ENGINEERING SCIENCES and TECHNOLOGY

EST-01

PARAMETRIC AND KINETIC STUDIES ON THE TREATABILITY OF DISTILLERY SLOP BY PHOTOCATALYSIS USING PAINT-IMMOBILIZED TITANIUM DIOXIDE

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Distillery slop is the large amount of wastewater generated which is equivalent to about 12 to 15x of the volume of ethanol produced. It causes serious disposal problem due to its large volume, high organic load, low pH, high temperature, and dark color (if coming from molasses-based distilleries).This study aimed to determine the efficiency of using paint-immobilized titanium dioxide for the photocatalytic reduction of color and chemical oxygen demand (COD). Titanium dioxide is a non-toxic white powder, resistant to photocorrosion, relatively inexpensive and effective in oxidizing organic and inorganic compounds. The synthetic distillery slop (color of 127,200 PCU, 46,600 mg/L COD and pH 4) was tested using three parameters: presence of light, catalyst loading and pH (4, 5, 6, 7 and 8) to determine which conditions will give the maximum degradation of organic and inorganic materials at 20x dilution. Highest color reduction of 33.65% was measured for the catalysis under solar exposure using the optimum catalyst loading of 50 g titanium dioxide mixed with 50 mL both of water and BoysenTM Gloss Latex Paint in Burnt Sienna. Two controls were used: plain paint and glass alone. Results of treatment with titanium dioxide were significant compared to those of the controls based on the analysis of variance. Kinetic parameters were calculated using the differential and integration methods, giving the preferred values of k at first order of reaction to be 3.5394×10^{-4}/min for color reduction; and $k = 9.1497 \times 10^{-4}$/min for COD reduction. Photocatalysis using paint-immobilized titanium dioxide may be used as a primary treatment for decolorization and COD reduction of distillery slop. However, secondary treatment should be performed to make it compliant to the requirements of the Philippine Clean Water Act.

Keywords: distillery slop, titanium dioxide, photocatalysis

EST-02

PARAMETRIC STUDY ON THE GROWTH OF GREEN ALGA *Chlorella vulgaris* Biej. (CHLOROPHYTA) CULTIVATED IN POLYETHYLENE PHOTOBIOREACTORS UNDER OUTDOOR OPERATIONS

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Microscopic alga is rich in oils (30% to 80% by weight in biomass), and can produce more than 30 times the amount of oil (per year per unit area of land) compared to oil seed crops used for biodiesel production. This study determined the growth kinetics (specific growth rate, doubling time, doublings per day and maximum cell concentration) of green algae *Chlorella vulgaris* Beijerinck, in polyethylene photobioreactor in batch and outdoor operation; and identified the effects of variations in the aeration rate, reactor diameter, and culture media. The batch and outdoor cultivation of *C. vulgaris* CV1 strain was done in polyethylene photobioreactors of varying diameters (4.0”D, 6.0”D, 7.0”D), aeration rates (vvm of 0.114, 0.275 and 0.377) and 3 kinds of culture media (fertilizer solution 0.17192 g/L of urea and 0.02073 g/L of NPK; hog manure mixture; BG-11 medium in Stanier et al, 1971). The biomass concentration at stationary phase for aeration settling of 0.275 vvm was 0.3202 g/L and for 0.114 vvm, it was 0.2670 g/L. The growth of *C. vulgaris* was most favorable in photobioreactor with smallest diameter (4.0”), and in the BG-11 in terms of specific growth rate. The highest oil yield (6.962%) was obtained from the reactor with 7.0”D, followed by 4.0”D (4.546%); least was 6.0”D (3.423%)

Keywords: *Chlorella vulgaris* Beijerinck, Chlorophyta, polyethylene photobioreactors

EST-03

PRE-TREATMENT STUDIES OF SWEET SORGHUM NON-GRAIN BIOMASS FOR BIOETHANOL PROCESSING

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Lignocellulosic biomass like the residual non-food biomass from agricultural sector is a potential alternative feedstock for bioethanol. However, the complex cross linking of cellulose, hemicellulose, and lignin make the biomass recalcitrant to hydrolysis for further processing to bioethanol and other products. Hence, pre-treatment is essential as this converts lignocellulosic biomass from its native form. In this study, combination of thermo-chemical was evaluated. The objective was to establish the most appropriate process for sweet sorghum bagasse, which will serve as basis for optimization for other agricultural residues. The thermo-chemical pretreatments were Soda, Kraft, and Organoslov with predetermined amounts of chemical catalysts. They were carried out at constant temperature (170^{o}C), liquid to biomass ratio (10:1), residence time at treatment temperature (60 min), and cooling down (60mins). Hydrothermal process was performed using the same conditions without chemical catalyst. Fiber yield (%) after pretreatment was in a decreasing order from Organoslov (58.75%)> Kraft (51.25)> Soda (38.28) >Water (25.63%). Sugar yields after acid hydrolysis of the pretreated biomass was highest in Soda (30.22%) and Kraft (29.29%) processes. Organoslov was at 15.37% and hydrothermal at 22.77%, respectively. Sugar degradation was at different extents ranging from 8.29-53%. Also, delignification was effected by the pretreatment protocols and was best observed in Kraft process at 70.72%, Soda at 62.49%; Organoslov at 27%, and hydrothermal at 16.64%. High powered microscopy provided clear degradation of the biomass. Soda and Kraft processes gave the best result while hydrothermal process in combination with biological treatment showed promising result for further investigation

Keywords: Biofuel, lignocellulosic biomass, feedstock, pre-treatment, thermo-chemical

EST-04

LAND COVER CHANGE AND WATER YIELD OF SILANG-SANTA ROSA RIVER SUBWATERSHED, LAGUNA, PHILIPPINES

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Patterns of land cover changes in the Silang-Santa Rosa River Subwatershed were documented through conduct of Participatory Rural Appraisal approaches and GIS mapping. 1993 and 2008 Land cover maps were generated from classified satellite images using ArcGIS with four identified cover classes that include perennials and coconut, cultivated or tilled areas, fallow and grassland, and built-up. Land cover patterns in the subwatershed begun from perennials to grassland to built-up, and from farmlands to idle lands then to built-up. A GIS-based water balance model of the subwatershed that predicts water discharge was derived from PCRaster's DISCHARGE MODEL with component parameters including rainfall, evapotranspiration, cover coefficient, and soil field capacity. Results of sensitivity analysis showed that the volume of water discharge changes with varying land cover coefficients. The model can be used to simulate various scenarios of land cover change and its impact to water yield. Simulation results show that increase in built-up areas resulted to increase in water yield implying reduction in groundwater recharge.

Keywords: Silang-Santa Rosa Subwatershed, Participatory Rural Appraisal, land cover change, land cover patterns, water balance model

EST-05

UTILIZING SPECTRAL REFLECTANCE AND VEGETATION INDICES OF *Bougainvilleae spectabilis* IN MONITORING PARTICULATE AIR POLLUTION IN METRO MANILA

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This research aims to examine the potential of multispectral remote sensing in assessing particulate air pollution at a wider scale and with relative ease wherein plant responses were utilized as indicators of air quality. Major result shows that materials exposed to a polluted area would likely decrease its reflectance mainly from visible to near infrared regions. Vegetation indices such as Ratio Vegetation Index (RVI), Normalized Difference Vegetation Index (NDVI) and Difference Vegetation Index (DVI) including Red Edge Parameter (REP) were utilized to assess potted bougainvillea plants exposed at different pollution level. Further, a spectral mixture analysis (SMA) was made to simulate the effects of exhaust pipe soot to the spectral characteristics of a bougainvillea leaf. The generated data was later used in creating a model thru Partial Least Squares (PLS) regression which produced a 0.91 coefficient of determination. The SMA-based PLS-ran model was then applied to *in situ* measured reflectance of the exposed specimen. Findings reveal an apparent association between the estimated soot content and the Total Suspended Particles (TSP). The same estimation model was also applied to multispectral high-resolution WorldView-2 imageries in producing an interpolated detailed air quality map which shows the spatial extent and concentration of suspended particulate matter. The clearest and least hazed image showed the most reasonable representation of particulate air pollution. The majority of main roads and intersections have high TSP concentration while lower level of pollution can be seen on rivers, cemetery, parks and mostly of residential areas which all suggests a valid scenario. However, some portion of vegetated areas seem to be unrealistic and does not represent TSP level as anticipated due probably to factors such as atmospheric conditions, canopy biophysical attributes, illumination conditions, soil reflectance as well as viewing geometry.

Keywords: air pollution, TSP, vegetation index, worldview-2

EST-06

DEVELOPMENT OF A COMPUTER VISION SYSTEM FOR BROWN RICE QUALITY ANALYSIS

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Conventional brown rice analysis is done by visually inspecting each grain and classifying according to their respective categories. This method is subjective and tedious leading to errors in analysis. Computer vision could be used to analyze brown rice quality by developing models that correlate shape and color features with various classification. The objective of the study was to develop a computer vision system (CVS) for predicting quality parameters of brown rice. Brown rice training samples were collected in Nueva Vizcaya, NFA Binalonan, Pangasinan, and SM supermarket. An ordinary flat bed scanner was used as image acquisition device coupled to a laptop computer equipped with image processing and analysis software developed at PHilMech. The CVS set-up was tested using samples collected at the regional NFA warehouses. The performance of the CVS was compared to human inspection based on their capability to classify brown rice samples. An artificial neural network using probabilistic neural network (PNN) model was developed. Sensitivity analysis revealed a true positive proportion ranging from 0.8792 to 1.00. Likewise, a weight prediction model based on the projected area was made using linear regression. The developed equation is $y = 0.00148A - 0.00018$ with a R^2 of 0.854. The results of performance testing revealed that the CVS could predict the weight of brown rice and detect color-related quality of brown rice such as: sound, damaged, chalky/immature, yellow fermented, red, and paddy. Processing time for classification using the developed CVS has an average of 18.53 minutes and sixty percent of its time (equivalent to 11.24 minutes) was consumed in the manual arranging of grain samples. If a digital separation could be developed, the total time can be reduced to 7.11 minutes compared to 40.07 minutes of manual assessment. Moreover, CVS classification is more accurate compared with the human inspection.

Keywords: brown rice, computer vision system, human inspection, accuracy, repeatability

EST-07

ESTIMATION OF ABOVEGROUND BIOMASS IN MOUNT MAKILING FOREST RESERVE USING LANDSAT ETM+ DATA

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Several studies have been made to estimate the aboveground biomass (AGB) of the different forest stands in the Mt. Makiling Forest Reserve - an important mountain landscape in the Philippines for its rich biological diversity - using ground inventory data. Our study provides an estimate of the total AGB of the landscape. Inventory and Landsat ETM+ data were combined to develop AGB regression equations. The normalized difference vegetation index (NDVI) came out to be the most important predictor variable. The total AGB of MFR based on December 2009 Landsat ETM+ image is 1,602,200 tons. This translates to an average value of 368 ton^{-ha}. The forest reserve has varied land cover types but tree cover is generally high even in what are traditionally classified as cultivated, grassland and built-up areas. Our estimate seems to agree with previous estimates that are based on ground data only. Because we used an SLC-off Landsat product, or image with scan gap error, we created a simple method of filling in missing pixels and we compared the mean AGB estimates from an image with gap pixels masked out and the same mage with gap pixels were filled in.

Keywords: Aboveground biomass, NDVI, scan-gap error, Makiling