ and -6.47 ‰ to -0.50 ‰, respectively, were observed for the water collected from the south. All sample showed $\delta^{18}\text{O}$ higher than $\delta^2\text{H}$. A good correlation between $\delta^2\text{H}$ and $\delta^{18}\text{O}$ was observed with $R^2 = 0.925$ and $R^2 = 0.900$ for water samples from the northeast and south, respectively. It is possible to separate water samples in the south from the northeast. The obtained result is useful database of the water for rice cultivation in the northeast and south of Thailand and will be used to discriminate the source of rice cultivation.

Keywords Stable isotope; Water; Hydrogen; Oxygen; Isotopic composition

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Adsorption of Cadmium from Aqueous Solution by Charcoal

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This research studied the capabilities and efficiencies of adsorption of cadmium by charcoal from mangrove. The synthetic cadmium-contaminated water was prepared at the concentration of 5.00 mg/L. The experiment was studied at room temperature (30°C). The factors affected to the adsorption process of cadmium were studied. The equilibration time of cadmium adsorption was 90 minutes. The pH value was studied in the range of 3-9. If the pH values of the solution were increased, the cadmium adsorption efficiencies were increased to about 90% at pH of 6-9. The maximum cadmium removal efficiency was 94.6% using charcoal dosage of 15.5 g/L. The adsorption isotherm of cadmium by charcoal from mangrove followed to Freundlich equation with adsorption capacity of 1.66 mg/g.

Keywords Adsorption; Cadmium; Charcoal

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Preparation and Application of Silane-modified Pectin for Treating Copper Contaminated Wastewater

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This research aims to study silane-modified pectin from pomelo peel (*Citrus maxima*) (Khao Num Peung) for treating copper contaminated wastewater. The extracted pectin was modified by silica in order to improve the capacity of copper ion adsorption. This silane-modified pectin was prepared in the form of beads by mixing 2.5% w/v pectin solution with silica sol. The silica sol. was prepared by adding 4.1668 g of tetraethylorthosilicate (TEOS), 1.1118 g of N-[3-(Trimethoxysilyl)propyl]ethylenediamine and 7.5 g of deionized water into 15 g of ethanol while stirring. The solution was stirred for 10 min and slowly dropped into 1 M CaCl₂. The obtained beads were kept in 1 M CaCl₂ solution for 24 hr. Then the beads were filtered, rinsed with distilled water and dried at 55°C for 96 hr until dry. The beads were analyzed by Scanning Electron Microscopy (SEM) and Energy Dispersive Spectroscopy (EDS). 2 g of dry silane-modified pectin bead was added into 250 mL of 100 ppm CuCl₂ solution at pH 3, 4, 5. 1 mL of Cu²⁺ solution was collected at 0.5, 10, 15, 20, 25, 30, 60, 90, 120, 150 min and 24 hr. with micropipette. The concentration of Cu²⁺ in each collected sample was determined by atomic absorption spectroscopy (AAS). The SEM image of the beads containing silane showed a rougher surface compared to the silane-free beads. The EDS data evidenced that silane-modified beads had a higher copper adsorption than silane-free pectin beads. From AAS results, the maximum Cu²⁺ adsorption of silane-modified was 37.07% at pH 3.

Keywords Silane-modified pectin beads; Copper ion adsorbent; Wastewater treatment

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CO₂ Reforming of Methane on Ni, Co-containing Al₂O₃-H-Beta Zeolite Prepared by Sol-gel Method

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In recent years, much attempt in industrial processes has been made to efficiently convert CO₂ to a useful and non-pollution compound. Specifically, the CO₂ reforming of methane is an attractive way to utilize CO₂ and CH₄ emissions that contributes to the greenhouse gas reduction. The reaction can be of important for increasing the hydrogen production. For this reasons, the majority of studies CO₂ reforming of methane (DRM) on Ni,Co-containing Al₂O₃-H-Beta zeolite. This work examined the use of H-Beta zeolite over modified Al₂O₃ support prepared by Sol-gel method. These H-Beta zeolite are characterized by their well-defined structure, high surface area, affinities for CO₂ and high thermal stability. Because of their performance, H-Beta zeolite are support of interest for DRM reaction. Nickel metal has been reported for an active metal for the DMR but suffered highly carbon formation and decreased CH₄ and CO₂ conversion. In this research, we compared between monometallic (10% Ni/Al₂O₃-H-Beta, 10% Co/Al₂O₃-H-Beta) and bimetallic (5% NiCo/Al₂O₃-H-Beta) catalysts prepared by the incipient wetness impregnation method. Samples were noticed by characterization using X-ray diffraction (XRD), N₂-physisorption, Temperature programmed desorption (NH₃-TPD), Temperature programmed reduction (H₂-TPR) and H₂-chemisorption. The catalysts were tested on dry reforming of methane with feed mixture composition of CH₄:CO₂ 50:50 Vol% and total flow rate of 70 cm³ min⁻¹ (GSHV= 37,570 h⁻¹) under atmospheric pressure at 700 °C of reaction temperature. The bimetallic 5% NiCo/Al₂O₃-H-Beta catalyst showed higher CH₄ and CO₂ conversion in comparison with monometallic system in DRM reaction. The better metal dispersion obtained in bimetallic catalyst system was believed to be responsible for the higher performance compared with the monometallic one. In the previous reason, we add Co as a reduction catalytic performance and significant increase CH₄ and CO₂ conversion.

Keywords Dry reforming of methane; Hydrogen production; Bimetallic catalyst; Al₂O₃-H-Beta zeolite support

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Effect of Extractant Type and pH on the Extraction of Amoxicillin from Pharmaceutical Wastewater

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Contamination of amoxicillin even at small level in aquatic environment may lead to the activation of antibiotic resistant in bacteria that consequently resulted in more difficulty or failure of antibiotic treatment from bacterial infection. To avoid such scenario, removal of amoxicillin from pharmaceutical wastewater should be conducted before the final discharge. One of the treatment methods to be considered is extraction, which is widely applied both in laboratory and industrial scale. This work is the preliminary study aimed to study the effect of extractant type, specifically Aliquat 336 and Di-(2-ethylhexyl)phosphoric acid (D2EHPA), as well as the pH of pharmaceutical wastewater on the extraction efficiency. The batch liquid-liquid extraction was implemented with the volume ratio of unity between synthetic pharmaceutical wastewater and 1-decanol solution of an extractant by employing a benchtop incubator shaker at room temperature and pressure. Results of the experiment revealed that the highest extraction efficiency of $54.58 \pm 0.11\%$ was achieved using 6 mM of Aliquat 336 at the initial pH of 10 for the synthetic pharmaceutical wastewater containing 500 mg/L amoxicillin. In contrast, the maximum extraction efficiency measured at $28.41 \pm 0.13\%$ was obtained when using 6 mM D2EHPA and maintaining synthetic wastewater pH at 10. The possible explanation for the obtained results was related to stronger electrostatic interaction between Aliquat 336 and amoxicillin than the intermolecular interaction of D2EHPA and amoxicillin at high pH.

Keywords Amoxicillin; Aliquat 336; D2EHPA; pH; Extraction

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Process Optimization for Biodiesel Production from Refined Palm Oil using Solid Catalyst for Environmental Friendly

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In the present research, calcium oxide particle was synthesized from quick lime and it was explored as solid catalyst for the transesterification of refined palm oil with 1.5%(wt) of free fatty content. The physicochemical properties of the catalyst were characterized by X-Ray diffraction (XRD), Scanning electron microscopy (SEM) and Energy dispersive X-Ray spectroscopy (EDX). The results from characterization showed that calcium oxide was successful synthesis when the results were compared with commercial calcium oxide. In the investigation of catalyst activity, the conventional experiment of approximate condition for transesterification of refined palm oil before response surface methodology (RSM) was performed. The results obtained from these experiments were selected and designed in five levels of each factor for RSM determination. The design of experiment was performed by application of 5-levels-3-factors central composite design in order to study the effect of different factors on the percentage of fatty acid methyl ester (FAME) conversion that determined by ¹H-NMR. The factors were catalyst concentration (%wt/wt), methanol to oil molar ratio (mol/mol) and reaction time (min). The result showed that a quadratic model was obtained for the prediction of %FAME conversion. In addition, three effect factors value obtained from RSM can improve when they are compared with conventional experiment value.

Keywords Biodiesel; Calcium oxide; Response surface methodology

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Simulation of Combined Biomass Gasifier and Reformer for Syngas Production Enhanced by using CO₂ Recycle

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Energy crisis and climate change problem are main global issues. Biomass gasification with CO₂ greenhouse gas as a gasifying agent is a solution for these problems. In this study, the suitable operating conditions for the combined biomass gasification and reforming processes for syngas production were determined by thermodynamic analysis. The simulations were carried out using Aspen Plus program. Charcoal, representing biomass, was gasified with mixture of O₂, CO₂ and steam, and then all products were fed directly to the reformer. The effects of various operating parameters such as molar feed ratio and reaction temperature on synthesis gas production and syngas ratio (H₂/CO) were considered. Simulation results indicate that higher reaction temperature and higher Steam/C feed ratio result in higher syngas ratio. However, the operation at higher ratio of CO₂/C or higher O₂/C ratio offers lower syngas ratio.

Keywords Thermodynamic; Biomass gasification; CO₂ reforming; Syngas production

Waste Spiral Babylon (*Babylonia spirata* Linnaeus) Shell as a Renewable Catalyst for Biodiesel Production

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The waste spiral babylon shells were found to be the good sources of calcium carbonate (CaCO_3), so it was converted to calcium oxide (CaO), as raw material for methyl ester catalyst used in biodiesel production. The glycerol is defined as byproduct via transesterification of palm oil with methanol. While calcination process, the calcium carbonate content in the shell will be converted to CaO under high temperature. To obtain an optimal calcination temperature, the waste spiral babylon shells were calcined at 500-900 °C for 5h. The XRD results showed high CaO content at 900 °C. The optimal condition to yield 97% biodiesel is 80 ± 5 °C for 7 hr, 10%wt of catalyst (waste shell calcined at 900 °C) and 1:3 ratio of methanol/oil. The reusability of the CaO catalyst derived from waste shell was also performed, over 4 times with 60% conversion.

Keywords Biodiesel; Transesterification; Waste spiral babylon shell; Calcium oxide

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Cadmium Induced the Synthesis of High-sulfhydryl Proteins in *Moina macrocopa*

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This study investigated the synthesis of high-sulfhydryl proteins in the water flea *Moina macrocopa*, a well established biomonitor of trace metal contamination in aquatic environment, in response to laboratory exposure to Cd concentration at 0, 0.02, 0.04, 0.08 and 0.16 mg.L⁻¹ for 48 h. The induced high-sulfhydryl proteins extract was obtained by ethanol/chloroform precipitation of the tissue homogenate. The SDS-PAGE separation and the fluorometric analysis of proteins, labelled with the fluorogenic thiols reagent monobromobimane (mBBr), showed the presence of four fluorescent protein bands, indicating the induction of sulfhydryl (-SH) rich proteins. The molecular weight of high-sulfhydryl proteins was estimated to be 50, 35, 30 and 14 kDa, respectively. The fluorescence intensity of each protein band increased significantly in a Cd dose-dependent manner except in the control group and in *M. macrocopa* exposed to the lowest concentration of Cd. This evidence led us to hypothesize that high-sulfhydryl proteins can be induced in *Moina macrocopa* by multiple exposures to Cd. The results implied that the induction of high-sulfhydryl proteins is an essential component of the heavy metal detoxification process by the microcrustacean.

Keywords Cadmium; High-sulfhydryl proteins; *Moina macrocopa*; Monobromobimane

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Doping of CeO₂ in V₂O₅-TiO₂ Catalyst for Low-Temperature Selective Catalytic Reduction of Nitrogen Oxide by Ammonia

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Nitrogen oxide (NO_x) is a major air pollutant, which was emitted from the fuel combustion in stationary sources. NO_x play a great role in the formation to acid rain and photochemical smog. Selective catalytic reduction (SCR) is a well-established and widely-used process for the abatement of NO_x present in waste gas streams from stationary sources. With the SCR unit, NO_x present in the waste gas streams is reduced by ammonia to yield nitrogen and water as products. This research investigated the selective catalytic reduction of NO by NH₃ over V₂O₅-CeO₂/TiO₂ catalyst at low temperature. Formation of nitrous oxide from the ammonia oxidation reaction and SCR reaction was also investigated. Titanium dioxide support was prepared by a sol-gel method. Then vanadium and cerium were deposited via an incipient wetness impregnation method. The amounts of vanadium and cerium in the catalyst ranged from 1 to 9%wt and 10 to 40%wt, respectively. The catalyst were characterized by N₂ physisorption, ICP-OES, XRD and NH₃-TPD techniques. The testing of SCR activity of the catalyst was carried out in the temperature range of 120-450°C. In this study, we introduce CeO₂ to V₂O₅ /TiO₂ and hope to achieve superior activity at low temperature.

Keywords Selective catalytic reduction; Sol-gel method; Vanadium and cerium catalyst; Formation of nitrous oxide; Ammonia oxidation reaction.

Dye-sensitized solar cell with TiO₂ electrode that is modified by Nb₂O₅, La₂O₃ or Er₂O₃

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In this research, we modified TiO₂ electrode of a dye-sensitized solar cell (DSSC) by adding the second metal oxide, namely, lanthanum trioxide (La₂O₃), erbium trioxide (Er₂O₃) and silver oxide (AgO). TiO₂-based mixed oxides were synthesized using sol-gel methods. The mixed oxide sols were then coated onto a conducting transparent glass as thin film using an ultrasonic spray coater. The thin film electrode was fired 400°C for 2 h. The thickness of the thin film electrode was approximately 10 μm, as measured by a surface profilometer. The amount of La₂O₃, Er₂O₃ or AgO was added to TiO₂ in the range from 0 to 10 %wt. The mixed oxide thin film or similar mixed oxide in powder form was characterized by several techniques, including as X-ray diffractometry (XRD), N₂ physisorption, UV-vis optical spectroscopy and inductively-coupled plasma optical emission spectroscopy (ICP-OES). The efficiency of dye-sensitized solar cell was measured by an IV-tester under standard condition (AM = 1.5), in which the effective area of DSSC cell was 0.196 cm². The photovoltaic conversion efficiency of DSSC with mixed oxide electrode appeared to be greater than that with undoped TiO₂ electrode. Furthermore, short-circuit photocurrent density (J_{SC}) and open-circuit voltage (V_{OC}) of DSSC were also enhanced. The addition of the second metal oxide was believed to increase the specific surface area of the electrode and suppress the recombination of photogenerated charge carriers.

Keywords Dye-sensitized solar cell; Mixed oxide; Sol-gel; Spray coating.

Colorimetric Determination of Toxic Pb(II) ions in Water using Ag Nanoshells

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A simple, cost effective, and sensitive detection method of toxic Pb(II) ions present in water has been developed using Ag nanoshell probe. The Ag nanoshell was prepared by reduction method of silver using trisodium citrate onto SiO₂ core. This simple colorimetric technique does not need to use any complexation of Pb(II) ions to any ligands, compounds or dyes in order to probe the ions in water. The silica particles were synthesized via sol-gel method and coated with silver nanoparticles via electrostatic attraction between the core and shell without using any primer. The UV-Vis absorption spectra of adsorbed Pb ions on Ag nanoshell were performed and monitored at room temperature. The observed changes in the shape and position of plasmon absorption band at 450 nm along with its damping indicating the chemisorption of Pb(II) ions onto the surface of silver nanoshells. The detection limit for Pb(II) ion was found to be excellent (10 µg/L) in water media. TEM analysis of Silica and Ag-coated SiO₂ nanoshell particles revealed the spherical silica particles and the covering of silica particles with silver nanoshell.

Keywords Lead ions detection; Silver nanoparticles; Silver nanoshells

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Catalytic Transfer Hydrogenation of Methyl Levulinate for Production of γ -Valerolactone (GVL) on Raney Nickel: Effect of Hydrogen Donating Solvents

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GVL can be produced via catalytic transfer hydrogenation of methyl levulinate on Raney nickel catalyst in this study. In conventional hydrogenation process, high pressure of hydrogen gas is required. However, only suitable hydrogen donating solvent is needed for catalytic transfer hydrogenation. Among different solvents, alcohols were selected in this investigation because of their high tendency to give up proton in hydrogenation process. To evaluate effect of various alcohols, ethanol, 2-propanol, and cyclohexanol were chosen. The results indicate that different types of alcohols affect GVL production differently. 2-propanol is found to be the most effective catalyst for production of GVL from methyl levulinate on Raney nickel catalyst at 100°C.

Keyword Catalytic transfer hydrogenation; GVL; Methyl levulinate; Raney nickel; Hydrogen donating solvent

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Novel Ruthenium Complexes for Dye Sensitized Solar Cell

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Two new ruthenium complexes namely tetrabutylammonium(4-carboxylic acid-4'-carboxylate)-2,2'-bipyridine-5,5'-bis(4-(methoxy)phenyl-5*H*-cyclopenta-1,2-*b*:5,4-*b'*-dipyridine)dithiocyanato ruthenium (II) (**CLC-C01**) and tetrabutylammonium(4-carboxylic acid-4'-carboxylate)-2,2'-bipyridine-5,5'-bis(4-(hexyloxy)phenyl-5*H*-cyclopenta-1,2-*b*:5,4-*b'*-dipyridine)dithiocyanato ruthenium (II)(**CLC-C08**) were synthesized and characterized by ¹H-NMR, ¹³C-NMR and FTIR. We expect that a different amphiphilic long chains could lead to higher hydrophobicity in the surface of dye-sensitized compared with bipyridine ligand of standard **N719** dye. However, we found that the **CLC-C01** and **CLC-C08** show low efficiency at 3.10 % and 3.36%, respectively, compared with **N719** (7.80%).

Keywords Dye-sensitized solar cell; **N719**; Ruthenium complex; Sensitizing dye

Adsorption of Pesticide on New Specific “Organoclay” (Palmatine/Bentonite)

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Bentonite is a type of clay minerals which has a great capability of organic cation adsorption and determined specific surface areas involved with its particle size. Interestingly, the native bentonite was probably reported to adsorb agricultural pesticides. Palmatine, an isoquinoline alkaloid, has been chosen to modify bentonite to be an organoclay (Palmatine/ Bentonite). In this work, comparisons of carbaryl pesticide adsorptions on the organoclay to that on non-organoclay have been intensively investigated by UV-Vis adsorption spectroscopy. The optimal combination of bentonite clay and alkaloid palmatine was 1 g of clay to 5 mg of palmatine in 50% aq. MeOH to yield 76% w/w yellow organobentonite. The modified organoclay was added to 50, 100 and 200 ppm of carbaryl pesticide solutions. Each suspension was stirred at room temperature for three different periods of time including 1, 3 and 18 hours. Likewise, the non-modified bentonite was mixed with the pesticide solutions under the same conditions as control systems. It was found that carbaryl pesticide residues after adsorption processes on Palmatine/Bentonite were less than that on the corresponding controls at 50, 100 and 200 ppm of carbaryl solutions. From the results, the highest carbaryl adsorption occurred when Palmatine/Bentonite was treated with 200 ppm of carbaryl solution for 18 hours. Absorbance (at 220 nm) of the residue carbaryl solution after the highest adsorption from Palmatine/Bentonite process was $A=0.2209 \pm 0.0003$ which was lower than that of non-treatment Bentonite $A=0.5117 \pm 0.0004$. The modified bentonite clay with alkaloid palmatine, therefore, could probably enhance the adsorption ability of carbaryl pesticide.

Keywords Bentonite; Palmatine; Carbaryl; Adsorption

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Effect of Extracted Carrot and Palm Carotenoid as Corrosion Inhibitors on the Corrosion of Copper in Palm Oil Biodiesel

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The present study aims to investigate the comparative corrosion of copper in three palm oil biodiesel, crude palm oil (CPO), palm kernel oil (PKO), and waste frying oil. Immersion test were carried out in each oils at room temperature, 40°C, and 60°C for 300 h, 600 h, and 900 h. The weight loss results showed that biodiesel from PKO is the less corrosive fuel. Corrosion rate of copper in all biodiesels were reduced by add carrot and/or palm carotenoid extracted. The corrosion rate and corrosion activation energy of copper in biodiesel with different extracted concentration were calculated from weight loss studied. The activation energy of copper corrosion in biodiesel was increased by add the hexane extraction of carrot and palm carotenoid. The copper strip corrosion standard (ASTM 130) and electrochemical methods were also applied on this work.

Keywords Biodiesel; Corrosion; Carotenoid; Carrot

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Zirconium Phase on Porous Silica of ZrO₂/Co/Aerosil for Fischer-Tropsch Synthesis

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Zirconium phase on porous silica of ZrO₂/Co/aerosil was investigated by Zr L₃-edge x-ray absorption near edge structure (XANES). Amorphous ZrO₂ with crystalline Co₃O₄ on aerosil was observed. Co₃O₄ and α-Co₂SiO₄ formed upon calcination by heating in Ar at 463 K 42 h as observed by time resolved Co K-edge XANES. The observations implied that Co₂SiO₄ was produced during the Fischer-Tropsch synthesis (FTS). The catalyst was heated for a period of a few days. The formation of Co₂SiO₄ could affect the amount of reduced and regenerated metallic Co available on Co/ZrO₂/aerosil corresponded to the high probability of chain growth from the FT sites on the catalyst surface during the reaction.

Keywords Fischer-Tropsch Synthesis; Fischer-Tropsch Cobalt Catalyst; Time Resolved XANES Calcination; Fischer-Tropsch Product Distributions

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Chemical Surface Modification of Charcoal from Macadamia Nutshell for Treatment of Water Hardness

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This work focused on the chemical surface modification of macadamia nutshell charcoal by using potassium permanganate. The macadamia nutshell was carbonized in 200 liter biomass furnace at 350–400°C for 6 hours. The carbonized macadamia nutshell was modified surface by impregnation with KMnO₄. The parameters of the mass ratio of macadamia nutshell charcoal to potassium permanganate (MC:KMnO₄, 1:1, 2:1 and 4:1) and the impregnate time (4 and 24 hours) were studied. The results of their CaCO₃ removal efficiency are compared. The mass ratio of MC:KMnO₄ is 2:1 and 24 hours for impregnate time gave the highest adsorption efficiency of CaCO₃. In the adsorption studies, the prepared charcoal was used for treatment 50 milliliter of 1000 ppm CaCO₃ standard solution. The adsorption efficiency depends on the adsorption times, 84% adsorption efficiency was achieved in 30 minutes when treated with 5 grams of the charcoal. The amount ratio of adsorbent and calcium ion (Ad:Ca) were also affected. In 2 hours of treated with macadamia charcoal, more than 80% adsorption efficiency was achieved by the amount ratio of Ad:Ca was only 50, while the amount ratio of Ad:Ca was up to 200 and 1500 for the commercial adsorbent such as manganese zeolite and activated carbon, respectively.

Keywords Charcoal; Chemical surface modification; Macadamia nutshell; Water hardness

Study on Pretreatment of Cellulose from Cassava Rhizome for Highest Glucose in Dilute Acid Hydrolysis

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Bioethanol from lignocellulosic biomass can be utilized for the source of clean and renewable energy. In this work, cassava rhizome (CR) was used as a feed stock for the production of bioethanol after pretreatment and saccharification hydrolysis. To obtain high concentration of glucose, CR was pretreated with acid and alkali solution to remove non-cellulose component. Then, pretreated CR was hydrolyzed with dilute sulfuric acid. In this study, different reagents were screened to select the best pretreatment agent. Comparison on pretreatment of CR cellulose of three methods using I. Formic acid-aqua ammonia (FAA), II. Formic-hydrogen peroxide (FHP) and III. Acid chlorite delignification (ACD), were performed by gravimetric analysis and thermogravimetric-differential thermal analysis (TG-DTG). Attenuated total reflection-fourier transform infrared (ATR-FTIR) was conducted to confirm some functional groups in all samples. Glucose liquicolor (using Glucose oxidase-peroxidase assay) was also used to detect glucose content from hydrolysis of cellulose. Physicochemical characterization of pretreated CR was carried out by scanning electron microscopy (SEM). The results showed that the pretreatment by FHP provided high cellulose content up to 77.1%. While, the ACD hydrolysates provided high concentration of glucose (61.2%) under optimum conditions of ratio of cellulose: 0.2 M H₂SO₄ (1:17 w/v) at 121 °C for 90 minutes.

Keywords Glucose; Cassava rhizome; Cellulose; Glucose liquicolor; Dilute acid hydrolysis

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The Quantity Analysis of Heavy Metals in Sediment of Loei River

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The determination of heavy metals (Fe, Mn, Cr, Pb, Cd, Ni, Cu and Zn) in sediments in Loei river were analysis by Atomic Absorption Spectrophotometry. The samples were collected in June 2014, to October 2014. Sampling stations were 11 stations from upstream to downstream. A complete digestion of sediments was achieved by using an extracting solution of 0.05 N HCl + 0.025 N H₂SO₄ (1:1) and atomic absorption spectrophotometer to determine the amount of heavy metals. The results showed that the quantity of iron, manganese, chromium, lead, cadmium, nickel, copper and zinc were N.D.-132.6190, N.D.-75.1195, N.D.-19.9800, N.D.-18.8798, less than 0.2340-2.1429, less than 1.0070-26.4198, 0.9100-3.2641 and N.D.-10.3911 mg/kg respectively. The percent recoveries of these metals were 93.96, 98.78, 97.92, 102.18, 98.07, 99.26, 97.29 and 96.41 % respectively. The LOD and LOQ were 0.9749-2.7165, 0.1071-0.1449, 0.0614-0.1587, 0.0881-0.2610, 0.0059-0.0234, 0.0307-0.1007, 0.0413-0.0847 and 0.0163-0.0499 ppm respectively.

Keywords Sediment; Heavy Metals; Loei River

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Green Production of Carbon Microsphere by Hydrothermal Carbonization of Xylose

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Carbon microsphere could be applied in many applications such as adsorbent, catalyst support, electrode, and capacitor. The carbon microsphere was obtained by many preparation techniques such as pyrolysis of hydrocarbon gas or polymer sphere. According the concept of green chemistry, the carbon source has been changed to biomass especially carbohydrate compound. Moreover, the mild condition such as hydrothermal was more considered. Xylose, one of carbohydrate, is an interesting carbon source because it is a major composition of hemicellulose. Therefore, this research presented the preparation of carbon microsphere from xylose using hydrothermal carbonization technique. The preparation was studied at the hydrothermal temperature in the range 150°C - 190°C and different hydrothermal times 12h, 16h and 24h. The effect of xylose concentration (10wt%, 25wt%, and 50wt%) was investigate. The physical properties of carbon microsphere were characterized by SEM, XRD, BET and FT-IR. The carbon microsphere was obtained with the particle size of 2 - 10 µm. The increasing of hydrothermal temperature and xylose concentration reduced the particle size. The bimodal particle size distribution was obtained at low xylose concentration due to agglomeration of carbon particle. However, 50 wt% xylose concentrations presented uniform particle size distribution.

Key words Carbon microsphere; Hydrothermal carbonization; Xylose

Adsorption of Pirimiphos-methyl from Aqueous Solutions by Montmorillonite-based Adsorbents

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Adsorption is an efficient process to remove herbicide contaminated water. This study focused on adsorption of herbicide pirimiphos-methyl from aqueous solution by adsorbents prepared from montmorillonite (MMT). The MMT with interlayer spacing of 1.54 nm and surface area of 49 m²g⁻¹ was modified with tetradecylamine MMT to produce organoclay TDA-MMT to increase interlayer spacing to 3.22 nm. MMT was also used in the preparation of mesoporous MMT and mesoporous Ti-MMT by intra-gallery templating method with cetyltrimethyl-ammonium bromide to increase surface area to 379 m²g⁻¹ and 716 m²g⁻¹, respectively. Pirimiphos-methyl adsorption was performed in a batch-type experiment and kinetic study was conducted with concentration of 1300 mgL⁻¹ under the equilibrium time of two hours. The concentration of pirimiphos-methyl was determined by a UV-Vis spectrophotometer at λ_{\max} of 247 nm. The adsorption kinetics from all adsorbents was pseudo-second order. The equilibrium adsorption capacity of MMT, TDA-MMT, mesoporous MMT and mesoporous Ti-MMT was 128, 909, 30 and 222 mg.g⁻¹, respectively. The highest adsorption capacity on TDA-MMT was plausibly from the expanded interlayer spacing of MMT by TDA cations which facilitated the penetration of pirimiphos-methyl into the MMT layers. The increase of adsorption capacity in mesoporous Ti-MMT was probably from the presence of Ti and high surface area.

Keywords Pirimiphos-methyl; Montmorillonite; Organoclay; Mesoporous clay

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Adsorptive Removal of Reactive Orange 122 from Aqueous Solutions by Ionic Liquid coated Fe₃O₄ Magnetic Nanoparticles as an Efficient Adsorbent

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In the present investigation a novel adsorbent, ionic liquid modified magnetic nanoparticles (IL-Fe₃O₄), was successfully synthesized and characterized by Fourier infrared spectroscopy (FT-IR), thermogravimetric analysis (TGA), X-ray diffraction (XRD) analysis, scanning electron microscopy (SEM) and theory of Brunauer, Emmett, and Teller (BET) for removal of Reactive Orange 122 (RO-122) from aqueous solutions. The effects of various experimental parameters such as pH, contact time, ionic strength, nanoparticle dosage and ionic liquid amount were studied and optimized. Experimental results indicated that the IL-Fe₃O₄ nanoparticles had removed more than 98% of proposed dye under the optimum operational conditions. Detection and quantification limits of the proposed method were 14 and 46 µg.L⁻¹, respectively. Desorption process of the adsorbed dye was also investigated using methanol, ethanol and propanol as the solvent. It was notable that both the adsorption and desorption of dye were quite fast. The adsorption process preferably followed the Freundlich isotherm and pseudo-second-order kinetic model. The RO-122 was removed successfully from environmental water samples too.

Keywords Reactive orange 122; Magnetic nanoparticles; Ionic liquid; Adsorption

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Olefin Metathesis for the Conversion of Fatty Acid Methyl Ester to Short-Chain Olefins and Esters

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The use of plant oils as renewable feedstock has become of an interest in recent years due to the depletion of fossil fuels and the warming of global climate. The major component of plant oils are unsaturated fatty acids such as oleic acid (C18:1) and linoleic acid (C18:2). In this work we investigated the olefin cross-metathesis of methyl oleate and 1-hexene using homogeneous ruthenium-based catalysts. The reaction yields short-chain olefins and esters which are useful starting materials for the chemical industry and can be used as transportation fuels. The optimized reaction was carried out using only 0.5 mol% of the 2nd generation Hoveyda-Grubb catalyst, 10 equivalents of 1-hexene and without additional solvent at 25 °C, resulting in 80% conversion of the methyl oleate within an hour. The products, analyzed by GC and GC-MS, were identified as cross-metathesis products (1-decene, 5-tetradecene, methyl-9-decenoate, and methyl-9-tetradecenoate). Only a trace amount of self-metathesis product of the methyl oleate was observed.

Keywords Olefin metathesis; Plant oil; Renewable

Effect of Anionic Surfactant on Chromium (III) Adsorption onto HCl-treated Fish Scales of JAVA BARB

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The aim of this work was to present the adsorption ability of HCl-treated fish scales (organic-rich materials) of JAVA BARB for Cr (III) in the presence of anionic surfactant (sodium dodecylbenzenesulfonate; SDBS). The effect of SDBS at a concentration lower than critical micelle concentration (CMC) was investigated through batch equilibrium experiments. Two types of batch experiments were carried out, mixed system (Cr (III)-SDBS) and sequential system. In sequential system, SDBS was first adsorbed at pH 3.0 and 5.0, followed by the adsorption of Cr (III) at pH 3.0, 5.0 and 7.0. The sequential system was found to perform better than mixed system and achieve the maximum adsorption percentage within 120 min (87.5%). Adsorption isotherm and kinetics were investigated for the sequential system. The equilibrium adsorption data were fitted into Langmuir, Freundlich, Temkin and Dubinin-Radushkevich (D-R) models. Of the four adsorption isotherm, the R² value of Temkin model was the highest (0.975). The experimental data were also fitted into the following kinetic models: pseudo-first-order, pseudo-second-order, Elovich and the intraparticle diffusion models. It was observed that pseudo-second-order model described the adsorption process with the R² value better than any other kinetic models (0.999).

Keywords Fish scales; Chromium; Adsorption isotherm; Kinetics

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Water Quality in Irrigated Paddy Field and Surface Water

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Nutrient Pollution from agricultural activities, particularly from paddy field occurs widely and it is a major cause of eutrophication in surface water. The purpose of this study is to investigate the water quality in paddy field and nearby surface waters during paddy plantation at Intaburi district, Singburi province. Water samples were taken from paddy field, canal and Chao Phraya river and analysed for pH, dissolved oxygen (DO), Biochemical oxygen demand (BOD), Total Kjeldahl nitrogen (TKN), nitrate (NO_3^-), ammonia (NH_3), total phosphate (TP) and orthophosphate (ortho- PO_4^{3-}). Results showed that pH of all water samples were in the range of 6.7-7.9. The concentrations of TKN, NO_3^- and NH_3 in paddy field have a tendency to decrease during rice plant growth because the uptaken by rice plant. However, they were high when fertilization. Drainage of water from irrigated paddy field affected the BOD and DO concentrations in the canal and river. BOD and DO concentrations in the river during rice planting were 4.25 and 4.3 mg/L whereas they were 0.33 and 7.1 mg/L during dry season. High BOD concentration dues to dead organic matter in the soil and organic fertilizer. Organic N from fertilizer still remained in the field which the concentration of 1.72 mgN/L. It can be changed to nitrate by nitrification process and leached to surface and groundwater. Therefore, the proper water quality management in the paddy field in necessary to reduce the pollution loads in the surface water.

Keywords Nitrogen; Phosphorus; Paddy Field; Water Quality

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Removal of Heavy Metal from Industrial Wastewater using Algae that Thrive in the Cooling Water System

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The batch process of heavy metal removal (Iron and Nickel) by algae that thrive in the cooling water system of the industry is discussed in this research. Its objective is to study the efficiency of heavy metal removal from industrial wastewater by blue-green algae, both of living cell and non-living cell in open system. The concentrations of iron (Fe) and nickel (Ni) were measured in the aliquot samples using Inductively Couple Plasma-Optical Emission Spectrometer (ICP-OES). The experimental results showed reduction of Iron level from 31.16 mg/l to 3.61 mg/l (more than 90%) and Nickel level from 2.56 mg/l to below maximum permissible limit by living cell algae within 48 hours. Similarly, levels of Iron were reduced to 2.66 mg/l and nickel reduced to below maximum permissible limit by non-living cell algae within 24 hours.

Keywords Heavy metal removal; Algae; Industrial wastewater

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Screening for Saxitoxin in Bivalve Molluscs in the Gulf of Thailand using the Receptor-Binding Assay

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Paralytic shellfish poisoning (PSP) has been a world wide concern in environmental health caused by the marine neurotoxins known as saxitoxin (STX). PSP is common seafood toxicity involving in the accumulation of STX in bivalve mollusc and can be passed to higher trophic level predators. The incidents of PSP will result in human illnesses and fatalities including losses to local economies due to shellfish harvest closures. To protect public health, the PSP screening data and the effective biotoxin screening technique are importance. The present study was to determine the STX concentrations in 265 shellfish specimens belonging to 5 bivalve species by receptor binding assay technique. Among the 5 bivalve species, blood cockle (*A. granosa*) collected from the upper gulf of Thailand was rated as the highest risk species. However, the results revealed saxitoxin concentrations much less than the US, European and Australian regulatory limit for human consumption of shellfish of 80 µg STX eq. 100 g⁻¹ tissues. In addition, the receptor binding assay technique was shown to be an effective tool for rapid screening and suitable for monitoring program.

Keywords Bivalve molluscs; Gulf of Thailand; Paralytic shellfish poisoning; Receptor binding assay; Saxitoxin

Water Quality and Organic Loads along the Chao Phraya River in Nakhon Sawan Municipality

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The purpose of this research is to study the water quality in the Nakhon Sawan municipality. Four sampling points along the Chao Phraya river and one sampling point of Ping river were analysed for biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO) and pH during 9.00 am - 7.00 pm. Results revealed that BOD and COD concentrations were fluctuated during daytime. The highest daily BOD and COD concentrations of 9.64 and 61 mg/L, respectively were found at Dechatiwong bridge because the drainage of wastewater from the residential area. Organic pollution was increased 2-3 times after rainfall which the BOD and COD loads of 264,902 and 326,919 kg/day, respectively. The pH of Chao Phraya river and Ping river were in the range of 7.0-7.5. The DO values for all sampling points were in the range of 5.0-7.0 mg/L. Therefore, the proper wastewater management is needed to improve the water quality to meet the class-II of surface water quality standards (BOD lower than 1.5 mg/L and DO higher than 6.0 mg/L).

Keywords: Chao Phraya river; Nakhon Sawan; Organic loads; Water quality

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Catalytic Conversion of Palm Oil for the Production of Biofuels over NiW Modified HZSM-5 and HY Zeolites

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The conversion of palm oil was investigated using HZSM-5 and HY zeolites modified with NiW as catalysts in the hydrocracking processes. Firstly, the HZSM-5 zeolite was prepared by conventional ion-exchange process refluxed with 1 M (NH₄)₂SO₄ at 90 °C for 2 h. Then, both HZSM-5 and HY zeolites were calcined at 550 °C for 3 h. After that zeolites supported by NiW catalysts modified were prepared employing the impregnation technique. Each supported catalyst containing 16 wt.% WO₃ and 16 wt.% NiO after impregnation was calcined at 550 °C for 3 h. NiW was added to the zeolites in order to induce bi-functional properties (both acid and metal sites) in the catalysts. Subsequently, the catalysts were characterized by X-ray diffraction spectrometry (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM) and Brunauer-Emmett-Teller (BET) surface area analysis. NiW/ZSM-5 and NiW/HY catalysts were studied in the hydrocracking of palm oil, which showed the catalytic activity. These results indicate that the incorporation of metals over HZSM-5 and HY zeolites leads to the specific catalysts with interesting properties for the conversion (>90 %) of palm oil into many types of biofuel such as gasoline, kerosene and diesel. The yields of liquid hydrocarbon products obtained over NiW modified with HZSM-5 and HY zeolites are not significant.

Keywords NiW/HZSM-5 zeolite; NiW/HY zeolite; Hydrocracking; Palm Oil

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Ecotoxicology of Copper on Freshwater Fish under Field Water with Different Water Hardness in Lao PDR

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The aquatic resources of the Mekong River are importance to supporting the livelihoods of a large percentage of 60 million or more people living in the Lower Mekong Basin. The study on the impact of heavy metal on freshwater fish in the Mekong River is needed. Ecotoxicology of copper on freshwater fish was studied using field-collected water from 2 local sites along Lower Mekong Basin in Lao PDR, which had two different water hardness. In this study, US EPA method was used for the acute toxicity experiment to *Cyprinidae* species; *Labeo rohita* (*Pla Yissok Tet*) with 7 different copper concentrations of high hardness (0, 0.02, 0.09, 0.16, 0.23, 0.3 and 0.37 mg/l) and low hardness (0, 0.02, 0.03, 0.04, 0.05, 0.09 and 0.13 mg/l). The mortalities of *Labeo rohita* (*Pla Yissok Tet*) was observed at 24, 48, 72 and 96 hrs. The results clearly showed that amount mortalities were increased up from low to high copper concentrations. The 96 hr LC₅₀ values of copper on *Labeo rohita* with high water hardness and low water hardness were 0.129 mg/l and 0.049 mg/l, respectively. Therefore, toxicity tests for copper will contribute the ecotoxicology data to manage the aquatic environment for revise environmental quality standard in Lao PDR.

Keywords Acute toxicity; Copper; *Cyprinidae*; Lower Mekong Basin

Radiocarbon Dating of Ancient Thai Talisman

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Ancient Thai talisman has a very long history and has always been regarded as unique object. Similarly to the pottery, the principal raw material used to make the Thai talisman was clay which would lead to a shift of ¹⁴C data to older ages. However, the carbon components in the clay materials could be possible to obtain the reliable ¹⁴C dates. In this paper, ancient Thai talisman specimens have been radiocarbon dated with the CO₂ direct absorption method. The produced CO₂ was absorbed on Carbo-sorb[®] and ¹⁴C determination was carried out using a low background liquid scintillation counter. Among the dated talismans, the specimens with carbon admixtures on the clay materials provided the reliable information on the accepted range of the time period. The amount of organic carbon in the ancient talisman is very important for the accurate determination of the age from ¹⁴C dating. Therefore, an accurate evaluation of the organic carbon quantity in the specimens is strongly suggested.

Keywords Ancient Thai talisman; ¹⁴C Dating; Direct absorption; Radiocarbon dating

Study on Chitosan-Polyaniline Membrane for Chromium(VI) Removal using UV-VIS Spectrophotometry Technique

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This work prepared chitosan from paddy field crab shells (ChC) using modified method from MTEC's method and synthesized the chitosan-polyaniline (Ch-PANI) membrane from both ChC and commercial chitosan (ChCO) in three different ratios of polyaniline. The structural and physical properties of Ch-PANI membrane were characterized by using Fourier Transform Infrared (FTIR) and Scanning Electron Microscopy (SEM) techniques. The conductive property was also measured. The chromium (VI) concentration was measured by using UV-VIS spectrophotometer at 420 nm. The results indicated that all ratios of Ch-PANI membrane could remove chromium (VI) in solution between 85.80 to 95.70 ppm. The capacity of removal was 15.31 to 41.09 mg/g. The minimum quantity of chromium (VI) removal was belong to ChCO-PANI (ratio = 1.0 : 0.15) membrane, while those of ChC-PANI (ratio = 1.0 : 0.15) membrane showed maximum quantity.

Keywords Chitosan; Chitosan-polyaniline membrane; Chromium(VI)

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Effect of Ultrasound and Calcination Temperature on the Catalytic Performance of K/NaY Catalyst for Transesterification of Palm oil

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Zeolite NaY was synthesized with a silica source from rice husk and impregnated with a potassium acetate buffer solution with and without ultrasound assistance to produce K/NaY catalysts with 12 wt.% of K. Analysis by XRD indicated that ultrasound assistance did not affect the NaY structure. Analysis by N₂ adsorption-desorption revealed that surface area and pore volume of catalysts prepared with and without ultrasound assistance were not significantly different. Calcination of the K/NaY catalysts above 600 °C caused the zeolite structure to collapse and resulted in low surface area. Analysis by CO₂-TPD suggested that the catalysts prepared with ultrasound assistance had stronger basicity attributing to better dispersion of active K species on NaY. The stronger basicity is a promising property of catalyst for transesterification. The optimum calcination temperature was in the range of 400-500 °C and the obtained catalysts with ultrasonic gave higher conversion in transesterification of palm oil than catalysts without ultrasonic.

Key words Zeolite NaY; Supported potassium; Transesterification; Palm oil

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Distribution of Pesticides and Their Relation to Land use in the Namphong River, Northeastern Thailand

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Large quantities of pesticides are used in the Namphong River, catchment Northeastern Thailand for protection of crops and agro industrial production. The aim of this study was to monitor pesticides in waters of the Namphong River from in-situ river aquaculture, surface runoff and agro industrial discharges. A passive sampling technique was used to estimate the level of pesticides in the river water. Pesticides were accumulated on polydimethyl siloxane (PDMS) strip passive samplers during 29 days deployment in January-February 2012, and then sent to Australia for analysis of pesticides at the University of Queensland and Queensland Health Laboratories. The PDMS passive samplers were deployed at 5 sites (3 replicated per site) in the Namphong River from below the Ubonratana Dam, the tributary downstream of the paper mill and vegetable and paddy fields down to the Chi River above the junction of Namphong River. Atrazine, ametryn, chlorpyrifos and oxadiazon were found at all sites, and N-butyl benzene sulphonamide at most sites, and elevated levels associated with vegetable and paddy field areas indicating their extensive application. Musk ketone, terbuthylazine, terbuphos and phosphate tri-n-butyl were found only in the paper mill discharge. Traces of galaxolide was found at all sites but was present in significant amounts (30 times higher) below the paper mill. Comparison of pesticides was made between the present study and an earlier 2005 study of the paddy field ecosystem 50 km North from Khon Kaen where sediment, water samples were collected and PDMSs were deployed. The results from this study show that a range of pesticides is being used in the Namphong river catchment. The need exists for more systematic and complex assessment of the catchment to develop a tool for pollution control and environmental risk assessment.

Keywords Pesticides; Monitoring; Passive Sampling; Land use Practices; Environmental Risk Assessment

Ecotoxicology of Copper on Freshwater Fish under Field Water with Different Water Dissolve Organic Carbon (DOC) in Cambodia

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The aquatic resources of the Mekong River are importance to supporting the livelihoods of a large percentage of 60 million or more people living in the Lower Mekong Basin. The study on the impact of heavy metal on freshwater fish in the Mekong River is needed. Ecotoxicology of copper on freshwater fish was studied using field-collected water from 2 local sites along Lower Mekong Basin in Cambodia, which had two different water dissolve organic carbons (5.74 and 1.12 mg DOC L⁻¹). In this study, US EPA method was used for the acute toxicity experiment to *Cichlidae* species; *Oreochromis niloticus* (*Nile tilapia*) with 6 different copper concentrations of high DOC (0.00, 0.45, 0.5, 0.6, 1, and 1.5 mg/l) and low DOC (0.00, 0.1, 0.3, 0.5, 1 and 1.5 mg/l). The mortalities of *Oreochromis niloticus* (*Nile tilapia*) was observed at 24, 48, 72 and 96 hrs. The results clearly showed that amount mortalities were increased up from low to high copper concentrations. The 96 hr LC₅₀ values of copper on *Oreochromis niloticus* with high water DOC and low water DOC were 0.742 mg/l and 0.397 mg/l, respectively. This series of laboratory experiment will provides a worst-case scenario and useful for determine the risk assessment of copper on tropical freshwater animals in Cambodia as well as the Mekong River Basin.

Keywords Ecotoxicology; Acute toxicity; Copper; Dissolve organic carbon; *Cichlidae*; Lower mekong basin

The Ketonization of Acetic Acid over Alkali Metal Titanates with Tunneled and Layered Structure

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Titanate-based catalysts with tunneled ($\text{Na}_2\text{Ti}_6\text{O}_{13}$ and $\text{K}_2\text{Ti}_6\text{O}_{13}$) or layered ($\text{K}_2\text{Ti}_4\text{O}_9$) structure was synthesized by a conventional solid state synthesis from the corresponding alkali metal carbonate and TiO_2 . These materials were employed as a catalyst in the ketonization of acetic acid into acetone. This reaction which removes an oxygen atom from the reactant is of practical importance in the production of biodiesel from renewable feedstock. The effect of the structure (tunneled vs layered), surface area, compensating cation, and the reduction temperature was studied in relation to anatase TiO_2 . The reactivity (normalized to surface area) of these catalysts in the ketonization of acetic acid at 400°C follow the order: $\text{K}_2\text{Ti}_6\text{O}_{13} > \text{Na}_2\text{Ti}_6\text{O}_{13} > \text{K}_2\text{Ti}_4\text{O}_9 > \text{anatase TiO}_2$. Such order can be explained considering the reducibility of the catalysts as determined from H_2 -temperature programmed reduction (TPR), highlighting the importance of an oxygen vacancy in the ketonization of carboxylic acids.

Keyword Ketonization; Alkali metal titanates; Acetic acid; Oxygen vacancy

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Electricity Generation and Wastewater Treatment from Canteen Wastewater at Silpakorn University using Microbial Fuel Cell

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Microbial Fuel cell (MFC) is an eco-technology for renewable energy recovery as wastewater is biologically treated and energy is generated at the same time. MFCs use bacteria present in wastewater to directly convert organic matter to electricity. The bacteria are able to convert a variety of organic matter into carbon dioxide, water and energy. In this study, Polytetrafluoroethylene membrane-dual-chamber MFC equipped with carbon cloth electrode, without mediator and catalyst was designed and fabricated for wastewater from septic tank of canteen at Silpakorn University. The MFC performance was evaluated in terms of internal resistance (R_{int} ; $0.03 \Omega \cdot m^2$), open circuit voltage (OCV; 0.792 V), maximum power density (P_{max} ; 12.54 mW/m^2) and chemical oxygen demand (COD) removal (63.4%). Based on the excellent performance on electricity generation and organic removal efficiency, canteen wastewater can be used as energy source for MFC system and can be treated at the same time.

Keywords Canteen wastewater; Carbon cloth; Microbial fuel cell

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Removal of Methylene Blue Dye from Aqueous Solutions by Adsorption using Sugarcane Leaves as Adsorbent

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In this study, the sugarcane leaves were used as a biosorbent for an adsorption of methylene blue (MB) dyes. The adsorption studies were carried out at different initial dye concentrations (10–80 mg L⁻¹), contact time (0-24 hours) and temperature (20-60°C) in a batch system. It was found that the removal of dyes increased with the increasing of initial dye concentration and the adsorption equilibrium was achieved in 6 hours. In addition, the equilibrium isotherm, kinetic and thermodynamic of this adsorption were investigated. The adsorption isotherm data were fitted well to Langmuir isotherm, with maximum sorption capacity of 4.8041mgg⁻¹. The experimental data fitted very well the pseudo-second-order kinetic model. The thermodynamic study revealed that The negative values of both the enthalpy (ΔH°) and Gibbs free energy (ΔG°) changes indicate exothermic and spontaneous of the biosorption process respectively. Hence, the sugarcane leaves were shown to be a very efficient and low-cost adsorbent for dye removal from aqueous solutions.

Keywords Sugarcane leaves; biosorbent; methylene blue

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Adsorption of Nitrate using a Film Complex of Chitosan and Pectin

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Chitosan/pectin (CS-P) polyelectrolyte film was used to study nitrate adsorption. Nitrate is a nitrogen source for phytoplankton. Excessive concentration causes eutrophication which leads to oxygen depletion in water. Polycationic chitosan and polyanionic pectin are natural polymers that are found abundantly in nature. They have received a high level of interest recently because of their nontoxic and biodegradable properties. The CS-P film composition was synthesized using a 70:30 mass ratio of chitosan and pectin, respectively. The clear film was then ground and sieved into particle size of 0.5-1.5 mm. The active functional groups of the CS-P film, chitosan and pectin, were analyzed using FTIR. Nitrate content was analyzed using Brucine method by spectrophotometry. The concentration of synthetic nitrate-contaminated water, between 10-100 mg NO₃-N/L, was used to study the adsorption. Factors investigated that were related to the adsorption were the effect of contact time, adsorbent dosage and initial concentration. The results showed that the time to reach equilibrium was 30 minutes. The adsorption studies indicated that higher dosage of adsorbent resulted in higher adsorption. Nitrate removal increased to 67% when using adsorbent dosage of 1.0 g with the adsorption capacity of 0.33 mg/g. The adsorption capacity increased when the initial concentration increased, 7.24 mg/g when using CS-P film 0.10 g and nitrate concentration of 100 mg NO₃-N/L. The Freundlich isotherm was the best fit to explain the adsorption mechanism.

Keywords Chitosan; Pectin; Adsorption; Nitrate removal

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Synthesis of Recycled $\text{Nd}_2\text{Fe}_{14}\text{B}$ Powder using a Composite Powder Recovered from $\text{Nd}_2\text{Fe}_{14}\text{B}$ Slurry

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A co-precipitation method was applied to recover RE from NdFeB slurry. A composite powder, containing RE and elemental Fe and Co, can be obtained using this method, which can be directly used as a raw material for preparing recycled $\text{Nd}_2\text{Fe}_{14}\text{B}$ magnetic powder, to avoid complicatedly and high-costly extracting high purity RE. The simulations and experiments in OH-NH₃ co-precipitation systems are discussed in detail. The optimum pH range for the co-precipitation process was determined by the log[Me(Nd, Fe, Co, Pr)]-pH curve simulated using a thermodynamics model. Fe_2O_3 , $\text{Fe}_2\text{O}_3 \cdot \text{Nd}_2\text{O}_3$, and Pr_2CoO_4 phases were detected in the final composite powders after firing the co-precipitated products at 1273K for 2 h. The content of the valuable metals (Nd, Pr, Co, Fe) in the obtained composite powders was greater than 99.8%. Recycled $\text{Nd}_2\text{Fe}_{14}\text{B}$ magnetic powders were successfully synthesized by adding desirable elements in reduction-diffusion process using the obtained composite powder at 1423K for 3 h. The influence of Ca amount on phases, morphologies and magnetic properties was investigated.

Keywords Co-precipitation; $\text{Nd}_2\text{Fe}_{14}\text{B}$ Slurry; Recycled $\text{Nd}_2\text{Fe}_{14}\text{B}$

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Synthesis of Biodiesel using Lignosulfonic Acid Sodium Salt with the Aid of Ion Exchange Resin

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Biodiesel has many merits as an alternative, renewable, non-toxic, biodegradable and environment friendly fuel. Biodiesel consists of alkyl esters derived from either the transesterification of triglycerides or the esterification of free fatty acids with low molecular weight alcohols, which can be produced by using both acid and base catalysts. The worldwide research in the biodiesel industry has focused on how to convert low cost feedstock especially renewable wastes into biodiesel products via low cost technology such as cheap catalyst and reactant, simple processes, economic and environmentally friendly, etc. This research aims to use lignosulfonic acid catalyst, which classified as a biopolymer of the sodium salt form, for synthesis of biodiesel. All parameters, molar ratio of alcohol and oil, an amount of catalyst, and time of reaction, were determined. The characterization of this catalyst was performed by FT-IR. The results showed that, the optimum condition for preparing biodiesel from oleic acid was 10%wt of lignosulfonic sodium salt with the aid of ion exchange resin, 1:10 molar ratio of methanol and oil at 65°C for 1 h of reaction time. This condition gave 89.78% of biodiesel production.

Keywords Biodiesel; Ion exchange resin; Esterification; Solid acid catalyst; Lignosulfonic acid

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