THE 4TH INTERNATIONAL CONFERENCE ON GREEN CHEMICAL ENGINEERING AND TECHNOLOGY
“Community Engagement in Green and Sustainable Technology”

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Venue
Double Tree by Hilton, Melaka

KEYNOTE SPEAKERS
Professor Dato' Seri Ir. Dr. Zaini Ujang
Dato' Ar. Dr. Ken Yeang
Dr Worajit Settapun
Dr Razam Abd Latip

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SYNTHESIS OF BIOLUBRICANT BASE-STOCK FROM PALM METHYL ESTER USING DIFFERENT TYPE OF POLYHYDRIC ALCOHOLS

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Abstract

Biolubricants derived from vegetable oils are environmental friendly products due to their low toxicity and high biodegradability. The synthesis of palm-based biolubricant base stocks were performed by transesterification of palm methyl ester with two types of polyhydric alcohol such as trimethylolethane (TME) and di-trimethylolethane (di-TMP) using sodium methoxide as a catalyst. The effects of temperature (100-150°C), pressure (5, 10, 15, 20, 25, 30 mbar) and time (60, 90, 120, 150 min) were investigated. The palm-based biolubricant base stocks were analyzed for its mono-ester (ME), di-ester (DE) and tri-ester (TE) compositions using gas chromatography as well as its lubricating properties such as kinematic viscosity at 40°C and 100°C, viscosity index, oxidative stability and density. TME was found to be the most effective polyhydric alcohol followed by di-TMP. Palm TME ester base stock containing 98% w/w TE was successfully synthesized. The lubricating properties of the palm TME ester base stock complied with the Lubricant American Petroleum Institute (API) standard.

Keywords: Lubricant, biodegradable lubricant, transesterification, palm methyl ester, polyhydric alcohol
PHYSICAL PROPERTIES OF FISH FEED CONTAINING HOUSEHOLD WASTE AS AN ALTERNATIVE SUBSTITUTE IN NEWLY DEVELOPED SOFT-DRY FISH FEED FOR RED TILAPIA

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Abstract

Most of the fish pellet in market is quite low in requisites of water stability and can swell easily when it is immersed in water. Therefore, the soluble minerals and vitamins will be easily drained out from the pellet. Hence, a study was conducted to reduce the degree of mineral leaching and swelling while the floating time was maximized. The study was conducted to study the effect of varying the concentration of protein, vitamins, fats and carbohydrate on the swelling, leaching, floating properties and morphology of the developed soft-dry fish pellets for Red Tilapia from household waste. The result shows the relationship between fish feed formulation and properties of fish feed pellet produced. The best leaching ability, floating time and stability of fish pellet was attained. Fish feed of formulation of 50% exhibit the desired swelling, leaching and floating properties with swelling rate of 10.20%, leaching rate of 8.23% and was on the surface of the water entire 30 minutes. The best leaching ability, floating time and stability of fish pellet was attained.

Keywords: Fish pellet; degree of swelling; mineral leaching; floating ability
AERATED AND UNAERATED STEEL SLAG FILTER SYSTEM AS POLISHING UNIT FOR PHOSPHORUS REMOVAL FROM TETILE INDUSTRY

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Abstract
Improper tertiary treatment of industrial effluent discharged causes an excessive phosphorus input which leads to eutrophication. Excessive growth of algae will degrade the natural ecosystem of surface waters. Conventional treatment such as activated carbon filter used as a polishing unit in the tertiary treatment is unable to eliminate the phosphorus completely. Approximately, 0.3 – 15 mg/l of phosphorus still presents in the final discharge of industrial effluent. Therefore, this study is conducted to provide alternative solutions using natural treatment with cost saving materials to further remove phosphorus from the textile industrial effluent. Aerated and unaerated lab-scale steel slag filters systems were run for 12 weeks at water treatment plant. The sample collected was analyzed twice a week for the parameters of pH, alkalinity, temperature, dissolved oxygen, total phosphorus, chemical oxygen demand, and total suspended solid. The results of this study showed that the USSF has a high percentage of phosphorus removal compared to ASSF which is 55% to 86% while ASSF have removal efficiency of 52% to 71%. However, the removal efficiency of ACF is slightly better than ASSF which is 52% to 81%. The mechanism of removal involved is likely to be through adsorption.

Keywords: Eutrophication, phosphorus removal, mechanism, textile wastewater, steel slag
APPLICATION OF DATE STONE ACTIVATED CARBON FOR THE REMOVAL OF CAFFEINE MOLECULES FROM WATER

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Abstract
Date stone activated carbon was prepared by impregnating the grounded date stone in 40% phosphoric acid solution. The obtained date stone activated carbon (DSAC) was applied against the caffeine mixed water to scavenge the caffeine molecules from the water. The independent variables such as, activated carbon dosage (0.5-10 g/L), contact time (1-80 min), temperature (25-50 °C), and initial concentration of the caffeine (12-260 ppm) were varied, and observed its effect on the adsorption efficiency of the DSAC. The recovery of the adsorbed caffeine molecules from the surface of DSAC was also studied with NaOH (0.1 N) solution and hot water. The 8 g/L activated carbon dosage was set for recovery after allowing them to adsorb in 100±3 ppm caffeine solution. The desorption efficiency of date stone activated carbon was observed around 27.90±1.08% for hot water and 28.84 ±0.64 % for NaOH (0.1N) solution.

Keywords: Activate carbon; Adsorption; Caffeine; Date stone; Desorption; Dosage.


**ADSORPTION OF SO₂ AND H₂S BY EGGSHELL NANO-PARTICLES**

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Abstract

Sulfur Dioxide (SO₂) and hydrogen sulfide (H₂S) are toxic pollutants which are formed during the burning of liquid or solid hydrocarbons. H₂S and SO₂ are well-identified pollutants known to cause acid rain, respiratory and other environmental hazards. Eggshell on the other hand is an abundant food industry waste with very limited recycling activity. In this study, the potential of modified eggshell to adsorb H₂S and SO₂ were analyzed. Raw eggshells were sonicated in the presence of N,N-dimethylformamide (DMF) to form nano-particles. Sonication was carried out at different temperature (25 °C, 60 °C, 80 °C) and time (1, 2, and 3 hours). For the adsorption performance test, 1 g of the adsorbent was tested with 300 ppm of SO₂ and H₂S, respectively. It was found that sonication at higher temperature (80 °C) and longer duration (3 hours) had the best adsorption capacities for both SO₂ (2.4 mg/g) and H₂S (1.85 mg/g). The increase was due to the increase in BET surface area. Moreover, with the changes in the process study, i.e. introduction of 40% relative humidity and reaction temperature of 200 °C, the nano-eggshell particles performed much better with an increase up to 120% and 180% for SO₂ and H₂S respectively. The findings show potential usage of nano-eggshell particles derived from waste eggshell for acidic gases adsorption.

**Keywords:** Eggshell Valorization; SO₂ Adsorption; H₂S Adsorption; Nano-Eggshell Particles
MECHANICAL AND PHYSICAL PROPERTIES OF BINDERLESS PARTICLEBOARD MADE FROM OIL PALM EMPTY FRUIT BUNCH (OPEFB) WITH ADDITION OF NATURAL BINDER

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Abstract

Malaysia produces abundant of oil palm biomass yearly especially the oil palm empty fruit bunch (OPEFB). The biomass can be converted into value-added panels such as particleboard that free from any chemicals or synthetic adhesives. This study evaluated the properties of binderless particleboard made from OPEFB with addition of natural binder such as corn, potato, tapioca and wheat starch. In this study, binderless panel from OPEFB was manufactured and the panel target density was 0.8 g/cm³. The following process conditions were applied: hot pressing temperature 180 °C, hot pressing time 20 min, and pressure 12 MPa. From this study, the highest strength and dimensional stability properties was found to be the panel with the addition of potato starch as the natural binder in OPEFB binderless particleboard following by corn, tapioca and wheat starch. Overall results meet the Japanese Industrial Standard (JIS) requirements except for water absorption and thickness swelling of the samples.

Keywords: binderless, particleboard, empty fruit bunch, potato starch, corn starch, tapioca starch, wheat starch
ECONOMIC, ENVIRONMENT, AND SOCIAL IMPACTS OF TWO ROUTES OF METHANOL PRODUCTION VIA SUSTAINABILITY EVALUATOR

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Abstract

Methanol is a clean energy resource as it can be produced from waste, natural gas, landfill gas, and many more. Nowadays, methanol can be considered as one of the primary feedstocks for many chemicals production. Thus, the production of methanol is now getting demanded around the world. However, one must consider the sustainability of methanol production. Sustainability will contemplate three significant impacts of the process that are economic (EI), environment (ENVI), and social (SCI). Hence, this paper aims to evaluate the sustainability of methanol processing plants using sustainability evaluator (SE) in conjunction with Aspen HYSYS. Two routes were chosen to simulate the methanol plants (i) via syngas (ii) and natural gas. NRTL and Peng Robinson were used as thermodynamic packages to ensure a good description of a nonideal system. The results generated from HYSYS such as purity, production yield, and the amount of energy consumed were extracted to be fed into the SE. Methanol via natural gas has higher purity, which was 99.2% compared to methanol via syngas that was only 94.1%. The SUI of the methanol production via syngas and methanol production via natural gas were found to be 0.34 and 0.15, respectively. Therefore, the overall sustainability index has shown that the methanol plant via natural gas that was simulated in this project via HYSYS is more sustainable.

Keywords: methanol, sustainability, natural gas, economic, environmental
OPPORTUNITY AND CHALLENGES OF USING ALTERNATIVE AGGREGATES IN CONCRETE

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Abstract
This paper discussed about the opportunity and challenges that researches were facing throughout the journey of searching an alternative material for the replacement of natural aggregates in concretes mixtures. The materials used were coming from non-recyclable household and construction waste such as eggshell, seashell, cockle shell and ceramic tiles waste. The findings revealed that generally using wastage lead to enhance the properties of concrete. It shows that the contributions of the mineral admixtures to performance improvement of the recycled aggregate concrete are higher than that to the natural aggregate concrete. Using wastage in concrete production causes no remarkable negative effect in the properties of concrete. The optimal case of using tile wastage as sand are amounts of 25 to 50 percent, besides, the best case of their use as coarse aggregate are as amounts of 10 to 20 percent. In these measures, not only an increase happens in compressive strength, but also a decrease in unit weight and lack of remarkable negative effect on water absorption is reported. Using wastage in concrete leads to removal of those materials from environment. Besides, decreasing the use of natural raw materials, using the wastage is considered positive economically. It is said that reducing the costs and keeping the environment clean along with wastage management, and ameliorating the strength of structures, is an effective measure in sustainable development. However, there are some challenges in these studies especially in collecting the waste materials in bulk quantity and it is still not been widely used in the construction industry. The concrete also hasn’t been tested in a huge concrete structure and only in laboratory testing. Current practice, waste of shells and construction were being dumped into the landfills. It can increase non-recyclable waste production thus affecting the environment.

Keywords: Aggregates; Eco-Concrete; Green Technology
REMOVAL OF NUTRIENTS FROM SMALL AND MEDIUM FOOD ENTERPRISE (SMFE) WASTEWATER BY USING MICROALGAE BOTRYOCOCCUS SP.

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Abstract

Wastewater treatment is purposed to reduce the suspended solid, biodegradable organics like BOD, pathogenic bacteria, nutrients and elements from contaminating the water body. The excessive content of nutrients in a water body will lead to high concentration of undesirable microorganisms such as phytoplankton. This then will lead to more serious problems that destroy the ecosystem and brings human health problems. In over many years ago, considerable research has been carried out on use of microalgae in wastewater treatment but the effect on particular type of wastewater which is discharged from Small and Medium Food Enterprises (SMFE) is less reported. Wastewater disposed from SMFE has high content of Ammonia Nitrogen and Orthophosphate as meat products contain high nutrients. Hence, this study is carried out to determine the efficiency of microalgae Botryococcus sp. to remove nutrients NH4-N and PO43- from wastewater from SMFE during phycoremediation and establishes the characteristic of this wastewater. Five concentrations of Botryococcus sp., 1x103, 1x104, 1x105, 1x106 and 1x107 cell/ml were cultivated with composite sample of wastewater discharged from SMFE obtained once every hour from 8.00 a.m. to 5.00 p.m. The composite sample of wastewater contains higher BOD, COD, TSS, NH4-N and PO43- than the standard limit recomended by EQA1974 (regulation 2009) (sewage and industrial effluents) Standard B for safe disposal. While the pH is in the range of recommended standard limit. For the removal of NH4-N and PO43-, the best concentration is Concentration 1x106 cell/ml with removal efficiency of 99.27 % and 99.93% respectively. In all samples cultivated with Botryococcus sp. the removal efficiency of NH4-N and PO43- achieved 60-100%.

Keywords: microalgae; nutrients; phycoremediation; Industrial Internet of Things (IIoT); Small and Medium Food Enterprise (SMFE), wastewater.
EFFECT OF TEMPERATURE, REACTION TIME AND SOLID LOADING ON LIGNIN FROM OIL PALM EMPTY FRUIT BUNCHES (EFB) UNDER SUBCRITICAL PHENOL CONDITIONS AS A PRECURSOR FOR CARBON FIBER PRODUCTION

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Abstract

Sustainable approach is needed to find an alternative precursor for carbon fiber. The resources should be low in cost with properties comparable to the present precursor. Malaysia as second largest producer of palm oil produced hundred million tons of waste especially oil palm empty fruit bunches (EFB) from its plantation. The extraction of its lignin from biomass is a challenge as it binds together with cellulose and hemicellulose to form a complex network. Hence, phenol under subcritical conditions has the potential to shorten the reaction time to dissolve relatively high molecular weight compounds without catalyst. This study aimed to determine the effect of temperature (260–300 °C), reaction time (1–10 min), and solid loading (6 and 10 g) towards ash, volatile and carbon content of the lignin obtained from EFB under subcritical phenol conditions. Highest carbon content (43.67%) achieved at reaction temperature of 260 °C, 1 min, 10 g for the lignin extracted from EFB while its ash and volatile content were 23.45% and 0.27% respectively. The correlation of these properties is discussed in this paper to understand its suitability as a precursor for carbon fiber production.

Keywords: carbon fiber, lignin, oil palm biomass, empty fruit bunches, subcritical phenol
MICROBIAL POPULATION INTERACTION WITH NATURAL SOIL COVER FOR SOIL MANAGEMENT

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Abstract

Soil composition plays very important role in balancing and maintaining our terrestrial ecosystem, home for various plants, microorganisms and abiotic components. Numerous activities for development and sustaining human life had disturbed the soil mixture leading to infertility and exposure to the environmental threats. Some techniques and methods had been applied to restore the soil composition and protect from the harsh development activities. One of the method is to use soil cover. Application of natural soil cover (NSC) as mulching and soil amendment may improve fertility and maintaining soil integrity. The interaction of the natural soil cover in promoting microbial population is vital for long term use of NSC. The evaluation on various NSC layers composition made of soil essentials conditioners towards the presence of microbial population were monitored and identified. Microbial population in soil was related to various factors such as observation on weather, morphological changes of NSC, soil pH, soil moisture content and soil organic matter (SOM). Throughout the study, it showed that there were microbial population changes with NSC application at the study site. It is because physicochemical characteristics of soil includes soil pH, soil moisture content and SOM had shown unique changes with different NSC composition responding to the interactions. Integration of biochar in the NSC increased the soil pH from acidic to alkaline and control NSC changed the acidic pH to neutral. Degradation of NSC composition through time increased the organic matter in the soil. In addition, microbial characteristics of the soil had shown a more dominant gram positive bacteria compared to gram negative bacteria resulted from the interaction of NSC with the soil mixture. In addition, actinomycetes and Arbuscular mycorrhizal fungi (AMF) were identified in the soil post NSC applications.

Keywords: natural soil cover, microbial composition, soil infertility, soil erosion
ADSORPTION OF ESCHERICHIA COLI FROM LANDFILL LEACHATE USING DREDGED MARINE SOILS AS GEOSORBENT: THE INFLUENCE OF TEMPERATURE

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Abstract

The heat generated by biodegradation in landfill site led to increasing in landfill temperature. This phenomenon considered to be a consequence of the heat generated by biodegradation process. The increasing temperature is one of the stress factor for the bacteria in landfill site. This factor will interfere with the cell’s metabolism and suppress the bacteria to grow. The focus of this study is to look into the influence of temperature on the adsorption of Escherichia coli (E. coli) from landfill leachate using a geosorbent. The geosorbent was made from Dredged Marine Soils (DMS). The application of geosorbent as landfill liner could potentially entrap and reduce the pathogenic bacteria in leachate. Least number of E. coli was found in the landfill leachate at high temperature degree. Concurrently a high number of E. coli was counted in the geosorbent. Findings from this study supported the idea that E. coli growth in landfill leachate was suppressed by the increment of the temperature. As a result, E. coli developed strategies to respond against this environmental stress. The E. coli shifted from landfill leachate to the geosorbent seeking for a protection. In general, the geosorbent using DMS material demonstrated the ability to adsorb bacteria at varied temperature degree.

Keywords: Geosorbent, Dredged marine soils, landfill leachate, Escherichia coli, adsorption, temperature
EFFECT OF POLYPROPYLENE FIBER INCLUSION ON THE COMPRESSIBILITY AND CONSOLIDATION CHARACTERISTICS OF DREDGED MARINE SOIL

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Abstract
In recent years, synthetic fiber such as polypropylene fiber (PP) was commonly used in soil reinforcement works and still relevant to the geotechnical industry. Hence, this experimental study evaluates the effect of PP fiber on the compressibility and consolidation behaviors of dredged marine soil (DMS). Various water contents (ranging from 0.90-2.40 times the liquid limit of the soil), aspect ratios of the fiber length-cell diameter (10-25 %), and fiber contents (0-1.00 % by dry weight of soil) were chosen as the experimental variables in this research. A series of one-dimensional consolidation test by using conventional oedometer were conducted on the reinforced DMS to determine the compressibility and consolidation characteristics such as compression index ($c_c$), coefficient of volume compressibility ($m_v$), and coefficient of consolidation ($c_v$). The test results show that the addition of PP fiber in DMS has improved the soil, but not substantial. It is recommended that higher content of PP fiber or admixed the soil with binding agent such as cement to greatly improve the soft and high water content DMS.

Keywords: Polypropylene fiber, dredged marine soil, compressibility, consolidation, oedometer, beneficial reuse
PHOTOCATALYTIC DEGRADATION OF BASIC RED 51 DYE IN ARTIFICIAL BATHROOM GREYWATER USING ZINC OXIDE NANOPARTICLES

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Abstract

The current work aims to optimise the photocatalytic degradation of Basic Red (BR51) in artificial bathroom greywater (ABGW) using zinc oxide nanoparticles (ZnO NPs). The factors investigated included ZnO NPs (10-200 mg), pH (3-9) and BR51 concentration (1-10 ppm). The results revealed that the maximum degradation (89.01%) of BR51 was recorded with 100 mg of ZnO NPs, pH 5 and 1 ppm of BR51. In conclusion, the ZnO NPs are able to degrade the BR51 dye in ABGW effectively.

Keywords: Photocatalysis, Decolourisation, Azo Dye, Nanoparticles
CARBON DIOXIDE SEQUESTRATION IN CONCRETE AND ITS EFFECTS ON CONCRETE COMPREHENSIVE STRENGTH


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Abstract

In recent years, the production of cement has grown globally in a very rapid manner due to the modernization of the world we live in, and after fossil fuels and land-use change, cement production is the third-largest source of anthropogenic emissions of carbon dioxide, CO₂. Cement being the primary binding material for concrete and with the prospects for the concrete industry continues to grow so will the emissions of CO₂. Hence, a method to reduce the CO₂ production while keeping up with the progression of the concrete industry is very crucial in current times. This is where CO₂ sequestration comes in. It is a process where CO₂ is converted into a mineral which will then be trapped into the concrete forever. Required data to carry out the research between CO₂ sequestered concrete and concrete without CO₂ have been observed, obtained and tabulated as necessary. These data are then used to compare the concrete samples with one another and also prove the theoretical effects of CO₂ exposure to concrete. Hence, experimental results on the compressive strength of the concrete samples for 7, 14 and 28 days has also been tabulated, graphed and further disputed. The objective of this research is mainly to determine the compressive strength of CO₂ sequestered concrete in comparison with concrete without CO₂ in order to decrease the effects the concrete industry has on the environment. The compressive strength of concrete samples with sequestration of CO₂ gas is expected to be higher than of the concrete without CO₂.

Keywords: Sequestration, Carbon Dioxide, Concrete strength
EFFECT OF TIO₂ NANOTUBES MORPHOLOGY STRUCTURE INTO PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE IN AQUEOUS SOLUTION

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Abstract

The catalyst helps the photocatalytic activity by the present of radiation including by natural sunlight radiation. Using TiO₂ nanotubes as catalyst such as right option in order to degrade organic compounds in aqueous solution. Uniformly array TiO₂ nanotubes were formed by electrochemical anodization on Ti foil in ethylene glycol as electrolyte solution. The effect of the anodization voltage and calcination time have been influencing the morphology structure of TiO₂ nanotubes. The photocatalytic performance has been determined by Methylene Blue removal. Methylene Blue was irradiated by TiO₂ nanotubes under the natural sunlight for 4 hours. The maximum efficiency of methylene Blue removal was at 3 hours of irradiation time. Photocatalytic activity increases when the morphology structure of TiO₂ nanotubes in strong and optimum condition. Therefore, TiO₂ nanotubes at 40 V anodization followed by 450 ºC calcination within 3 hours gave the highest photocatalytic performance in Methylene Blue removal.

Keywords: Nanotubes, photocatalytic, catalyst, Methylene Blue
OPTIMIZING DECOMPOSITION OF FOOD WASTES USING RESPONSE SURFACE METHODOLOGY

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Abstract

The present study aimed to optimize the decomposition of food wastes based two independent factors on effective microorganisms (EM) dose (0-50 mL) and temperature (40-50°C) using Response Surface Methodology (RSM). The dependent variable included total nitrogen (TN) and total phosphorus (TP) reduction. The results revealed that EM dose improved the TN reduction while temperature was more significant on the TP reduction. The interaction between EM dose and temperature has improved the decomposition process. The maximum reduction of TN was recorded with 25 mL of EM solution and at 45 °C where 23.3% of TN was reduced. In contrast, the highest reduction of TP was 84.3% recorded with 50 mL of EM solution and at 40°C. These findings indicated that the decomposition process was effective in reduction of TP in the food wastes.

Keywords: response surface methodology; total nitrogen (TN); total phosphorous (TP); effective microorganism, temperature
ELECTROPERSULPHATE OXIDATION OF MATURE LANDFILL LEACHATE

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Abstract

Landfilling is the most common method used to treat municipal solid waste in Malaysia. Landfill leachate (LL) is typically produced by infiltration of precipitation through landfill that contains potential hazards to the environment. Only 9 operating landfills in Malaysia can be classified as modern sanitary landfills. Subsequently, substantial amounts of untreated landfill leachate will be discharged into the surrounding environment. Electro-persulfate oxidation process is introduced in order to degrade pollutants contained in mature LL. In this study, the impact of current density, contact time, \(S_2O_8^{2-}\) dosage was investigated and optimized using Response Surface Methodology (RSM). The optimum performance was obtained at current density 44.66 mA/cm², contact time 68.3 minutes and \(S_2O_8^{2-}\) dosage of 0.88g/L, respectively. The optimum removal efficiencies were 97.30%, 45.70% and 98.50% for colour, COD and turbidity. The final pH was 7.12. The treated LL effluent meet the discharge standard limit of Malaysia.

Keywords: Landfill leachate, organic pollutants, electro oxidation, persulfate, Response Surface Methodology
PHYCOREMEDIATION OF SMALL AND MEDIUM FOOD ENTERPRISE (SMFE) WASTEWATER BY INDUSTRIAL INTERNET OF THINGS (IIoT)

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Abstract

Water is used in the production of many materials and finished products in the industries. The commercial Small and Medium Food Enterprises (SMFE) generates huge quantities of wastewater. Disposed SMFE wastewater contains high range of nutrients such as ammonia nitrogen and orthophosphate which will cause eutrophication and lead to destruction of ecosystem. The conventional method for wastewater treatment is expensive and SMFEs could not afford to treat the wastewater. There are a number of aerobic and anaerobic wastewater treatment methods that can be used to treat wastewater disposed from SMFE. Phycoremediation is one of the most effective and economical wastewater treatment method that is suitable for treating SMFE wastewater. Phycoremediation is a process that requires more accuracy and optimization in the procedures. For a greater efficiency and effectiveness in the phycoremediation of SMFE wastewater, Industrial Internet of Things (IIoT) will be highly beneficial. Based on the studies conducted on the application of microalgae in wastewater treatment and IIoT application in wastewater treatment, this paper discusses on the application IIoT in the SMFE wastewater treatment through phycoremediation and its benefits.

Keywords: microalgae; nutrients; phycore
ADSORPTIVE REMOVAL OF PHOSPHATE FROM AQUEOUS SOLUTION USING WASTE CHICKEN BONE AND WASTE COCKLE SHELL

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Abstract

The removal of phosphates from surface waters is crucial to avoid water pollution problems such as eutrophication and algae blooms. There are many established methods that normally used to remove phosphates such as by chemical precipitation, biological processes and physicochemical by sedimentation. On the other hand, calcium carbonate (CaCO3) is recognised as an efficient phosphorus (P) binder in lake sediment which contribute to the permanent burial of P in the sediments. Therefore, this paper studies the potential of raw chicken bone (RCB), calcined chicken bone (CCB), raw cockle shells (RCS) and calcined cockle shells (CCS) in phosphates removal from aqueous solutions. The collected chicken bone waste and cockle shells waste were washed, boiled and dried at 70°C for raw sample and decomposed at 800°C for calcined sample before been grinded into granular size between 1-2mm. The dosage of 0.1g, 0.2g, 0.3g, 0.4g, 0.5g, 0.6g, 0.7g, 0.8g, 0.9g and 1.0g of the adsorbent were applied into the artificially prepared phosphate solution and stirred for 20 minutes at 30°C. The result indicated that the maximum removal of phosphate was achieved at 0.6g (96% removal efficiency) for RCB, 0.8g (87% removal efficiency) for CCB, 1.0g (57% removal efficiency) for RCS and 0.5g (99% removal efficiency) for CCS. As a general conclusion, phosphate species seem to be efficiently removed from solutions using chicken bone and cockle shell as natural adsorbent. In addition, the waste from the adsorption process can be recycle and used as fertilizer for acid soils.

Keywords: phosphorus removal, natural adsorbent, chicken bone waste, cockle shells waste
AN APPLICATION OF PHYTOREMEDIATION BY USING Heliconia sp. TO LAKE WATER

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Abstract
A study application of phytoremediation, the floating bed was constructed with thick polystyrene foam board on water taking from the lake, and the potential of Heliconia sp. To serve as a phytoremediation plant in the cleaning up of contamination from polluted lake was evaluated in this study. About 180 Heliconia sp. in average height of 55 cm were planted on the floating bed in turn. The results showed that NH$_3$-N and NO$_3$ of study lake water reduced 66% and 92%, respectively. Harvesting Heliconia sp. can carry quantities of contaminant from aquatic system. In which case, phytoremediation is and effective way, practically and economic environmentally technology (green technology) to remove organic matter from the polluted lake water.

Keywords: Phytoremediation, Plant Floating Bed, Heliconia sp, Lake water.
IONIC LIQUID ASSISTED CELLULOSE AEROGELS FOR CLEANING THE OIL SPILL

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Abstract

One of the major emerging disasters for aquatic life as well as humans is an Oil spill. Aerogels are a suitable alternative for the cleaning of the oil spill. In this study, a facile method was presented for the production of aerogel from cellulose/lignocellulose using Ionic liquids. This method is sustainable as it employs greener materials. Aerogels were prepared using sol-gel reaction with ionic liquids, gelation, and freeze-drying for 24 hours. The ionic liquids used were 1Ethyl 3Methylimidazolium Acetate [Emim][Ac] and 1 Butyl 3 methylimidazolium chloride [Bmim][Cl]. The resultant aerogel possesses an interconnected porous structure depending upon the type of ionic liquid employed. The effect of the anion on the thermal stability of aerogels is to be observed. The TGA results suggest that thermal stability of cellulose aerogel using [Bmim][Cl] was better as compared to [Emim][Ac]. FESEM results suggest that dissolution was better in [Emim][Ac] than [Bmim][Cl].

Keywords: Cellulose aerogel, Ionic liquids, freeze-drying.
INSIGHTS INTO PYROLYSIS OF WASTE TYRE IN FIXED BED REACTOR: THERMAL BEHAVIOUR

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Abstract
This study examines the thermal behaviour of pyrolysis products of waste tyre. The pyrolysis of solid waste tyre was conducted under N₂ atmosphere in a lab-scale fixed bed reactor. Three different factors were investigated, which were temperature (300, 400, 500, 600 and 700 °C), particle size (80 mesh, 40 mesh and 18 mesh size of particles) and carrier gas flow rate (1 L/min and 5 L/min). The optimised liquid product yield was obtained at a pyrolysis temperature of 500°C for a feedstock of 80 mesh size waste tyre, with a carrier gas flow rate of 5 L/m. The tyre pyrolysis oil was then characterised via fuel properties determination, FT-IR and GC-MS analysis. The fuel properties of the tyre pyrolysis oil encourage the product as a potential replacement of conventional liquid fuels. The analytical results of the optimised pyrolysis oil showed that the liquid product consists of the complex mixture of C₅-C₁₆ organic compounds, with high contents of light hydrocarbon benzene, toluene, xylene and limonene. The present research is a promising approach for an alternate, renewable energy and better environment in the future.

Keywords: Pyrolysis, waste tyre, particle size, thermal analysis
PHOTOCATALYTIC DEGRADATION OF PHENOL USING SILVER-MODIFIED ZINC OXIDES UNDER VISIBLE AND UV LIGHT IRRADIATION

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Abstract

The objective of this study is to evaluate the performance of synthesized silver doped zinc oxide (Ag-doped ZnO) photocatalysts for the degradation of phenol. The effect of initial phenol concentration, catalyst loading and reaction time on the degradation of phenol were studied at different visible light intensity (25 W, 40 W and 60 W). Experiment results indicated that intensity of light significantly influenced the photocatalytic degradation of phenol. Highest degradation of phenol (65%) was achieved at highest light intensity of 60W after 90 min reaction time. Obtained results also revealed that the photocatalytic performance was also affected by the initial phenol concentration, catalyst loading and reaction time. The performance of Ag-doped ZnO was also evaluated using two different light sources (visible and UV light). The interaction and optimization of the parameters were studied by using Response Surface Methodology. The obtained RSM model with $R^2 = 0.96$ suggested a satisfactory correlation between the predicted values and experimental results of phenol degradation. The RSM optimization experiment of photocatalytic degradation indicated that the highest degradation of phenol (83%) could be observed at 60 W visible light irradiation, 19.55 ppm (initial phenol concentration), 1.86 g/L catalyst loading, and 145.57 min reaction time. It can also be concluded that photocatalytic degradation under visible light demonstrated better phenol degradation up to 82% as compared to UV light (76%). The outcomes from this study would be beneficial to further understand the potential of Ag-doped ZnO as an efficient visible-light driven photocatalyst, particularly for water and wastewater treatment.

Keywords: photocatalytic degradation, phenol, silved-modified, Zinc Oxide
FTIR AND TGA ANALYSIS OF CELLULOSE TO BIOCHAR

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Abstract

The aim of this work is to analyse and compare some of the properties of cellulose obtained from oil palm empty fruit bunch (EFBC) with commercial cellulose (CC) intended to be used as positive control. Ultimate analysis showed the empirical formular of EFBC and CC as: CH$_{0.18}$ O$_{1.39}$ N$_{0.01}$ and CH$_{0.18}$ O$_{1.28}$ N$_{0.01}$ respectively. Recalcitrance index which is a measure of the degree of thermal stability (as measured by Harvey et al. 2012) showed the recalcitrance index of EFBC and CC as 0.375 and 0.381 respectively. FTIR spectra showed similarities in peaks in all four spectral regions with slightly higher peak intensity for the CC. The highest average degradation temperature peaked for both CC and EFBC at 357 oC. The yield of char residue obtained from pyrolysis (pyrochar) and gasification (gasichar) were within close range of 17% and 12% respectively. However, the final char yield in the case of torrefaction (torrechar) of CC was higher by 10% than that for EFBC. These results indicate that the EFBC is closely similar in properties to that available commercially.

Keywords: Empty fruit bunch cellulose, commercial cellulose, positive control, recalcitrance index, Char yield, torrechar, pyrochar, gasichar
STUDY OF GELLING TIME OF PALM OIL EMPTY FRUIT BUNCH FIBER/SOL-GEL SILICA PROCESS

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Abstract
Oil palm empty fruit bunch (EFB) fibers were impregnated by silica through sol-gel process. The focus of the study was to investigate the gelation time during the synthesis of the silica sol-gel process using rheometer. The gelling time was determined from crossing over of storage moduli (G’) and loss moduli (G”). Process parameters (i.e. catalyst ratio: 0.03, 0.05, 0.07, water ratio: 2, 4, 6 and temperature: 30, 40, 50°C) were correlated with gelling time using Response Surface Methodology (RSM). The determination of appropriate polynomial equation to represent the relationship between the process parameters and the gelling time was performed by carrying out sequential model sum of squares (SMSS) and Lack of Fit Tests. Analysis of variance (ANOVA) depicted that all examined parameters have a profound effect on gelling time for EFB/sol-gel silica.

Keywords: Empty fruit bunch (EFB), Sol-gel silica, Gelling time, Response Surface Methodology (RSM)
PHYSICAL AND CHEMICAL PROPERTIES OF BOTTOM ASH COAL-FIRED POWER PLANT

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Abstract

Coal power plants are known as plant that burning coal to generate electricity, and its application in industrial construction for nearly a century. The objective of this study is to determine the physical and chemical properties of bottom ash coal-fired Jimah power plant, Port Dickson, Negeri Sembilan and to study its potential usage of bottom ash in industrial construction. Bottom ash is a by-product of coal combustion from coal power plant during the electricity generating process. Apart from that, excess of bottom ash produced during electricity production in Malaysia has caused some environmental problems. Thus, a few tests have been carried out in order to determine the physical and chemical properties of bottom ash. For physical properties, test for dry bulk density, water absorption and particle size was conducted by following British Standard (BS) procedure. While, for chemical properties, metal extraction was carried out to study the presence of few heavy metals in bottom ash which are Iron (Fe), Potassium (K), Calcium (ca) and lead (Pb). Based on the results, it shows that the characteristic of bottom ash which is porous structure, angular and rough texture are affected its dry bulk density and water absorption. So, from the analysis, it can be concluded that particle size of bottom ash is suitable to be used in concrete as a replacement in industrial construction.

Keywords: Bottom Ash, Coal-Fired Power Plant, Physical Properties, Chemical Properties
COAGULANT ACTIVITY SCREENING OF PARTIALLY CHARACTERISED WATER-SOLUBLE SEED PROTEINS FROM MORINGA OLEIFERA

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Abstract

In this study, partially characterised water soluble seed proteins from Moringa oleifera were screened for coagulant activity. Seed proteins were extracted from defatted M. oleifera using distilled water, followed by adjustment to pH 7 and sequential ammonium sulphate precipitation. Positive coagulant activity was observed for 40% fractionated isolate that was characterised by SDS-PAGE as mixture of peptides of molecular weights ~32, ~31, ~23, ~17, ~14 and ~12 kDa respectively. At total protein concentration of 0.79 ± 0.03 mg/mL, the isolate removed 93% of initial turbidity. Our findings suggest 40% fractionated isolate as a promising semi-purified coagulant.

Keywords: Moringa oleifera; coagulant activity; ammonium sulfate precipitation; semi-purified coagulant
CHARACTERISATION OF INDUSTRIALLY PRODUCED PKS BIOCHAR AND ITS POTENTIAL AS SLOW RELEASE NP FERTILIZER

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Abstract

The main objective of this study is to determine the release pattern of nitrate nitrogen, ammonium nitrogen and phosphate in PKS biochar impregnated with synthetic NPK fertilizer. The PKS biochar was produced by PFS Energy, Kuching Sarawak with a … and characterized by ultimate and proximate analysis, FTIR and SEM-EDX. The synthetic fertilizer was prepared using NH4NO3 and KH2PO4, and the impregnation was done at a fertilizer to PKS biochar ratio of 25:75 (w/w). A commercial controlled release fertilizer (17:8:9:3 NPKMg; Agroblen) was used as positive control, and pure PKS biochar as negative control. Distilled water was added to the leaching column, soaked for 1 hour before collecting the leachate for analysis using HACH DR 2800 Spectrophotometer. This leaching procedure was repeated several times. The proximate analysis of PKS biochar revealed a fixed carbon content of 73.1 ± 0.7 wt.% (d.b) and a volatile matter and ash content of 11.7 ± 0.05 wt.% (d.b.) and 15.2 ± 0.0 wt.% (d.b.), respectively. The total carbon, hydrogen, nitrogen and oxygen content of PKS biochar was 75.3 ± 9.2, 0.86 ± 0.91, 0.79 ± 0.25 and 7.9 ± 0.0 wt.% (d.b.), respectively. SEM-EDX results for total carbon were in good agreement (77 wt.%), and confirmed the presence of oxygen (17 wt.%) and plant nutrients such as Mg (0.77 wt.%),
Si (0.66 wt.%), K (2.38 wt.%) and Ca (1.50 wt.%). The atomic H/C and O/C ratios were 0.137 and 0.079 satisfying the International Biochar Initiative’s biochar requirements. The carbon sequestration potential of this biochar was estimated to be 0.3982 ton CO₂ per ton biomass making it a suitable candidate for climate change mitigation and carbon credit trading. The BET (N₂) PKS biochar surface area was 135 m²/g while BJH average pore diameter was 49.3 nm. FTIR revealed the presence of lignin in PKS biochar hence not all lignin is carbonised. Leaching experiments showed that impregnated PKS biochar had the greatest nutrient release followed by positive control and negative control. Further research into the impregnation of NP fertilizer on PKS biochar with suitable coatings is required to improve the nutrient release.

**Keywords:** oil palm kernel shell, biochar, slow release fertilizer, carbon sequestration potential
COMPARATIVES STUDIES OF QUERCETIN (FLAVONOID) EXTRACTION METHOD FROM MORINGA OLEIFERA LEAVES

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Abstract
The purpose of the study is to compare the performance of Soxhlet Extraction and Ultrasound-assisted extraction (UAE) method in extracting quercetin from Moringa Oleifera leaves. The extraction of quercetin from Moringa Oleifera leaves was studied by varying experimental conditions, namely type of solvent (Ethanol and Methanol) and solvent concentration (50%, 70% and 95%). As the result, the UAE method showed a better performance in extracting quercetin from Moringa Oleifera leaves compared to Soxhlet Extraction method. High concentration of quercetin (2.5 ppm) were extracted using 50% of methanol. Besides, antimicrobial activity of Moringa Oleifera leaves extract against Staphylococcus aureus was identified in this study. The maximum inhibition zone was exhibited on 50% methanol extract of Moringa Oleifera leaves against S.aureus with the value of 28.0 mm. FTIR analysis showed the present of phenolic compound and aliphatic ketone in the Moringa Oleifera leaves.

Keywords: Ultrasound-assisted extraction, Soxhlet Extraction, Moringa Oleifera leaves, Quercetin, antimicrobial activity
OPTIMIZATION AND KINETIC MODELLING OF TOTAL WATER EXTRACTS AND WATER SOLUBLE PROTEINS IN ROOT EXTRACTS OF EURYCOMA APICULATA BY MICROWAVE ASSISTED EXTRACTION

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Abstract

Tongkat Ali is a well-known plant for its’ various bioactivities, that benefits human health. A few investigated the protein content in its water extracts with the consideration of establishing the most suitable extraction method to increase their yields with high efficiency and less time consumption. However, the extraction by microwave assisted have been less studied. The objectives of this study is to obtained the Water soluble extract (WSE) and water soluble proteins (WSPs) from the Eurycoma apiculata roots. The circumscribed composite central design (CCCD) was based on four factors, namely the radius of particle size (D), temperature (T), microwave power (W) and irradiation time (i). Results illustrated that the optimum conditions for obtaining the maximum WSE were (P: 0.025mm; T: 60°C; W: 286W and i:15 min) while for the WSPs were (P: 0.025mm; T:51°C; W: 278W and i:13 min). The kinetic investigation were based on the comparison of three empirical models; the second order extraction rate, Pelegs’ model and the two site kinetic for the WSPs. Results revealed that the best empirical models to represent the kinetic characteristics of extraction process were the second order extraction rate and Pelegs’ model ($R^2$: 0.974); the capability of the two site kinetic model to express the extraction behaviour of the WSPs ($R^2$: 0.917) was enhanced with the consideration of the degradation factor ($k_D$)and reached ($R^2$: 0.924).

Keywords: Eurycoma apiculata, Microwave assisted extraction, Optimization, Water soluble proteins, kinetic models
ANTIMICROBIAL ACTIVITY OF DALDINIA ESCHSCHOLTZII AND NIGROSPORA SPHAERICA ON DIABETIC WOUND PATHOGENS

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Abstract

Diabetic wound constantly associates with amputations and high mortality rate. In 2015, diabetes caused 5 million deaths. It is also estimated that the number of people with diabetes will increase from 424.9 million in 2017 to 628.6 million in 2045. Meanwhile, the emergence of multidrug resistance microorganisms also delayed the curing time of diabetic wounds. The aim of this study is to evaluate the antimicrobial activity of two endophytic fungi, Daldinia eschscholtzii and Nigrospora sphaerica on diabetic wound pathogens. The endophytic fungi were isolated from Homalomena pineodora. Kirby–Bauer assay was used to screen the antimicrobial activity of both fungal isolates. The test was then proceed to Broth Microdilutions Assay to determine the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). On Kirby–Bauer assay, both fungi exhibited significant inhibitory activity on 4 Gram positive bacteria, 7 Gram negative bacteria and 1 yeast with minimal inhibitory concentrations ranged from 3.125 to 12.5 mg/ml and minimal bactericidal concentration range from 3.125 to 25 mg/ml. The antimicrobial activity was concentration-dependent. In conclusion, two endophytic fungi Daldinia eschscholtzii and Nigrospora sphaerica showed potent antimicrobial activity on wound bacteria. Further study should be conducted to further purify and identify the antimicrobial compounds from these two fungal isolates.

Keywords: Antimicrobial compound, diabetic wound, endophytic fungi, Homalomena pineodora
PHARMACOLOGICAL EFFECTS AND ANTIBIOTIC MECHANISM OF A NEW COMPOUND PHOMOPSIDIONE ON EXTENSIVELY DRUG RESISTANT PSEUDOMONAS AERUGINOSA

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Abstract
Antibiotics resistance of Pseudomonas aeruginosa have caused in significant increase of morbidity and mortality in humans. The term extensively drug resistant (XDR) is used to describe a bacterial strain that is resistant to at least 3 classes of bacteria. Current antibiotics therapies are not effective against this bacterial strain. A new compound discovered, Phomopsidione shows a rapid bactericidal activity on XDR P.aeruginosa. Based on disc diffusion assay the result implicates that phomopsidione inhibits mostly Gram-negative bacteria including Pseudomonas aeruginosa, Proteus mirabilis, Escherichia coli, Acinetobacter anitratus, Salmonella thyphimurium and Klebsiella pneumoniae. The phomopsidione also shows a significant inhibition zone towards Candida albicans and Gram-positive Bacillus subtilis. According to the results of microdilution broth assay the bacterial strains was susceptible to phomopsidione with the range concentration from 1 mg/ml to 2.5 mg/ml. Then, phomopsidione will be tested by time kill kinetic assay to determine the bacterial growth inhibition based on dose and time dependent manner. The pharmacological effects and antibiotic mechanism of phomopsidione will be further identified via virulence factor expression analysis, electron microscope observations and molecular approach by a gene expression profile.

Keywords: Antibiotic mechanisms, Phomopsidione, Pseudomonas aeruginosa
ANTIMICROBIAL ACTIVITIES OF PHYLLOSTICTA FALLOPIAE, AN ENDOPHYTIC FUNGUS ISOLATED FROM ALOE VERA

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Abstract

Endophytes are defined as microorganisms residing in the plant tissue without causing apparent disease symptoms to the host. They are great reservoir of antimicrobia compounds. \textit{Phyllosticta fallopiae} was isolated as an endophytic fungus from the traditional medicinal plant, \textit{Aloe vera} by using surface sterilization method. The fungus was identified based on morphological and molecular approaches. This study aimed to partial purify the antimicrobial compounds from the dichloromethane (DCM) extract of \textit{P. Fallopliae}. The antimicrobial activity of this fungal isolate also tested diabetic wound pathogens. On disc diffusion assay, the DCM extract exhibited significant antimicrobial activity on both Gram positive and Gram negative bacteria and yeasts. The antimicrobial activity was broad spectrum. On broth microdilution assay, the lowest minimal inhibitory and minimal lethality concentration (MIC and MLC) of DCM extract was recorded against \textit{Yersinia} sp. with the values of 0.08 and 0.63 mg/mL, respectively. The antimicrobial activity was concentration dependent. In order to partial purify the antimicrobial compounds, volume-based fractionation of DCM extract using column chromatography followed by thin layer chromatography (TLC) was employed. A total of 21 fractions were collected from the column chromatography. At a concentration of 100 µg per disc, 4 fractions (Fraction 34, 41, 69 and 76) were found to be inhibited at least 8 out of 10 test microorganisms with the diameters of clear zones ranging from 8-13 mm. Agar overlay bioautography with TLC further confirmed that the Fraction 34 and 76 exhibited significant antimicrobial activity. In conclusion, the partially purifed fractions from \textit{P. fallopiae} showed broad-spectrum antimicrobial activity. Further investigations should be done the isolate and identify the antimicrobial compounds present in the extract.

Keywords: \textit{Phyllosticta fallopiae}; Endophage; Antimicrobial activity; Partially purified
SYNTHESIS OF *HOMALOMENA PINEODORA* ESSENTIAL OIL NANOPARTICLES AND ITS ANTIMICROBIAL ACTIVITY AGAINST DIABETIC WOUND PATHOGENS

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Abstract

Diabetic patients with foot ulcer showed a 150-fold increased risk of amputation, which primarily caused by microbial infections. The aim of this study was to synthesize and characterize *Homalomena pineodora* essential oil nanoparticles by using chitosan as encapsulant. *H. pineodora* is a new tropical plant species discovered in peninsular Malaysia. The essential oil was extracted by hydrodistillation and analyzed with gas chromatography-mass spectrometry (GC-MS). The major compound present was 2-octylcyclopentanone (53.8%). *H. pineodora* essential oil was successfully encapsulated in chitosan nanoparticles using ionic gelation method to enhance the antimicrobial efficiency. The obtained nanoparticles display an average size of 70±20 nm, with spherical shape and positively charged. The encapsulation efficiency of *H. pineodora* essential oil nanoparticles was 27.53% and loading capacity was 25.60%. The nanoparticles showed an initial burst release followed by a slow drug release pattern after a period of 72 hours. The drug release followed first order of kinetic. *H. pineodora* essential oil nanoparticles displayed significantly better inhibitory activity compared to free essential oil. The synergistic effect of *H. pineodora* essential oil and chitosan nanoparticles was evidence by the low fractional inhibitory concentration index on Checkerboard Assay. *H. pineodora* essential oil nanoparticles also eradicates pre-formed...
biofilm and inhibiting biofilm formation of several clinical isolates. In 3D collagen diabetic wound models, H. pineodora essential oil nanoparticles exhibited 60 – 80% growth reduction against all test microorganisms relative to control. The findings indicated that delivery of *H. pineodora essential* oil was enhanced by nano-encapsulation with chitosan. In conclusion, H. pineodora essential oil nanoparticles were successfully developed and they exhibited significant inhibitory activities on diabetic wound pathogens.

**Keywords:** *Homalomena pineodora*; Nanoparticle; Antimicrobial activity; Essential oil.
PHYSICOCHEMICAL PROPERTIES OF RESISTANT STARCH TYPE III FROM SAGO STARCH AT DIFFERENT PALM STAGES

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Abstract

In this study, resistant starch type III (RS3) was produced from different sections, the top and bottom part of Metroxylon sagu palm at different growth stages namely, Plawei Manit, Bubul and Angau Muda. Sago starch was subjected for two cycles of autoclaving, debranching by pullulanase and cooling for the production of resistant starch. The physicochemical properties of sago RS3 studied were the starch morphology by Scanning Electron Microscopy (SEM), resistant starch content, amylose content, swelling power and solubility as influenced by different palm growth stages and sections. Significant differences in the resistant starch content as well as amylose content from the different growth stages were observed. Granules of resistant starch showed irregular and rough surface structure as compared to smooth granular surface, oval shaped of native sago starch. No significant variation was observed in the results of swelling power and solubility from the different growth stages.

Keywords: Sago Starch, Resistant Starch, Amylose, Autoclaving, Swelling power and Solubility
YIELD AND PHYSICOCHEMICAL PROPERTIES OF STARCH AT DIFFERENT SAGO PALM STAGES

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Abstract

Sago (Metroxylon sagu) starch used in the current study was derived from palm separated into Plawei Manit, Bubul and Angau Muda growth stages. The three palm stages were characterized by separation into top and bottom part of trunk. The present study was conducted to determine the total sago starch production, particle size distribution, colour, swelling power and solubility of sago starch as influenced by different palm growth stages. Total starch obtained from sago pith was ranged from 55kg to 155kg with the bottom palm produced higher output than top palm. The particle size distribution was distinctive for sago starch isolated either from top or bottom part of palm stages and the value found to be between 21.53 µm and 56.56 µm.. Colour parameter of L*, a* and b* showed significantly different (p<0.05) colour tone for three growth stages with the results ranged from 80.70 to 94.81, -0.81 to 1.34, and 5.35 to 8.48, respectively. The swelling power and solubility was ranged from 13.14 to 18.85 and 5.63 to 8.07. The swelling power and solubility displayed higher results in sago starch obtained from bottom palm as swelling power larger in Plawei Manit whereas solubility was greater in Bubul growth stage.

Keywords: Sago Starch, Colour, Particle Size, Swelling Power and Solubility
OIL PALM TRUNK DERIVED BIOCHAR AS A POLISHING ADSORBENT FOR BIOLOGICAL TREATED POME

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Abstract

Oil palm waste used in this study was oil palm trunk. This biomass was collected from the local plantation and then pyrolyzed in a Belinio gasifier. The characteristics of biochar produced from this biomass was evaluated to determine whether it is suitable to be used as polishing adsorbent in wastewater application. The biochar produced from this biomass contain high carbon content and high in fixed carbon content as the biochar was produced at the temperature of more than 500 °C at which suitable for water water application. About 20 % w/w of biochar was obtained from the Belinio gasifier. It was expected that the biochar produced from the gasification process was low in moisture content and had high in porous structures which is an indicator of many adsorption sites thus showing desirable characteristics for potential application as an adsorbent in wastewater treatment application. Other than that, the presence of various functional group in this biochar also one of the characteristic that made the biochar had potential to be polishing adsorbent.

Keywords: adsorption, biochar, gasification, oil palm waste, wastewater
POTENTIAL OF PALM STEARIN AS COATING MATERIAL AND BINDER FOR SLOW RELEASE FERTILIZER

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Abstract
The main objective of the present work is to evaluate the potential of palm stearin as biodegradable coating material and binder for slow release fertilizer. Three different types of samples were tested which involved uncoated urea, palm stearin coated urea and palm stearin coated urea with addition of allicin as urease inhibitor. Urea granules were coated with different mass of palm stearin by using pan coater. The effects of palm stearin in single and double coating method towards dissolution rate of coated urea were investigated. Results showed reduction of 20% in urea release when double coated palm stearin is used to coat urea as compared to control. Scanning electron microscopy images demonstrated that the presence of palm stearin as coating layer able to form smooth surface on urea granules and covered the large pores that originally belongs to urea granules. Meanwhile, Fourier transform infrared spectra showed no significant difference between structure of coated urea and uncoated. Even though elemental analysis showed reduction of nitrogen towards coated urea, but the increment in coating layer increased the strength of urea granules. The study proved that palm stearin is suitable to be used as coating materials and binder for slow release fertilizer with no effects on properties of urea.

Keywords: Urea, Palm stearin, Allicin, Slow release, Dissolution
RATIONAL ENGINEERING OF ARGINASE FOR ENHANCED ANTICANCER ACTIVITY

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Abstract

Human arginase (ARG I) is an enzyme involved in urea cycle, where it catalyzes the hydrolysis of L-arginine into L-ornithine and urea. Previous studies on ARG I revealed its capability as a therapeutic enzyme for arginine-auxotrophic cancers via amino acid deprivation therapy. However, its short half-life and low affinity of this enzyme towards arginine has become its major shortcomings. In this study, the substrate affinity of ARG I was improved via rational engineering. Protein structure of human arginase was obtained from National Center for Biotechnology Information (NCBI). The mutants of this enzyme engineered by altering the amino acid residues at the catalytic triads location known as His-141, Glu-277, and Asp-128 before proceed with protein docking and molecular dynamic simulation. Molecular modelling of ARG I studies revealed that glutamic acid residue at position 186 plays a role in substrate binding. Mutants in two combinations of His-141, Glu-277, and Ser-128; and His-141, Glu-277, and Thr-128 results in higher number and stability of hydrogen bonds towards substrate. Mutants will be developed via site-directed mutagenesis. Studies on the enzymatic performance and in vitro anticancer assay will help in evaluating this enzyme as a potential anticancer agent.

Keywords: Human arginase, L-arginine, amino acid deprivation therapy, rational engineering, catalytic triads, protein docking, molecular dynamic simulation
IDENTIFICATION OF POTENTIAL ANTIMICROBIAL COMPOUNDS FROM ENDOPHYTIC FUNGI ISOLATED FROM HOMALOMENA PINEODORA

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Abstract

Endophytes are microorganisms residing in living plant tissues, which cause no apparent disease symptoms to the host. They are well known as a source of novel bioactive compounds. In present study, a total of 29 endophytic fungi were isolated from the leaves of Homalomena pineodora, a tropical plant found in Peninsular Malaysia. All isolates were cultivated and the fermentative cultures were extracted with ethyl acetate, with the assistance of ultra-sonication. 5 out of 29 isolates showed significant antimicrobial activity on most of 9 diabetic wound bacteria in disc diffusion assay. These 5 isolates were identified genotypically as Nigrospora sp., Cerrena sp., Hypoxylon sp., Daldinia sp., and Phomopsis sp., respectively based on internal transcribed spacer (ITS) gene sequence analysis. Two isolates were selected (Hypoxylon sp., and Cerrena sp.,) for the partial purification of bioactive fraction and toxicity test. The selected fractions for both extracts exhibited promising antibacterial activity against most of the tested bacteria. The GC-MS analysis of the fraction from extract of Hypoxylon sp., showed 1,7-Dioxaspiro[5.5]undec-2-ene (15.88%), 1-(3,3,3-Trifluoro-2-hydroxypropyl)piperidine (79.90%) and 9-Octadecenoic (4.22%) as major compounds found in the fraction. While the active fraction of Cerrena sp., extract showed 2,4-Di-tert-butylphenol (70.75%), 3-Hexadecene (12.31%) and 3-Octadecene (10.27%). Zebrafish embryo toxicity test (ZFET) and brine shrimp lethality assay (BSLA) have been used to study the toxicity of the isolate’s extract. Both isolates displayed no toxicity effect. In conclusion, these endophytic isolates showed significant inhibitory activity on diabetic wound bacteria. In vivo animal studies will be carried out to further investigate its therapeutic effects.

Keywords: Endophytic fungi, Homalomena pineodora, Antimicrobial activity
APPLICATIONS OF NATURAL COMPOUNDS IN FOOD PACKAGING AND FOOD SAFETY

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Abstract

Food spoilage can be defined as the undesirable changes take place in food due to the influence of air, heat, light and moisture, which encourage the growth of microorganisms. According to United Nations Food and Agriculture Association (FAO), one third of food are not consumed and wasted, which about 1.3 billion tons per year worldwide. Therefore, food security can be assured by reducing the amount of food wasted due to the food spoilage. Active food packaging is an effective alternative to improve the safety and prolong shelf-life of food products from microbial spoilage. Antimicrobial agents are often coated or incorporated into packaging materials. However, the use of inorganic and metal such silver, Cu and Zn compounds have raised various concerns over health and environment issues. Thus, we have been developing antimicrobial packaging materials containing natural antimicrobial agents in our studies. The packaging materials were synthesized with biodegradable polymeric matrix such as polyvinyl alcohol, polyvinylpyrrolidone, dextran, and gelatine. We successfully synthesized the polymeric film incorporated with anthocyanin, luteolin, cinnamaldehyde, allicin and limonene. The developed polymeric film showed significant antimicrobial efficiencies on food borne microorganisms. The film also prolonged release of the bioactive compounds on food system, which helps to prolong the efficiency of biopreservative.

Keywords: Antimicrobial activity, Natural bioactive compounds.; food packaging film.
MODIFICATION OF MESOPOROUS SILICA NANOPARTICLES WITH PH RESPONSIVE POLYMER POLY (2-VINYLPYRROLIDONE) FOR CONTROLLED RELEASE ANTICANCER DRUG 5-FLOROURACIL

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Abstract

Mesoporous Silica Nanoparticles (MSN) as a platform for controlled drug delivery system (DDS) was studied. Highly interest has developed among researchers due to their physicochemical characteristic of MSN leads to effectively promising future for DDS. On the other hands, modification of MSN with polymer poly (2-vinylpyrrolidone) (PVP) upon synthesis of this drug carrier by co-Condensation method was successfully synthesized and it was confirmed through data of X- Ray Diffraction (XRD), Transmission Electron Microscope (TEM) and Fourier Transform Infrared (FTIR). As per result, it revealed the modification of MSN with PVP has improvised the drug loading and release of anticancer drug model 5-florouracil (5-FU) without major changes of MSN characteristic. Thus this suggested that for addition of PVP into MSN will not affect the noble characteristic of MSN but promotes improvised version of MSN. Furthermore, as comparison of drug loading and release between MSN and MSN-PVP, based on UV-Vis Spectrophotometer (UV-Vis) analysis, MSN-PVP has improvised the adsorption of 5-FU from 83% to 88%. Meanwhile, for release of 5-FU from MSN-PVP has improvement in which 66% for release using MSN to 81% by using MSN-PVP. Impromptu release profile pattern indicate the important of modification of MSN with polymer. Finally, through released profile of MSN-PVP, it has shown that the release of 5-FU was in gradually release condition as desired in DDS.

Keywords: mesoporous silica nanoparticles, poly (2-vinylpyrrolidone), 5-florouracil, drug delivery system.
THE EXTRACTION AND ACTIVITY TEST OF BIOACTIVE COMPOUNDS IN Phaleria macrocarpa AS ANTIMICROBIAL AGENT

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Abstract

This study was designed to develop an alternative of new antimicrobial agents produced by using dried Phaleria macrocarpa’s fruits extract. The bioactive compounds from this fruit were extracted by using two different extraction methods such as Ultrasound-Assisted Extractor and maceration process with two different extraction solvents. The ideal extraction solvent was determined from significant effect on bioactive compounds eluted by performing activity test. For Ultrasound-Assisted Extraction, the variable parameter changed in this process was three different extraction time, 15 minutes, 30 minutes and 45 minutes were applied. Another parameters during this process such as solvents used were ethanol and methanol with concentration of 80% respectively, the amplitude was 50% with 20KHz frequency. While for maceration extraction, the grinded Phaleria macrocarpa’s fruits was immersed in a beaker that consists of same extraction solvents. Then, the samples were left for three days with gradually stir. All the samples were concentrated by using rotary evaporator at specific temperature with respect to solvent used. Phytochemical analysis shows that the desired bioactive compounds that can act as antimicrobial agents do exist in the extracted sample. In addition, anitmicrobial activity analysis by using disc diffusion and Minimal Inhibitory Concentration (MIC) analysis shown that the samples could inhibit the growth of microorganisms such as Bacillus subtilis and Candida utilis. The screening process by FTIR shown the present of functional group in the samples which reflect to the existence of desired bioactive compounds.

Keywords: Phaleria macrocarpa; Antimicrobial agents; Ultrasound-Assisted Extractor; Maceration
DECOLOURISATION OF AZO DYES IN GREYWATER BY MYCOREMEDIATION AND MYCOSORPTION PROCESS OF FUNGI FROM PEATLAND; PRIMARY STUDY

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Abstract
The current study investigated the potential of fungi from peatland for decolorizing azo dyes in the artificial greywater as a function of oxidative enzymes which included laccase (Lac), manganese peroxidase (MnP), lignin peroxidase (LiP). The fungal isolates were obtained from the peatland on potato dextrose agar (PDA) and purified using single spore technique. Remazol Brilliant Blue R (RBBR), Methylene blue (MB) and Congo red (CR) were used as models for detecting the applicability of the fungal enzyme to decolorizing the dyes. The screening of fungal isolates for the decolourisation of RBBR, MB and CR were investigated using plate assay and liquid-phase assays. The results revealed the fungal isolates varied in their ability to produce oxidative enzymes dependent on the production medium. However, the decolourisation of RBBR in the PD broth medium ranged from 17.96 to 44.89\% after 7 days, while ranged from 55.98 to 99.99\% in artificial greywater after 15 days of the incubation period. The fungal isolates exhibited also differences in the production of oxidative enzyme. The maximum production of Lac in artificial greywater was recorded by Cochliobolus sp. No. 403 while the highest production of MnP and LiP was noted by Trichoderma sp. No. 102, and Aspergillus sp. No. 506, respectively. However, Aspergillus sp. No. 605 was used for further studies, because the fungus exhibited ability to produce Lac,
MnP and LiP enzymes simultaneously. It can be concluded that the fungal isolates obtained from the peatland has a potential to decolorize the azo dyes in the artificial greywater.

**Keywords:** Mycoremediation, fungal isolates, RBBR, plate assay, enzyme activity
FUNCTIONALIZATION OF HYBRID ORGANO SILICA BASED MEMBRANES USING ETHYL SILICATE 40 (ES40) AND P123 FOR WATER DESALINATION

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Abstract

Hybrid organosilica are recency type of membranes derived from Ethyl Silicate 40 (ES40) and pluronic triblock copolymer (P123) precursors. These attributes make them defeat pure silica membranes performance on water desalination. This work aims to functionalize of hybrid organosilica (ES40 - P123) membranes for water desalination. Silica sols are produced by combining ES40 and P123 by sol–gel method through hydrolysis and condensation reactions with acid-base catalysts. P123 added together with base catalyst in sols mixture to form hybrid silica P123 structure then coated on membrane support α-Al2O3 and calcined at 450 °C by Rapid Thermal Processing (RTP) technique in air condition. RTP involves a rapid heating rate and a short period of high temperature exposure up to 1 hour without dwelling time and possibility replacing the conventional silica precursor tetraethyl orthosilicate (TEOS) with an industrial precursor ethyl silicate 40 (ES40). The characteristic results of organosilica (ES40-P123) xerogels by FTIR wavelength at 1063 cm⁻¹ detected by siloxane (Si-O-Si) group and 796 cm⁻¹ detected by Si-C. The presence of silica-carbon is indicating the organosilica structure become enhance and more stable toward water. Further, ES40 with RTP technique could save time, energy and cost during membrane fabrication.

Keywords: Water Desalination, ES40-P123, hybrid organosilica membrane, interlayer-free, RTP, sol-gel method, TEOS,
SUGARCANE (SACCHARUM OFFICINARUM L.) BAGASSE BINDERLESS PARTICLEBOARD: EFFECT OF HOT PRESSING TIME STUDY

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Abstract
Binderless particleboard panel made from sugarcane (Saccharum officinarum L.) bagasse was manufactured by waste product of sugarcane. The target density, pressing temperature, pressing time and pressing pressure used were 0.8 g/cm³, 180 ℃, 10-40 min and 12 Mpa respectively. Modulus of rupture, internal bonding strength, thickness swelling and water absorption of the boards were evaluated based on Japanese Industrial Standards (JIS A 5908: Particleboards). From this research, the 30 min pressing time panel had the highest MOR, MOE and IB values. Panels made from sugarcane bagasse with hot pressing time of 20, 30 and 40 min met the mechanical properties requirement stated in Japanese Industrial Standard (JIS). Nevertheless, the satisfactory results were obtained for water absorption and thickness swelling test. Therefore, the binderless particleboard made from sugarcane bagasse waste were successfully manufactured and can be alternative and consideration for building material especially for indoor application.

Keywords: binderless, particleboard, sugarcane bagasse, hot pressing, time
HYDROPHILIC COMONOMER IMPACT ON POLY(VINYL ALCOHOL-CO-METHYL METHACRYLATE) BASED HYDROGEL COATING

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Abstract

Presence of functional group in monomer chain is significantly affect the properties of finished coating. Thus, this study reports the copolymerization and behaviors of polyvinyl alcohol (PVA) and methyl methacrylate (MMA) with three different monomers with different functional group namely acrylamide (AAm), acrylic acid (AA) and ethylene glycol (EG). Four type of hydrogel coating were synthesized via semi batch emulsion polymerization namely poly(VA-co-AAc -co- MMA) (HAAC), poly(VA-co-EG-co- MMA) (HEG), poly(VA-co-AAm-co- MMA) (HAAM) and Poly(VA-co-MMA) (PVA-MMA). The functional groups of all coating were confirmed by FTIR spectra analysis and collapsed microgels with size less than 0.5µm were observed grafted on the surface of hydrogel using FESEM. HAAM shows the highest water absorbency of up to 81% of its weight. Thermal decomposition showed rapid degradation rate of HEG at the initial curve compared to other coating samples. Nevertheless, due to strong bonding of carbonyl group and the carbon steel, HAAC has the highest adhesion strength of 4.0MPa. Among HAAM, HAAC and HEG, amide has greatly improved the water absorbency, carboxyl aided the adhesion strength and hydroxyl has led to denser matrices of hydrogel coating.

Keywords: copolymer; emulsion; hydrogel coating; equilibrium water content; adhesion; functional group
UTILIZATION OF SEWAGE SLUDGE IN CONSTRUCTION MATERIAL

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Abstract

Sewage generation rate in Malaysia keeps increasing due to growth of population, especially in urban area. This high generation rate leads to sewage sludge disposal problem, which relatively contributes to high cost of treatment, human health effect as well as environmental pollution. One alternative to reduce the disposal problem is to incorporate the sewage sludge into construction materials, specifically clay brick, that has shown a positive effect to enhance the properties of the fired clay brick in previous study. Therefore, the sewage sludge effects towards physical and mechanical properties of clay bricks have been investigated. In order to make sure this study is well designed, Design of Experiment (DOE) has been carried out during start-up experiment. The clay brick with added various proportions of sludge (20%, 30% and 40%) was burnt at different temperature (500°C, 650°C and 800°C). Compressive strength, water absorption, leachability and qualitative analysis tests were carried out. The leachability test showed no traces of all heavy metals in all final brick samples while water absorption test indicated comparable result ranging from 23.43% to 37.74%. However, the compressive strength showed lower test value, which ranges from 4.19N/mm² for the 20% sludge bricks to 1.39N/mm² for bricks with 40% sludge. High amount of organic material in all samples, which originated from sewage sludge, is a factor that contributes to low quality of produced brick.

Keywords: sewage sludge, clay bricks, leachability, strength test, water absorption
CATALYTIC GRAPHITIZATION OF OIL PALM FROND USING IRON AND SILICA

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Abstract
Graphitic carbon has raised great interest in many industrial areas including adsorbent, electrodes, hydrogen storage, and many more. This paper report simple method of transforming biomass waste into highly crystalline graphite. Graphitic structure is successfully obtained by direct transformation of lignocellulosic waste via simple methodology consist of (i) carbonization at 500°C, (ii) impregnation of catalyst followed by thermal treatment by using Ferum and Silica as catalyst. A green biomass resource, Oil Palm Frond (OPF) was used as carbon precursor due to it abundant availability. This study is focusing on the correlation between the structural transformation of carbon material dependence on heat treatment temperature and catalyst dosage. Both Raman spectroscopy and XRD allowed the observation of microstructural change of the sample prepared at broad temperature ranges from 1000°C to 1400°C. From XRD pattern, sample prepared at higher dosage of Ferum shows intensified peak at 2θ=26.5° and it also shows that at higher heat treatment temperature sharper and narrower (002) peak observed. Indicating higher degree of graphitization was achieved. Raman spectrum also suggest accordance finding with XRD in which sample prepared without catalyst and with 40% catalyst at 1200 °C, show different I_d/I_g value 1.05 and 0.4 respectively. Higher I_d/I_g ratio indicate the presence of large amount of amorphous carbon. The comparison on heat treatment temperature also suggest that, at higher temperature lower I_d/I_g ratio were observed. This result indicate significant correlation between temperature and catalyst ratio on degree of graphitization. Overall graphitic structure was successfully synthesis, it structural transformation can be tailored dependence on the synthesis condition.

Keywords: biomass precursor, carbon, graphitization
PRELIMINARY FINDINGS IN PREPARATION OF DOPED POLYANILINE AS FILLER FOR VULCANIZED LATEX ARTICLE

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Abstract

In this preliminary study, the polymerization of polyaniline (PANI) as filler for latex films (PVL) was prepared and examined stage by stage. Initial research work carried out was to evaluate the ideal formulation of PANI synthesis and to be applied as standard formulation throughout the study. Equal molar ratio of APS: aniline (0.2:0.2) was selected compared to (0.1:0.3). The formulation was later enhanced with either cellulose (MMC), metal oxides (ZnO and CuO) as well as hybrid MMC/ metal oxides and to be referred to as doped PANI. Doped PANI was then successfully prepared and later used as filler in latex film dispersion. At early stages, homogeneity was not achievable when PANI was mixed directly to the latex leading to phase separation in the films due to compatibility issue. Homogeneity between PANI and latex was later improved when KOH was introduced to alter the pH of the mixing, using a high speed mixer to breakdown particles into finer size thus decreasing the agglomeration in the mixture. The dispersed films were dried and later made into tensile specimens; labelled as PANI-PVL, PANI-MCC-PVL, PANI-ZnO-PVL, PANI-CuO-PVL films as well as hybrid PANI-MMC-ZnO-PVL and PANI-MMC-CuO-PVL films generally known as doped PANI-PVL films. As the overall results, the addition of PANI and doped PANI in PVL have improved the overall mechanical properties of the films. The PANI-PVL and doped PANI with PVL films showed improved mechanical properties compared to untreated PVL films. Improvement in tensile of PANI-PVL film is 156%, YM 50%. PANI-
ZnO-PVL film and hybrid PANI-CuO-PVL film showed increments as much of 148% and 142% for TS, 60% increase in YM with better extension rate. The result is also supported by SEM and EDX findings. The electrical conductivity of PANI-PVL films showed a promising increase compared to untreated PVL. This results indicates that PVL with addition of PANI showed improvement in both mechanical and electrical conductivity properties.

**Keywords:** natural rubber, latex, polyaniline, tensile properties, thermal properties
CORRELATION BETWEEN COPPER OXIDE WEIGHT PERCENTAGE IN FIBROUS SILICA HZSM-5 TOWARDS CO₂ ADSORPTION PERFORMANCE

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Abstract

CO₂ adsorption is one of the technologies to reduce CO₂ from gas mixture in atmosphere which contributes to global warming through greenhouse effect. Hence, many studies have been conducted to explore the most effective techniques for reducing the amount of carbon dioxide in the atmosphere. In this study, effect of different weight percent CuO (5-20 wt%) loaded onto fibrous silica HZSM-5 (FHZSM-5) towards CO₂ adsorption performance was investigated. Firstly, fibrous silica HZSM-5 (FHZSM-5) was synthesized via microemulsion technique and followed by CuO loading using wet impregnation method. Furthermore, characterizations were performed by using XRD, FTIR, N₂ physisorption, FESEM and TEM in order to confirm the structure and morphology of the material. Lastly, the CO₂ physisorption capability of the material is examined. The XRD and N₂ physisorption results showed the presence of CuO peaks, reduced crystallinity and decreased the surface area of FHZSM-5 with the increasing loading of CuO. The FESEM and TEM analysis demonstrated the presence of wrinkle and dendrimer lamellar structure on FHZSM-5. The CO₂ adsorption performance was in sequence of FHZSM-5 (36.8 cm³/g) > 5wt%CuO/FHZSM-5 (26.1 cm³/g) > 10wt%CuO/FHZSM-5 (20.5 cm³/g) > 20wt%CuO/FHZSM-5 (18.9 cm³/g) > CuO/SiO₂ (4.5 cm³/g).

Keywords: CO₂ adsorption; copper oxide; fibrous silica HZSM-5; weight percentage
EFFECT OF POLY(METHYL METHACRYLATE)-MODIFIED NATURAL RUBBER ON THE MECHANICAL PROPERTIES OF POLY(METHYL METHACRYLATE)

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Abstract

Poly(methyl methacrylate) (PMMA) is a hard and brittle thermoplastics. Thus, its application is limited. PMMA-modified natural rubber (MNR) is a NR derivative which was synthesized in the laboratory. MNR has lower glass transition temperature, Tg as compare to PMMA. The blend of PMMA/MNR is expected to produce a physical blend with better mechanical properties with the optimum melt mixing parameters. The recommended melt mixing parameters at rotor speed of 50 rpm are pre-blending at 170°C for 5 minutes and then blended again at 200°C for 4 minutes. This technique produce blends with optimum properties, as opposed to prolonged shear technique which produce negative effect to PMMA/MNR blend. The mechanical properties of PMMA/MNR blends studied were tensile, flexural, impact (notch and unnotched) properties and single-edge notch bending (Sen-B) at different loadings of MNR (2.5-10 wt.%). The optimum tensile and flexural properties were obtained at 2.5 wt.% MNR loading while optimum impact and fracture toughness are reported at 7.5 wt.% MNR loading. Better compatibility of MNR at 2.5 wt.% loading was observed through morphological studies where no cavitations were observed on the surface of the fractured samples. Compared with pure PMMA, the tensile strength and elongation at break increased about 17 % and 41% respectively, while the flexural strength and flexural strain increased about 12 % and 72% respectively at 2.5 wt.% MNR loading. Increment of 43% and 20% were observed for impact strength at 7.5 wt.% MNR loading for unnotched and notched samples compared to pure PMMA while for fracture toughness, $K_{IC}$ and $G_{IC}$ increased about 81% and 42% at 7.5 wt.% MNR loading compared to pure PMMA.

Keywords: PMMA/MNR blend, mechanical properties, morphological analysis
FABRICATION OF ES40-P123 MEMBRANES TEMPLATED THROUGH THE RAPID THERMAL PROCESSING (RTP) FOR WATER DESALINATION

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Abstract

Fresh water is a need of human being and mostly affected of all aspects in life. Unfortunately, nowadays it becomes big issues and need to treat. It is due to the mining activities, and the intrusion of seawater into rivers, etc. This work aims to fabricate ES40-P123 membranes templated applied for water desalination. ES40 (ethyl silicate 40) is used as the main precursor, and P123 as the templating agent. Meanwhile, HNO_3 and NH_3 take a role as organic acid and base catalyst. The combination of silica material, ES40 with P123 as an organic polymer is produced via sol-gel process. A two-step organic acid and base catalyst was used to prepare silica sols. Those catalysts were applied during hydrolysis and condensation reactions within 3 hours. The molar ratios between ES40; ethanol; nitric acid; ammonia; aquadest; and P123 are 1: 38: 0.0007: 0.003: 5: 0.0207, respectively. RTP (Rapid Thermal Technique) was applied for calcination method (350 °C, 1 hour). The xerogels was characterized by FTIR. It shows peaks at the wavelength: 785; 975; and 1080 for Si-C; Si-OH, and Si-O-Si, respectively. Besides that, TGA, N_2-sorption were applied to investigate the xerogels bulks. Lastly, SEM was applied in order to understand the thickness of membranes itself.

Keywords: ES40-P123 organosilica membranes, water desalination, sol-gel process, RTP
SYNTHESIS AND CHARACTERIZATION OF LOCAL BIOMASS SUPPORTED MAGNETIC CATALYST FOR ESTERIFICATION REACTION

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Abstract
Biomass supported solid catalyst have shown significant potential in various applications. Biomass supported magnetic solid catalysts have great advantage especially in catalyst separation. The present work highlights the preparation magnetic acid catalyst through simple and inexpensive in-situ impregnation approach using oil palm empty fruit brunch (EFB) fiber as support material. The synthesized catalyst was characterized by X-ray diffraction (XRD), Fourier transform infrared (FTIR), scanning electron microscope (SEM), electron dispersive X-ray spectroscopy (EDX), Brunauer–Emmett–Teller (BET) and vibrating sample magnetometer (VSM) analyses. XRD result indicates that after calcination at 500°C, the iron oxide presented on the catalyst was γ-Fe₂O₃. Magnetization value of 13.3 emu/g proved that the catalyst has good magnetic properties. The resulted catalyst has strong acid density of 3.2 mmol/g. Catalytic performance was evaluated via esterification of oleic acid. The effect of catalyst loading was studied to determine the optimum amount of catalyst required for high conversion. This study suggests that magnetically separable catalyst can be easily recovered and a future outlook on utilization of biomass as support material for production of economically sustainable catalyst.

Keywords: Oil palm empty fruit brunch; magnetic; catalyst; esterification; oleic acid
ROLE OF RIBLET IN DEVELOPMENT OF TURBULENT BOUNDARY LAYER STRUCTURE ON NACA 0026 AIRFOIL SURFACE

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Abstract

The main theme of the research is to improve fuel efficiency based on the aerodynamic effect of surface amid increasing awareness and tighter vehicle fuel efficiency and emission laws. Turbulent boundary layer structure in wall-bounded flow develops over wall surface. Surface conditions affect the development of boundary layers. Skin friction is one of the factors affecting the development of boundary layer. The performance and efficiency of appliances especially in aerodynamics could be affected significantly. In aerodynamics, the skin friction has tremendous influences over fuel usage and therefore pollutions. A lot of research to control turbulence generation with the aims to reduce skin friction has been carried out. One such method is the riblets technology usually for high-performance aerodynamic devices. The application of meso-scale V-groove riblets with straight, diverging and converging arrangements on part of the airfoil surface is the main focus in this thesis. A medium size wind tunnel for turbulence, an airfoil and the hotwire anemometry as well as other turbulence delicate measuring devices are used to measure the mean velocities, turbulence intensities, energy spectrum and higher order flow statistics. The airfoil used here in the NACA 0026, following the standards by National Advisory Committee for Aeronautics (NACA). The mean speeds approximately 10 m/s produce boundary layer-Reynolds numbers $Re = 280$, over the airfoil. The mean velocity profiles analysis produces information regarding the skin friction via the Karman’s law of the wall relationship. The experiment results show that convergence and divergence riblets reduce skin frictions. However, they produce higher turbulence intensities both in the near and outer-regions within the boundary layer. When the turbulence intensities increase, it produces greater turbulence kinetic energy within the shear layer. Based on the results in this experiment, riblets applications on engineering devices could significantly reduce skin frictions. The airfoil with riblet could be applied on aircrafts’ wing, wind turbine and hydro turbine for applied research to improve the equipment performance and efficiency.

Keywords: Riblet, Turbulent, Airfoil and Surface
APPLICATION WITH INITIATIVE TO REPLACE COMMON INSECT FUEL FOR FOGGING SYSTEM WITH BIODIESEL

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Abstract

The project addressed the application of biodiesel as a fuel in replacing the petroleum-based liquid carrier in common fogging system. In controlling the population of larvae and adult mosquito using chemical pesticide spraying through fogging method, the dilution rate based on the efficient mixing of pesticide and biodiesel is yet to be investigated. A simulation field trial was conducted indoor in a visible container with the designed dimension of 50cm x 50cm x 50cm with the method of fogging was adapted from the principle of thermal fogger. The biodiesel was produced through the transesterification reaction of palm oil with methanol using hydrotalcite as catalysts. To evaluate the larvicidal and adulticidal mortality, dilution of pesticide which is Sumithion L-40 into biodiesel as liquid carrier is varied. The 5 mL pesticide-carrier mixture with the dilution ratio of 1:9, 3:7 and 5:5 were used and dispersed into the ambient in the form of fog. After several tests, it can be deduced that the most effective dilution ratio for against larvae is 1:9 and adult mosquito is 5:5. The larvae mortality rate achieved 100% at the duration of 117 minutes due to effective settlement of the spraying droplet of formulation mixture on exposed water. The result also proven that, biodiesel as liquid carrier capable to overcome the solubility problem encountered by the conventional petroleum-based carrier. The adult mosquito needs shorter knockdown time with the higher dosage of pesticide. Sumithion L-40 consists of two active ingredients which are tetramethrin and fenitrothion that provide quick knockdown and residual effect especially to adult mosquito.

Keywords: Biodiesel, fogging system, transesterification, mosquito
EVALUATION OF MODIFIED CALCIUM CARBIDE DUST AS A HETEROGENEOUS CATALYST IN FATTY ACID METHYL ESTER SYNTHESIS FROM SUNFLOWER OIL

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Abstract

The developed heterogeneous catalyst from calcium carbide dust (CCD) with potassium nitrate is investigated for transesterification of sunflower oil to fatty acid methyl ester (FAME). The objective of this study is to develop the heterogeneous catalyst from CCD and test it at different operating parameters such as wt.% of KNO₃/CCD, molar ratio of methanol to oil, reaction time and reuseability of the developed heterogeneous catalyst with fixed reaction temperature of 60 °C and 3 wt.% of catalyst loading. The FAME yield was up to 97 wt.% with 15 wt.% of KNO₃/CCD, 15:1 methanol-to-oil molar ratio and 7 h reaction time. Unfortunately, the developed heterogeneous catalyst could not be used after regeneration using n-hexane washing followed by recalcination at 500 °C for 3 h.

Keywords: Calcium carbide dust; Fatty acid methyl ester; Transesterification; Heterogeneous catalyst; Sunflower oil; Catalyst reusability
CHARACTERIZATION OF BIOMASS FUEL PELLETS MADE FROM MALAYSIA TEA WASTE AND OIL PALM EMPTY FRUIT BUNCH

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Abstract

Tea waste (TW) and oil palm empty fruit bunch (EFB) are one of the biomass resources in Malaysia. Both biomass have the great potential as bioenergy resource due to its nature properties such as good calorific value and etc. The usage of biomass pellet creates new market opportunities in agricultural sector and it will reduce the dependence on fossil fuels. Thus, in this study, fuel pellet was prepared by mixing both local TW and EFB fibers. Effect of different types of biomass on the pellet properties was investigated. Properties of raw fibers and fuel pellets was characterized through different analysis method. Pellet made from 100% TW showed the highest calorific value (17.393 MJ/kg), durability index (99.93%) and good pellet moisture content (9.581%). The results show the TW has the great potential to be a good resource for fuel pellet.

Keywords: Tea waste; Oil palm empty fruit bunch; Biomass; Fuel Pellet
PRODUCTION OF OIL PALM MILK POWDER BY SPRAY DRYING TECHNIQUE

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Abstract

Oil palm milk was spray dried to produce palm milk powder to prolong the shelf life, easier handling, storage and transportation. The objective of this research was to determine the effect of spray drying parameters on palm milk powder properties, which are inlet temperatures (120°C, 140°C, and 160°C), feed flow rates (5 mL/min, 7 mL/min, and 14 mL/min), and ratio of additive (maltodextrin) to oil palm milk. The optimum conditions for oil palm milk powder production was determined based on yield of powder. Moisture content, fat content, solubility in water, flowability of powder, and hygroscopicity were analysed for the powder samples. Powders produced at the highest inlet temperature show the lowest moisture and fat contents. Inversely, the moisture and fat contents were the highest at the highest feed flow rate. However, the moisture content was the lowest and fat content was the highest at the highest ratio of maltodextrin to oil palm milk. The powder were easily soluble in water as shown by the time taken to dissolve varies between 8 to 24 s. Based on Hausner ratio, the palm milk powder was categorised as medium-flowing and low cohesiveness which match to good flowability as indicated by Carr’s Index. The powder achieved non-hygroscopic state when it was produced with the highest ratio of maltodextrin to oil palm milk. The optimum spray drying conditions was at 160°C for inlet temperature and 7 mL/min for flow rate and 9% (w/v) of maltodextrin for percentage ratio of maltodextrin with the highest powder yield obtained was 44%.

Keywords: Oil palm milk, Oil palm milk powder, Spray drying, Maltodextrin
FACTORS AFFECTING THE STABILITY OF TOCOTRIENOL EMULSIONS USING SPONTANEOUS EMULSIFICATION

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Abstract

The demand of natural source of vitamin E (α-, β-, γ- and δ-tocopherols and α-, β-, γ- and δ-tocotrienols) has increased in recent years. Tocotrienol is a powerful antioxidant that protects body from free radicals action. In the past, tocotrienols have been extracted from palm oil with concentration of 50% purity. The tocotrienols has been used in food applications and encapsulated as supplement. Due to its fat-soluble characteristic, application of tocotrienol in beverages is still limited. Therefore, microencapsulation of tocotrienol via emulsification process helps maximising dissolution of tocotrienols during the processing and shelf life of the products. The spontaneous emulsification process was studied against factors such as interfacial tension, surfactant structure, behaviour and solubility. In this study, the factors affecting the particle size including the surfactant concentration, stirring time, stirring speed and mixing temperature in preparation of tocotrienol emulsion formulation were investigated. Stable phase emulsions were formed after storage for 30 days at ambient temperature using 12 wt.% surfactant concentration with particle size maintained at 180nm.

Keywords: Spontaneous emulsification, palm tocotrienols, emulsion, particle size
POST – HARVEST LOSSES ON SAGO LOG PHYSICO-CHEMICAL PROPERTIES DUE TO DELAYED OF PROCESSING IN DIFFERENT ENVIRONMENT IN MUKAH SARAWAK

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Abstract

Poor handling at post – harvest and processing stages are among the key factors resulting in low quality of sago starch in sarawak. Currently, a sago log is usually kept in the river for up to four weeks before it is processed. Therefore within the period of storage, the properties of the log and the starch harvested from it also decreased due to degradation of organic compound of the sago log. The aim of this study was to screen and identify associated physical and chemical properties of sago starch affected due to deterioration of sago log. The viscosity of the starch extracted differed significantly between the logs that were stored in varying length of period ranging from 1 week up to 1 month. The result ranged from 600 BU to 777 BU with the viscosity reading decreased as the storage time increased. No significant differences of swelling power observed in the results of period of storing within base and top part of the sago log. The swelling power was ranged from 25.55 to 28.80 and 21.25 to 25.62. Higher swelling power in sago starch was obtained from bottom palm as the size of the starch granule was larger compared to the top part of the palm.

Keywords: Sago Log, Sago Starch, Viscosity and Swelling Power.
WHAT IS HIDDEN IN THE CRYSTAL LATTICE? EFFECTS OF DIFFERENT FORMS OF DATES TOWARDS CHOCOLATE CRYSTALLIZATION

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Abstract
Chocolate is the like of people at every state of ages. However, consuming a lot of chocolate containing high amount of sucrose, calories, and low vitamins and mineral will lead to multiple health issues such as obesity, gastrointestinal discomfort and even dental caries. Therefore, study to replace sucrose with alternative sweeteners was considered. Alternative sweetener was evaluated by their taste that match closely with sucrose. In this study, the potential of using dates as sweetener was explored. Dates was produced as syrup, paste, powder and chopped to be mixed together with other ingredients to produce chocolate. The physico-mechanical properties of the chocolate were measured to evaluate the influence of different forms of dates towards the crystallization properties of chocolate. These includes, the hardness, shine, snap, texture, shelf-life as well as the crystallisation time. Results showed that the particle to particle interaction was disrupted by the different forms of dates used hence effect the quality of the chocolate produced. It was found that the chocolate made with dates syrup was having the best quality and highest acceptance amongst the other form.

Keywords: crystallization, interparticle interaction, alternative sweetener, dates, chocolate
DEVELOPMENT OF ‘BILIS’ CUBE USING LACTIC ACID FERMENTATION AND PROTEOLYTIC ENZYME DUAL TREATMENT METHOD

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Abstract

The aim of this research is to develop ‘bilis’ flavouring cube by a combination method of fermentation of anchovies using *Pediococcus halophilus* and enzymatic treatment of the fermented anchovies using Alcalase and Flavourzyme. Fermentation of anchovies were carried out by inoculating 10 % (v/v) *Pediococcus halophilus* in 300 ml 17 % salt solution containing 100 g of dried anchovies, with or without the addition of 5 % the tomato broth. Both fermentation was carried out at 25°C for 4 weeks. Total nitrogen, lactic acid bacteria count, soluble protein and pH were determined at day 0, 7, 14, 21 and 28 of fermentation whereas for titrable acidity analysis was conducted at day 0 and 28. At day 29, the fermented anchovies were homogenised and divided further into two portions each, with or without the addition of enzymes. For enzyme treatment, 1% (v/v) of Alcalase was added and incubated at 55 °C for 3 hours followed by addition of 1% (w/v) Flavourzyme and incubated at 55 °C for 3 hours. The anchovies broth were then oven dried and used for formulation of ‘bilis’ cubes. The fermentation with presence of tomato broth produced higher solubilised protein and higher titratable acidity. The formulated cube with a combination using tomato broth for fermentation and enzyme treatment using Alcalase and Flavourzyme was most preferred by the panellist in the sensory evaluation conducted.

Keywords: ‘Bilis’ Cube, *Pediococcus halophilus*, lactic acid fermentation
DEVELOPMENT OF GRILLED FISH PASTE BY SEQUENTIAL ANCHOVIES AND CHILI FERMENTATION METHOD

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Abstract
This research aims to produce a ready-to-eat grilled fish paste and cooking preparations for other dishes by using fermented anchovies and fermented chili as enhanced ingredients. Traditional fermentation of anchovy takes up to a year or more. Under controlled condition, the duration can be shortened and the flavour production can be increased. Fermentation of anchovies were carried out by inoculating 10% (v/v) starter culture in 300 ml 17% salt solution containing 100 g of dried anchovies, with or without the addition of 5% the tomato broth. Both fermentation was carried out at 25°C for 4 weeks. Total nitrogen, lactic acid bacteria count, soluble protein and pH were determined at day 0, 7, 14, 21 and 28 of fermentation whereas for titratable acidity analysis was conducted at day 0 and 28. The research was continued with the fermentation of chilies. The composition of the formulation contained 77% (w/w) red or green chili, 10% (w/w) fermented anchovies, 7% (w/w) salt and 6% (w/w) garlic. The blended mixer was incubated at 25°C for 2 weeks. The fermented products were used as ingredient for grilled fish paste formulation followed by sensory evaluation to determine consumers’ preference. The fermentation of red chili using fermented anchovies in the presence of tomato broth produced higher crude and solubilized protein. Sensory evaluation of grilled fish paste indicated that the red chili inoculated with fermented anchovies with tomato juice broth was the most preferred ingredient.

Keywords: Pediococcus halophilus, anchovies, fermentation, chili
EFFECT OF PECTIN CONCENTRATION ON EDIBLE COATED- Musa acuminate CV BERANGAN QUALITY

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Abstract

Banana was prone to decay specifically under tropical conditions because of its high moisture content. Pectin and sodium chloride were used to develop edible coatings for shelf-life study throughout 5 days at ambient temperature of banana fruits. The edible coating effectiveness with different concentrations of pectin (1, 2 and 3%, w/v) on Berangan banana properties were evaluated such as weight loss, microbial growth, TSS, pH, firmness, colour and sensory attributes. In general, results exhibited higher pectin concentration influenced the changes in properties in maintaining the banana quality. The coating method used was the dipping method. Banana samples were dipped into sodium chloride (200ppm) for 30 seconds and left dried on for 10 minutes. This step was repeated using pectin coating solution (1%, 2% or 3%, w/v). Sample of 2 & 3% were significantly lower in weight loss compared to sample uncoated and 1%. Again, 2% coated sample has the significant lowest TSS (7.40 °Brix) in all samples. In addition, 2% pectin coated sample proved to prolong the banana shelf-life by having the lowest value (3.72 log CFU/ml) in microbial analysis throughout 5 days of storage. Meanwhile, 2% (w/v) coated sample showed significantly higher values compared to uncoated sample in firmness (40.42 and 31.25 N, respectively); however vise versa result of pH values were obtained (4.80 and 5.23, respectively). Finally, no significance different in all sensory attributes between uncoated and coated samples were recorded. In conclusion, the 2% (w/v) coated pectin with 200ppm sodium chloride was found to be the best coating solution in this study. This composite coating could be applied as an edible coating for post-harvest banana fruits and have beneficial effects on delaying the ripening process, maintaining quality attributes and prolonging the shelf life of the fruit.

Keywords: Pectin, Banana, Concentration, Coating, Quality
NUMERICAL INVESTIGATION OF BLADE PROFILE PERFORMANCE IN VERTICAL AXIS HYDROKINETIC TURBINE

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Abstract
Off-grid electricity generated by micro-hydro system has been used to supply electricity for isolated locations located at hilly terrains with sufficient head for small dam construction. Nevertheless, conventional micro-hydro system is unsuitable for rural communities residing at lowlands or along the main riverbank. One of the solutions is by introduction of hydrokinetic technologies to utilise energy from free flow moving water to generate power using ultra-low-head turbine. However, tropical climates characterised by stochastic river hydrodynamic conditions contribute to inefficient and poor performance of hydrokinetic energy system including unstable power, production, cavitation, and structural vibration. The aim of this study is to apply a numerical performance analysis on pre-developed blade sections to be used in vertical axis hydrokinetic turbines. The lift, drag and pressure coefficients of various NACA airfoil blade profiles were studied. The most suitable blade sections were pointed out considering high lift/drag ratio and low cavitation criteria.

Keywords: micro-hydro, hydrokinetic, vertical-axis, NACA airfoil, numerical
CONSTRUCTING FILM'S CHARACTERISTIC CURVES OF BLACK & WHITE PHOTOGRAPHIC FILMS USING IMAGE MANIPULATION SOFTWARE

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Abstract

In the processing of photographic films, a photographic developer is type of chemical that converts latent image to a visible image. This was achieve by reducing the silver halides into silver metal which only acts on those particles of silver halides that have been exposed to sufficient light. The aim of this study is to develop new black & white film characteristic curves using image manipulating software. Various development variables were conducted prior to analyzing the shift in Exposure Value (EV) of each sample. These analysis is made possible by utilizing The Zone System technique developed by Ansel Adams. At recommended illuminance, results shows a higher development rate of silver halide into its metal form as development period increased while the trend has stunted when illuminance is at 1/16th recommended level.

Keywords: Photographic films, manipulating software, Exposure Value
OPTIMIZATION OF LABISIA PUMILA EXTRACT CONCENTRATION VIA BLOCK FREEZE CONCENTRATION ASSISTED WITH CENTRIFUGATION METHOD

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Abstract
In order to improve the concentration efficiency of Kacip Fatimah (Labisia pumila) extract, an alternative method has been explored which is block freeze concentration. In this study, the extract was freeze by using total-block technique. The effects of freezing time and centrifugation speed were evaluated. The highest value of 63% of TPC preservation is observed at the range between 0°C to 80°C and 6500 rpm to 7000 rpm for freezing time and centrifuge speed respectively. The highest percentage concentrate, 85.38% is observed at the range of 60°C to 130°C of freezing time and centrifuge speed range of 3000 rpm to 7000 rpm. Lastly, the highest concentration efficiency, 85% is observed at the range of 50°C to 160°C and 1000 rpm to over than 7000 rpm for freezing time and centrifuge speed respectively. Therefore, block freeze concentration is proven to be an effective technique to concentrate Kacip Fatimah extract.

Keywords: freeze concentration, freezing time, centrifugation speed
MATHEMATICAL MODEL OF SILICA SOL-GEL/KENAF GELLING TIME

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Abstract

Rheological properties of silica sol-gel/kenaf gelling formation were monitored using rotational rheometer. Correlation between the gelation time and the examined compositional parameters (i.e. the catalyst concentration: 0.03, 0.05, 0.07, molar ratio: 2, 4, 6 and temperature: 30, 40, 50oC) are reported. The gelation time was determined from crossing over of storage moduli (G’) and loss moduli (G”). Based on the experimental results, a mathematical model was developed for predicting the gelation time of silica sol-gel/kenaf. The results showed that catalyst concentration had the highest impact on the gelation time of the silica sol-gel/kenaf synthesis with an effect estimate of (-209.94) followed by water ratio with an effect estimate of 126.94. The temperature variables recorded the lowest impact with an effect estimate of (-73.11). The interaction between catalyst concentration/temperature and molar ratio/temperature had significant model terms. Using this mathematical model, the gelation time of silica sol-gel/kenaf synthesis can be estimated with the compositional parameters concerned.

Keywords: Rheological, gelling formation, silica sol-gel/kenaf
OPTIMIZING OF HEAVY METALS REMOVAL FROM CAR WASH WASTEWATER BY CHITOSAN-CERAMIC BEADS USING RESPONSE SURFACE METHODOLOGY

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Abstract

The current study aimed to optimize the heavy metals (Zn\(^{2+}\), Fe\(^{2+}\), Pb\(^{2+}\), Cu\(^{2+}\) and Cd\(^{2+}\)) from the car wash wastewater by chitosan using response surface methodology (RSM). The chitosan was prepared from the shrimp shells waste with ceramic wastes. The independent factors investigated in the present study included chitosan-ceramic beads dose (1-3 g/L), shaking speed (100-150 rpm) and time (60-120 mins). The result revealed that the optimum parameters for heavy metal removal was recorded with 2.2 g/L of chitosan-ceramic beads, 123 rpm and after 90 min, at which 50.41 vs. 54.74% of actual and predicted removal of Zn\(^{2+}\), 25.60 vs. 70% of Cu\(^{2+}\), 32.52 vs. 99.98% of Fe\(^{2+}\), 64.49 vs. 76.74% of Pb\(^{2+}\) and 75.77 vs. 62.24 of Cd\(^{2+}\) was recorded. These findings revealed the chitosan-ceramic exhibited an efficiency for heavy metal removal from the wash war wastewater.

Keywords: heavy metals, car wash wastewater, optimization, interactions
TRIBOLOGICAL CHARACTERIZATION OF WASTE PALM COOKING OIL (WPCO): A STRIBECK CURVE FRICTION ANALYSIS

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Abstract

The proposed study analyze lubricant Striebeck curve for Waste Palm Cooking oil (WPCO) derived biodiesel by coupling modified Reynolds solution with Greenwood and Tripp’s rough surface contact model. In order to accommodate the lubricant properties such as density and viscosity, this Reynolds equation is modified considering another formula known as Gibbs energy additivity approach. Hence, the result of this modified Reynolds equation will provide the fluid film properties of WPCO such as film thickness and contact pressure. These information are used as the input to investigate the boundary and viscous friction of the lubricated contact using Greenwood and Tripp’s rough surface contact model. A measured data form pin-on-disc tribometer is compared with the predicted values earlier. It is shown that the experimental data and proposed mathematical solution correlates well, where the frictional behavior has been captured throughout the whole range of lubrication regimes for both methods. The result of this mathematical solution will be used to further explore another types of alternative biodegradable oil.

Keywords: Striebeck Curve, Reynolds Equation, Rough surface contact, WPCO
PRELIMINARY STUDY OF GREEN MULCHED SHREDDING MACHINE FOR MANAGING PINEAPPLE RESIDUE

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Abstract

Pineapple is a tropical crop that contributes in generating Malaysian economy. In Malaysia, pineapple are mostly planted on mineral and peat soil. In Malaysia, pineapple is generally grown on two main areas, peat and mineral soil, where each has different practice and approach. In Peat soil condition, nowadays farmers normally managed the pineapple residues by using a chemical to kill and fire to burn before it been replanted. This is common practice to remove the pineapple residues. With this method it will may affect the soil fertility and open burning will be polluting the environment as the government nowadays recommend toward green approach. In 9th Malaysian plan (RMK-9), MARDI has come out with a machine to shred and plough pineapple plant residues back into the soil which are practice for mineral soil. The machine is adopting a motivator concept. Unfortunately, The machine had the unsatisfied result because the plants were not chopped into small pieces but only separated as several big parts. A new concept and prototype were develop with double rotor drum, type of the rotor blade, special blade arrangement and speed has given a promising result in a way to manage pineapple plant residues in a green approach. The objective of the study is based on the type of blade a double rotors, speed and the action has resulted in fine and easy disposal pineapple plant residues.

Keywords: pineapple residue, soil, shredding machine
EFFECT OF PECTIN-CMC-BASED COATING ON TEXTURE OF HOT AIR DRIED HONEYDEW

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Abstract

The optimization of temperature, immersion time and coating treatment, during hot-air drying of honeydew, was investigated by the response surface methodology. The results show that the coated sample with immersion time of 35 minutes at temperature 55°C was determined as the optimum factors. Next, the honeydew was coated with pectin-CMC-based edible coating (except non-coated sample) and was then hot-air dried. The data from the chromameter for colour analysis showed that the decreasing value of ∆E as the immersion time and temperature increase and non-coated samples also shows higher value than coated samples. The results of the texture (skin strength) analysis showed that the longer immersion time resulted in lower skin strength.. Furthermore, non-coated sample shows higher skin strength value than coated sample. Highest moisture content recorded was from coated sample with 60 minutes immersion time at 58°C. This could happen as the plasticizing effect of sugar and acid absorbed by the fruit tissue from the coating solution can be the reason why the textures soften. Coated sample showed lower rehydration ratio than non-coated sample. Longer immersion time also showed lower rehydration ratio compared to shorter immersion time.

Keywords: Response Surface Methodology, Pectin-CMC-based, Chromameter, ∆E, plasticizing, rehydration
EVALUATION ON USING INCLINED BED DRYER (IBD) FOR GRAIN CORN DRYING

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Abstract

A evaluation study regarding the drying behavior and performance of an inclined bed dryer (IBD) on grain corn were implemented. The shelled grain corn variety GWG was used and the study was carried out on a pilot scale paddy mill located at Laman Padi, MARDI Serdang, Selangor. Drying parameter such as drying time, moisture reduction profile and diesel consumption throughout were investigated. Shelled corn average initial moisture content of 24% wet basis was dried down to about 13.7% of final moisture content in 8 hour. This contributed to result of drying rate in range 1.23%/ hour or 16.76 kg water removed/ hour. The rate of diesel consumption throughout drying process was 5.6 litres/ hour. Based on the result of this study, it is shown that the use of IBD for drying shelled grain corn are not recommended due to the different angle of repose between corn and rice.

Keywords: Inclined bed dryer, grain corn, drying performance, angle of repose
MECHANICAL PROPERTIES OF EPOXY/BANANA FIBER/EGGSHELL COMPOSITES

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Abstract

In this project, different weight percentage of banana fibers and eggshell particulate are used as fillers and epoxy as matrix composition for preparing material composite. This project focuses on the mechanical and thermal properties of single composite and hybrid composite of epoxy/banana fiber/eggshell and finally to determine the optimum composite either single or hybrid composite which results better properties in both thermal and mechanical analysis. There are four types composite materials fabricated with various percentage compositions which are epoxy, banana fiber/epoxy, eggshell/epoxy and hybrid of banana fiber/eggshell/epoxy with constant processing parameters such as stirring rate and curing temperature. The analysis of flexural test, hardness test and FESEM (Field Emission Scanning Electron Microscope) has determined the structural strength of mechanical of the material composites. The hybrid composite of composition 15\% Eggshell 20\% Banana Fiber showed excellent properties for mechanical properties with highest flexural modulus of 1624.14MPa. For the FESEM analysis, the hybrid composite exhibits an excellent bonding of the banana fiber and eggshell particulate in the epoxy matrix. The analysis of further study can be done by applying cyclic analysis test to study the properties of the hybrid composite to be used in industrial application.

Keywords: banana fibers, eggshell particulate, hybrid composite, mechanical properties
STUDY ON THE EFFECT OF REACTION AND CALCINATIONS TEMPERATURE TOWARDS GLUCOSE HYDROLYSIS USING SOLID ACID CATALYST

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Abstract

Levulinic acid (LA) comes from the family of ketone and carboxyl, contributes to a very versatile building block for the synthesis of high value added chemicals. Glucose can be converted into LA at certain conditions. Hence, a study on the effect of reaction and calcinations temperature towards the conversion glucose to LA was conducted. The effect was studied by varying the reaction and calcinations temperature from 80°C–100°C and 200°C- 400°C respectively. Solid acid catalyst was prepared using wet impregnation method to incorporate 30wt%SO₄²⁻ on silica alumina. FTIR analysis was conducted to characterize the solid acid catalyst where the catalytic conversion took place in a batch reactor. It was found that the highest temperature used for the reaction (100°C) contributes to a higher conversion of glucose to LA which is 56.81%. The reaction took place for 6 hours. Meanwhile, as for the effect of calcinations temperature, it was revealed that lower temperature of calcinations favors the reaction. This is because up to 48% of glucose was converted into LA. From this study, it is proven that parameters such as reaction and calcinations temperature highly influence the conversion of glucose to LA.

Keywords: Hydrolysis, glucose, levulinic acid, solid acid catalyst, calcinations and reaction temperature
DESIGN AND DEVELOP A MACHINE FOR ACTIVATED CARBON PRODUCTION FROM COCONUT SHELL

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Abstract

Coconut shells have been regarded as an agro waste since they were produced from coconut milk processing. It has the right features to be processed into activated charcoal for a variety of uses. Coconut shells in Malaysia are produced at 80,000 tonnes/year in 2017. A processing machine for activated carbon production has been developed to overcome the abandoned coconut shells. This paper explained design requirements required to fulfill the purpose and also prototype of the machine. Machine functional test was conducted in MARDI’s lab to ensure all components and mechanisms worked well. Main components of the machine are heating elements, heating chamber, alumina fiber board, temperature controller and thermocouple. The heating temperature for this machine can go up till 1000 °C. A supply of water to create reaction between steam and charcoal takes place at the internal surface area in heating chamber. In conclusion, the machine was capable to produce activated carbon from coconut shells and the quality of the activated carbon produced must be analysed in the future.

Keywords: coconut shells, activated carbon, heating temperature
TREATMENT OF CRUDE OIL EMULSION USING COCONUT OIL AND ITS DERIVATIVE AS GREEN DEMULSIFIERS

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Abstract

Crude oil emulsion is an uncontrollable process that mostly happened at the oil rig during drilling or recovery of oil. Emulsion creates problems at the oil refinery and can cause corrosion in the processing equipment and pipeline. Demulsification is a method used to separate the emulsion in crude oil where the demulsifier can break interfacial surface of the water droplets and coalesce with each other. Chemical demulsifier is conventionally used by industries as it promises good and fast separation in water-in-oil emulsion. However, chemical demulsifiers may increase water toxicity and become harmful to the aquatic lives if discharged to the water resources. Therefore, the use of green demulsifier is important for industries to reduce the impact to environment. The ability of coconut oil and its derivative, coco betaine as green demulsifiers was investigated in the present study. Effects of different parameters such as temperature, demulsifier dosage, ratio of additive/demulsifier have been studied to examine their impacts on the performance of demulsifiers. Bottle test method was used to analyse the separation of water in crude oil. Results revealed that coco betaine has better performance as a green demulsifier compared to the coconut oil in separating the water-in-oil emulsion.

Keywords: Green demulsifier, Emulsion, Coconut oil, Coco betaine
COMPARISON OF LDPE/CORN STALK WITH ECO DEGRADANT AND LDPE/CORN STALK WITH MAPE: INFLUENCE OF COUPLING AGENT AND COMPATIBILISER ON MECHANICAL PROPERTIES

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Abstract

This study investigated the effect of corn stalk (CS) content with different coupling agents, namely eco degradant and maleic anhydride polyethylene (MAPE), on tensile properties, as well as the morphology of Low Density Polyethylene/Corn Stalk (LPDE/CS) biocomposites. The dispersion and interfacial adhesion between CS filler and thermoplastic emerged as significant factors that affected the tensile properties of biocomposites system. In order to improve interfacial adhesion, incorporation of eco-degradant into LDPE/CS composites is recommended. The Scanning Electron Microscopy (SEM) analysis displayed improvements to the interfacial adhesion between LDPE as matrix and corn stalk powder (CSP) filler with the presence of eco-degradant.

Keywords: Corn Stalk Powder (CSP), eco-degradant, Maleic Anhydride Polyethylene (MAPE)
PERCEIVED PHYSICAL DEMANDS AND WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES

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Abstract

Work-related musculoskeletal disorders (WRMSDs) are amongst the most common occupational illnesses in nurses due to the physically demanding and stressful occupational activities involved in their job routines. This study aimed to examine the relationship of workplace physical demands and the WRMSDs among nurses. A self-administered questionnaire survey was carried out among female nurses working. The Standardized Nordic Musculoskeletal Questionnaire was used to identify the annual prevalence of WRMSDs, while, the physical demands were assessed using Karasek’s Job Content Questionnaire. In addition, the participants’ profiles of the participants were also obtained. 73.1% of the nurses sustained WRMSDs for the past 12 months. The most common site was neck, feet, upper back and shoulders. Nurse perceived high physical demands were significantly presenting WRMSDs in region one (neck and shoulders) and region four (hips, knees, ankles, and feet) with odds of risk ranging from 1.68-1.83. The prevalence of WRMSDs among Malaysian nurses is high and neck was the most prevalent site. The analyses revealed that workplace physical demands increased the risk of WRMSDs. As such, interventional program aims to prevent and reduce physical risk factors are required in the near future.

Keywords: nurses; physical demands; health
PRODUCTION OF BIODIESEL FROM PALM OIL REFINERY PILOT PLANT WASTE USING NI/CAO CATALYST

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Abstract

Biomass has demonstrated to be an appropriate substitute for petroleum-based fuel since this energy can solve petroleum-based fuel-related problems. This research was carried out to investigate the suitability of palm oil refinery pilot plant waste to be considered as raw material for producing biodiesel catalytically using 15wt.%Ni/CaO. This research focused on the Fatty Acid Methyl Ester (FAME) characterizations using Gas Chromatography–Mass Spectrometry (GCMS), Fourier-Transform Infrared Spectroscopy (FTIR) and Nuclear Magnetic Resonance (NMR) as well as physical properties (density, flash point, volatility and kinematic viscosity) of FAMEs were measured according to ASTM D6751. It was revealed that 8wt.% of catalyst loading contributes to a higher esters content which is 90.31%. Carbonyl and methoxy group presence in the FAMEs from IR spectra result (1741.10cm⁻¹ and 170.33cm⁻¹) proved that the FAMEs were produced. Additionally, results obtained from physical properties ratify that the FAMEs produced have aligned with the ASTM standard. The density, flash point, kinematic viscosity and volatility were found to be 0.877g/cm³ at 15°C, 130°C, 2.51mm²/s at 40°C and 1.02kPa respectively. From this work, the pilot plant waste consists of mainly olein and stearin has been successfully converted into biodiesel.

Keywords: Biodiesel, FAME, palm oil refinery waste, catalyst, nickel, calcium oxide
DEVELOPMENT OF ALTERNATIVE CULTURE MEDIA USING *DIOSCOREA ALATA* (Purple yams), *SPINACIA OLERACEA* (Spinach) AND *ORYZA SATIVA* (White rice)


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Abstract

Basic medium such as nutrient agar and nutrient broth commonly used as cultivation media for most of living microorganisms. A few studies had developed new culture media as alternative to the available basic medium using their own local products which working towards cost-effective development. This study focused on designing alternative media using local products of spinach and white rice that have suitable composition for growth of *S. aureus*, *B. subtilis*, *Salmonella* spp. and *E. coli*. Effectiveness of the media to support the bacteria growth was determined by the colony forming units (CFU) counting technique. Development of alternative media was started with plant extract containing yams, spinach and white rice with different ratios and cultured with *S. aureus*, *B. subtilis*, *Salmonella* spp. and *E. coli*. Then, the best formulation was chosen based on the colony forming unit (CFU) counting following incubation of bacteria in the alternative media. The study was then continued by analysing the effect of different spinach concentrations on the growth of the bacteria. **Results:** Initial results showed that media containing high carbohydrate content (Formulation A, B and C) slightly affected growth of the bacteria. The Formulation D media was chosen for the next analysis and changing of the spinach concentration demonstrated that high concentration of spinach favoured growth of *Salmonella* sp. White rice and spinach have great potential to be used as source of carbohydrate and other nutrients in developing a new basic bacterial culture media.

**Keywords:** Alternative culture media, *E. coli*, *Salmonella* spp., *S. aureus*, *B. subtilis*, spinach and white rice.
IDENTIFICATION OF ENVIRONMENTAL IMPACT ON PRODUCTION OF POLYOXYMETHYLENE VIA LIFE CYCLE ANALYSIS

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Abstract

In the framework on how community is engaged in green and sustainable technology, the present work describes how life cycle assessment can be used to determine the environmental impact caused by the inputs and outputs along with the manufacturing process of Polyoxymethylene. This paper will focus on the life cycle assessment of polymerization process (gate-to-gate) of Polyoxymethylene. It is divided into feed blending, polymerization, stripping, recovery, and finishing. The ReCiPe method was used and the analysis to the specific process could help to reduce the environmental impacts. The result of analysis showed that, the most significant contributor to the overall damage assessment for human health is formaldehyde (26.98458 DALY), for ecosystem damage quality is electricity (0.037454 species.yr) while resources depletion is formaldehyde (2499623 surplus). The environmental impacts can be reduced and improved by performing some actions such as carrying out energy audit in the factory. According to the hierarchy of control, the control method includes the elimination of source of the hazard, substitution of element, engineering control, administrative control and the least favourable is providing PPE for the worker. It is recommended to widen the scope of study to cradle-to-grave to have better understanding of the analysis result. This will also lead to a better life cycle interpretation analysis.

Keywords: Gate-to-Gate, Life Cycle Assessment, Polyoxymethylene, Polymerization, ReCiPe methodology
THE PRELIMINARY STUDY IMPACT OF EXERCISE ON THE COGNITIVE FUNCTION IN MELAKA INTERNATIONAL COLLEGE OF SCIENCE AND TECHNOLOGY (MICOST)

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Abstract

This paper presents the study impact of exercise on the cognitive function among students in Melaka International College of Science And Technology (MiCoST). Physical activity is usually related to body fitness. Physical activity will effect on the cognitive function in individuals. The objective of this study is to determine the differences between the students are doing exercises and students don’t do the exercises towards their cognitive function through cognitive test provided and to determine the effect of exercises through cognitive test. Their cognitive function were being tested through the cognitive tests such as State-Trait Anxiety Inventory (STAI), Brief Symptom Inventory 18 (BSI18), Arithmetic and Digit-Coding by Weschler Adult Intelligence Scale and Symbol Search. Subject is divided into two groups, one group for doing exercise is futsal and jogging (n=30) and another one group for not doing exercise (n=30). Basically subject who were doing exercise were asked to undergo physical activities for 20 minutes. Followed by cognitive function test were given to them after doing exercise. While the subjects that are not doing the exercise were given the test during their free time.

Keywords: Exercise, Physical activities, Cognitive function, STAI, BSI18, Arithmetic and Digit Coding
MECHANICAL PROPERTIES OF EPOXY/EGGSHELL COMPOSITE

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Abstract

Properties between modified and unmodified eggshell powder (ESP) with Isophthalic acid solution. Epoxy based composites were prepared by reinforcing the epoxy with 0, 5, 10, 15, 20 and 25wt.% weight percent and ≤100, ≤150 and ≤200µm particle size of ESP filler in epoxy matrix. Mechanical (Tensile and Hardness) properties, water absorption behavior and microstructure of fracture feature of the developed composites were studied. According to the result, both modified and unmodified ESP show increasing on tensile strength and hardness with increasing filler loading and size particles in epoxy/eggshell composites. However, unmodified ESP has higher tensile strength compare to modified ESP but, hardness value gave a vice versa value. Fractography study of unmodified ESP showed the ESP as reinforcement having a smooth spherical surface embedded firmly in epoxy matrix whereas modified ESP showed holes resulting from ESP pulled out. Besides, water absorption capacity increased with filler content.

Keywords: Eggshell particulate, hybrid composite, mechanical properties, thermal properties
NATURAL DYE EXTRACTION FROM RAMBUTAN LEAVES.

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Abstract

The aims of the study is to extract natural dye from rambutan leaves by Soxhlet extraction, to test the presence of tannin and saponin in extracts, to study the effects of solvent type, time and weight of sample on yield of extraction and to formulae and evaluate the natural hair dye. Soxhlet extractions were performed using four type of solvent (acetone, ethanol, methanol and water) for two sample weights (10g and 20g) at three extraction times (2hr, 3hr and 4hr). The phytochemical tests were positive for presence of tannins and saponins in the extracts. UV-vis analysis showed the highest concentration of tannis, 107.595 ppm for methanol extraction at 4 hours in 20g sample. The highest concentration of saponins was 356.615 ppm from ethanol extraction at 3 hours in 20g sample. However, the highest yield for tannin was 2.58% by water from 10g sample followed by 1.55% by methanol from 20g sample with sample with both at 4hr of extraction time. The highest yield of saponin was 8.86% from methanol extraction with 10g sample; followed by 5.16% from ethanol extraction with the sample of 20g which both were at 3hr of the extraction time. The multi-level factorial design has shown that the type of solvent, which are the alcoholic solvents (methanol and ethanol) were the significant factor of the yield of extraction. Hence, it is proven that alcoholic solvents have higher dielectric constants compared to acetone and water. The highest yield came from the 20g sample of Soxhlet extraction within the time duration of 3 hours. The chemical and physical properties of the dye have shown some positive result without causing any skin irritation. The formulated hair dye from rambutan leaves had provided a safer alternative.

Keywords: Rambutan leaves, Soxhlet extraction, Natural hair dye
DO FIREFIGHTER’S SAFETY BEHAVIOUR REFLECTS THEIR WORKPLACE SAFETY CLIMATE?

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Abstract

The study investigated the relationship of safety climate and safety behaviour among firemen in Selangor, Malaysia. Safety climate was measured in terms of employee perceptions for safety and health management, safety communication, safety standard and goal, and individual involvement in their organisation. Using a cross-sectional survey design, 150 firemen completed the questionnaire on safety climate and safety behaviour. Descriptive analysis and Pearson’s correlation test were used to identify the significant relationship between variables. The analysis found that there is a significant relationship between safety climate and safety behaviour ($p < 0.01$) among firemen. There are positive correlation of safety climate factors of communication ($p < 0.01$), safety standard and goal ($p < 0.01$) and individual involvement ($p < 0.01$) towards safety behaviour. Hence, the results indicated that the more positive safety climate is viewed, the more likely the firemen to practise the safety behaviour in job duties. In conclusion, this study can serve as the baseline for the management to prioritize the safety and health issue in the department and improvise their strategies to ensure the safety, health and well-being of the firemen.

Keywords: Occupational safety and health, safety climate, safety behaviour, firemen.