

ENGINEERING SCIENCES & TECHNOLOGY DIVISION

ESTD-1

FORMATION OF BIODIESEL FROM DIFFERENT OILS

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Biodiesel is a renewable and biodegradable fuel extracted from plant oils. It is a natural hydrocarbon with little sulfur content and can be used in diesel engines without any need for engine modification. This study was undertaken to produce and compare the biodiesel derived from coconut oil, vegetable oil, used oil and lard. Biodiesel is produced from the transesterification of oil using methyl alcohol in the presence of a catalyst in 0.1N NaOH, heated to 50-80°C for four hours. The biodiesel is separated from the glycerol by decantation, 5 N HCl is added to neutralize the pH, washed with water at 50°C and the washed water evaporated. This process forces out the unwanted components in the oil, which could cause the gumming and clogging of fuel systems and eventually lead to engine failure in the long term. Coconut oil produced a clear to yellow liquid, pH 7.0, acid value of 0.27, viscosity of 2.6 mm²/sec at 40°C. Vegetable oil produced a clear yellow liquid, pH 7.0, acid value of 0.29 and viscosity of 3.2 mm²/sec at 40°C. Used oil was a clear brownish liquid, pH 7.0, acid value of 0.42 and viscosity of 4.7 mm²/sec at 40°C. The above data were within the American Society for Testing and Materials (ASTM) standard limits. No data was obtained for lard because it solidifies in a very short period of time and no biodiesel was produced. The gas chromatography-mass spectra of the biodiesel gave a base peak at 74m/z corresponding to mono alkyl esters of long chain fatty acids which confirmed the presence of methyl esters in the samples.

Keywords: biodiesel, transesterification, viscosity, acid value, gas chromatography-mass spectra

ESTD-2

ENZYME-ASSISTED EXTRACTION AND *Carica papaya* LATEX-CATALYZED TRANSESTERIFICATION OF *Jatropha curcas* L. OIL FOR BIODIESEL PRODUCTION.

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The never ending oil price hike and growing environmental concerns with regards to the use of these fuels have triggered the search for alternative sources of energy, biodiesel is one. Biodiesel is produced from the transesterification of oil. The seed from the *Jatropha curcas* plant contains extractable oil and it can be used to produce biodiesel.

The oil was extracted enzymatically using the enzymes xylanase, cellulase, amylase and lipase. The enzyme together with the seed slurry was incubated in a water bath at the optimum temperature and incubation time for each enzyme. Extraction was done individually with these enzymes as well as combinations of the four enzymes. Individually the highest oil yield of 44.13% was obtained for the enzyme xylanase (X), then 42.13% for cellulase (C), 32.38% for amylase (A) and 28.88% for lipase (L). These enzymes were used consecutively in the order XACL and this resulted in a higher oil yield of 74.44%. The solvent extraction process resulted in a 76.63% oil yield.

The oil extracted was then transesterified with *Carica papaya* latex acting as catalyst. Methanol and oil was mixed in a 4:1 mol/mol ratio, papaya latex was then added and the mixture incubated at the optimum temperature. Papaya latex transesterification resulted in a percent conversion of 80% while the base-catalyzed process resulted in an 84.5% conversion.

The use of enzymes and enzyme combination for oil extraction was found to be comparable to the traditional chemical extraction method using solvents. The same was observed for the transesterification of the oil using latex from papaya.

Keywords: jatropha, extraction, transesterification, biodiesel, enzyme

ESTD-3

RE-MAP: A DECISION SUPPORT SYSTEM FOR MAPPING RENEWABLE ENERGY RESOURCES AND SYSTEMS IN THE PHILIPPINES

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Renewable energy (RE) resource data and information are important in the development and implementation of RE projects in the country. These include technical data and information that are required in the conceptualization/design of potential RE projects and market information that are necessary in evaluating the economic/financial viability of RE projects. Hence, there is a need to address such updating of RE data and information to aid and fast track development and implementation of RE projects; facilitate the generation of useful databases and the expedient exchange of information; and to update and augment existing resource data for use by RE developers/investors, for use in policy advocacy and strategic planning to estimate energy mix and address energy independence. Thus, the MMSU-ANEC developed a decision support system called *RE-MAP* or *Renewable Energy-Mapping Analysis Program* to build wealth of geo-referenced data and information on RE resources (solar, wind, hydro, and biomass) *for policy research and development on RE resources and systems. Geo-referenced database and thematic maps as major outputs of RE-MAP showed various indicators on assessment, monitoring and evaluation, and efficiency thrusts that are useful for energy research, planning and policy options for rationalization and resource management of energy mix required under the medium- and long-term energy development and investment plan of the country. The use of remote sensing, geographic information system, and global positioning system for building of wealth of spatial databases on RE resources and systems, as well as other geographic features of the country are innovative geoinformatics mapping tools to share RE data and information which could be easily updated, stored, ready for any subsequent analysis, and can be shared to other twenty ANECs strategically located all over the country, Department of Energy, and other stakeholders.*

Keywords: decision support system, geographic information system, global positioning system, renewable energy

ESTD-4

PERSISTENT ORGANIC POLLUTANT INFORMATION AND SURVEYING SYSTEM

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An international warning has been raised against a dangerous group of chemicals, the Persistent Organic Pollutants (POPs). They are a class of chemicals that are capable of long-range transport, can accumulate into plant and animal tissues and can persist for a long period of time. Pollutant concentration within living tissues is dangerous. It would cause various health problems. This threat is further worsened by the fact that even if a pollutant was not manufactured in an area, it could reach distant places far from where it was originally produced.

It is a good precaution if people know of the presence of POPs in their area. The Online Persistent Organic Pollutant Information and Surveying System is developed as means of risk assessment for citizens and authorities, so that they may take proper action in response to the threat. The system allows the general public to view the map marking pollutant concentration of different POPs within Metro Manila. Staff from the DENR-Environment Management Bureau for example who are represented in the system as the researcher is allowed to input areas of pollutant concentration and environmental data. The system leaves to the chemical analyst the task of verifying and accepting or rejecting data submitted by field researchers. The chemical analyst is also allowed to add and edit pollutant records. The system administrator manages the accounts of other system users. All of the registered users are allowed to access the bulletin board, where discussions concerning the system can be held.

The system is able to make predictions of the future levels of POPs concentration. However it neglects transfer of pollutants from other areas and also disregards pollutants produced after the data's time of entry.

Keywords: bioaccumulation, persistence, persistent organic pollutants, risk assessment

ESTD-5

ANIMAP: A WEB-BASED CITY POUND MANAGER AND GEOGRAPHICAL INFORMATION SYSTEM

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Animap is a web-based city pound geographic information system (GIS) for collection and storage of information related to dogs impounded by the city pound; specifically designed to be utilized by the City Pound of Makati. The City Pound and the Makati Veterinary Office works together for the control of strayed dogs in the area since both are concerned on areas where there is high prevalence of strayed dogs. City Pound needs to know areas where dog impounding operations is required while the Makati Veterinary Office needs the same information to determine where to hold informative lecture on proper animal care including schedule of vaccination.

With an integrated Geographical Information System, location of dogs impounded is depicted in a dynamic map interface. Managing records of impounded dogs is done using point-click system that does not only update the database with data concerning the animal but also shows other information through the map. Information about the dogs is also available to the general public for browsing to facilitate adoption and retrieval.

Since one of the primary information supplied in the records are locations in Makati where impounded dogs are found, the system would efficiently assist the officials of the said institution to *visualize* these information.

Keywords: city pound, dogs, geographical information system, scalable vector graphics, Makati

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ESTD-7

MT. ISAROG BIODIVERSITY INFORMATION SYSTEM

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The Philippines used to have rich tropical rainforests but much has been reduced during the latter half of the 20th century. The loss of habitats for many species has led to their extinction. Mount Isarog in Camarines Sur has a rich diversity of flora and fauna and home to at least 143 kinds of birds 15 of which are endemic in Luzon. Recent studies have shown that many species had become locally extinct and are now listed as endangered by the International Union for the Conservation of Nature and Natural Resources (IUCN).

Biologists gather vast amounts of data that comprise biodiversity databases especially in the light of rapid species declines and extinctions. There is a need for the development of information infrastructure to support the collection, management and dissemination of biodiversity data.

The Mt. Isarog Biodiversity Information System contains the different biodiversity data in its database. Biologists can update the species database and store data on environmental factors such as rainfall, temperature and humidity. Users can view all these information entered by the biologist. Users can also view the map of Mt. Isarog, view frequently asked questions on biodiversity issues in Mt. Isarog and view the message board containing biodiversity issues. Registered users can post new topics and messages on the message board. The government representative (Mt. Isarog Protected Area Office, Provincial Environment and Natural Resources Office) can upload laws/legislations pertinent to Mt. Isarog. The system administrator can update user accounts and moderate message board.

A biodiversity informatics system greatly satisfy the need to systematize the data in a usable format by the decision-making individuals and institutions particularly the Mt. Isarog Protected Area Office. The availability of online information satisfies the need for larger publicity and access about biodiversity with the aim to increase public awareness on its preservation.

Keywords: biodiversity, mt. Isarog, endangered species, information systems

ESTD-8

SCALE UP FACTORS FOR CHEMICAL OXYGEN DEMAND (COD) REMOVAL FROM SUGAR REFINERY SPENT ION EXCHANGE PROCESS (SIEP) EFFLUENT BY INDIRECT ELECTROCHEMICAL OXIDATION

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Batch electro-oxidation experiments were conducted on raw and undiluted sugar refinery spent ion-exchange process (SIEP) effluent beyond the point of near complete decolorization, to determine whether complete COD removal is possible with the process, and to obtain useful engineering relationships for operation and scale up. Electro-oxidation involves the electrolytic generation of oxidants from the chloride ions present in the effluent. Experiments were conducted at different levels of constant operating current. With an initial COD of 26,000 mg/L and color of 39,000 PCU, results showed that near-complete COD removal is possible with a proper combination of operating current and electrolysis time. The rates of COD removal were initially high but gradually slowed down and leveled off to values nearing complete removal. The initial COD removal rates increased with higher operating current, in accordance with Faraday's Law which predicts that higher operating currents would generate higher amounts of oxidants for removal of COD and color. Complete decolorization was verified to occur earlier than near-complete removal of COD, indicating that COD removal controls the treatment process. An alternative approach to charge dose, for scale-up and operation, was explored using the relationship between volumetric current and the reaction rate constant (determined as first order by the integral method).

Keywords: electro-oxidation, electrolysis, charge dose, volumetric current

ESTD-9

DEVELOPMENT AND PHYSICAL PROPERTIES OF CORDIERITE BASED MATERIAL FOR THERMAL INSULATION APPLICATION UTILIZING SOLSONA WHITE CLAY, BANGUI SOAPSTONE AND OTHER ADDITIVES

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This study was conducted to develop and determine the physical properties like bulk density and apparent porosity of the formulated cordierite based material for thermal insulation application utilizing Solsona white clay, Bangui soapstone, and other additives like imported clay, imported talc and magnesium carbonate containing different percentages addition of pulverized charcoal and fired at different temperatures.

It aims also to determine the possibility of substituting local raw materials to the very expensive imported raw materials to minimize the cost of producing cordierite insulating firebrick. Five formulations were developed with specific ratio of raw materials used. Test specimens were formed in a metal mold having a dimension of 4x1x1 inches. The pressing pressure was set at 150 MPa using manual hydraulic pressing machine during forming. The formed test specimens were fired at temperatures 1100°C and 1050°C with soaking time of two (2) hours. ASTM standard method was used to determine the bulk density and apparent porosity of the fired test specimen.

Results showed that the test specimens in all five developed formulations fired at temperature 1100°C have higher bulk density and lower apparent porosity than the test specimens fired at temperature 1050°C.

The developed formulations of cordierite material substituting local materials were very much acceptable and have strong potential to be used in the manufacture of cordierite insulating firebrick.

Keywords: cordierite material, thermal insulation, insulating firebrick