Production Of Biodiesel From Waste Cooking Oil And Factors

Bioenergy: Biomass to Biofuels and Waste to Energy, 2nd Edition presents a complete overview of the bioenergy value chain, from feedstock to end products. It examines current and emerging feedstocks and advanced processes and technologies enabling the development of all possible alternative energy sources. Divided into seven parts, bioenergy gives thorough consideration to topics such as feedstocks, biomass production and utilization, life-cycle analysis, energy return on invested, integrated sustainability assessments, conversions technologies, biofuels economics, business, and policy. In addition, contributions from leading industry professionals and academics, augmented by related service-learning case studies and quizzes, provide readers with a comprehensive resource that connect theory to real-world implementation. Bioenergy: Biomass to Biofuels and Waste to Energy, 2nd Edition provides engineers, researchers, undergraduate and graduate students, and business professionals in the bioenergy field with valuable, practical information that can be applied to implementing renewable energy projects, choosing among competing feedstocks, technologies, and products. It also serves as a basic resource for civic leaders, economic development professionals, farmers, investors, fleet managers, and reporters interested in an organized introduction to the language, feedstocks, technologies, and products in the biobased renewable energy world. • Includes current and renewed subject matter, project case studies from real world, and topic-specific sections on the impacts of biomass use for energy production from all sorts of biomass feedstocks including organic waste of all kinds. • Provides a comprehensive overview and in-depth technical information of all possible bioenergy resources: solid (wood energy, grass energy, waste, and other biomass), liquid (biodiesel, algae biofuel, ethanol, waste to oils, etc.), and gaseous/electric (biogas, syngas, biopower, RNG), and cutting-edge topics such as advanced fuels. • Integrates current state of art coverage on feedstocks, cost-effective conversion processes, biofuels economic analysis, environmental policy, and triple bottom line. • Features quizzes for each section derived from the implementation of actual hands-on biofuel projects as part of service learning. The use of biofuels around the world has taken a huge impulse due to the awareness that most of the governments and their people have taken regarding the global warming and the health effects of burning fossil fuels (Durante, 2009) and also because of the eventual end of the oil era (Roberts, 2004) which has raised the proces of oil and its derivates". This dissertation, "Alkaline-catalyzed Production of Biodiesel Fuel From Virgin Canola Oil and Recycled Waste Oils" by Yan, Guo, ??, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: Abstract Alkaline-Catalyzed Production of Biodiesel Fuel from Virgin Canola Oil and Recycled Waste Oils Submitted by Guo, Yan for the Degree of Doctor of Philosophy at The University of Hong Kong in November 2005 Diesel fuel has been widely used in industry and in automobiles for over a century. But as petroleum prices continue to rise, diesel supply becomes scarce and concern for environment grows, scientists have invested considerable effort in searching for renewable substitutes of diesel fuel. Biodiesel is a non-toxic, biodegradable and renewable fuel that can be used in diesel engines, and is becoming one of the fastest growing fuels in the global fuel market. Biodiesel is produced from transesterification of vegetable oil or animal fat with simple alcohol in the presence of a catalyst. It is a type of fatty acid ester which has fuel characteristics similar to petro-diesel. Of the several transesterification methods, alkaline-catalyzed transesterification is widely used industrially due to its fast reaction rate, high levels of conversion, moderated reaction conditions and less corrosiveness to equipment, compared to other methods such as acid-catalyzed, enzymatic-catalyzed and uncatalyzed transesterification (using supercritical fluids). In this study, three feedstock oils (virgin canola oil, used frying oil (UFO) and grease trap oil) were converted into biodiesel by alkaline-catalyzed transesterification iAbstract operating conditions for this chemical transformation (i.e. degree of mixing, type and amount of catalyst, molar ratio of methanol to oil, reaction temperature and reaction time) and the product purification process were thoroughly investigated and optimized. The optimal values of these factors were found to be related to the chemical and physical properties of the feedstock oils. Based on the results, the degree of mixing was found to be a key factor affecting the reaction rate and product yield. Even when vigorous mechanical mixing has been applied in the transesterification process, significant mass transfer still exists. Continuous mechanical stirring throughout the entire reaction process, which has been the common practice in most of the biodiesel researches and production plants, is unfavorable for achieving the maximum biodiesel yield. A mechanism for the alkaline-catalyzed transesterification process is proposed, consisting of two stages: an initial two-phase stage mainly controlled by mass transfer and a subsequent multi-phase stage mainly controlled by chemical reaction. The presence of a clear phase is a turning point or criterion of completion of the first stage and beginning of the second stage. If the amount of catalyst or methanol is offset from the optimal value, the reaction is either incomplete or will lead to a reduction in the product yield. Higher reaction temperature has a negative impact on the product yield for neat oil, but a positive effect for waste oils. The amount of catalyst and methanol showed greater influences on the product yield than reaction temperature and reaction time. The efficiency of various methods of washing biodiesel using water (gravitational settling, stirring, introduction In this study, the use of waste coffee grounds for biodiesel production, its solid by-product after oil extraction for bioethanol generation, and the second by-product after bioethanol generation for solid fuel generation is explored. For the study, waste coffee grounds samples were gathered from TOMOCA PLC, Addis Ababa, Ethiopia. The oil was then concentrated utilizing n-hexane and brought about an oil yield of 19.73 %w/w. The biodiesel was acquired by a two-stage
process, i.e. acid catalyzed esterification followed by base catalyzed transesterification utilizing catalysts sulfuric acid and sodium hydroxide respectively. The change, after esterification of waste coffee grounds oil into biodiesel, was about 80.4%w/w. Different parameters that are fundamental for biodiesel quality were assessed utilizing the American Standard for Testing Material (ASTM D 6751-09) and revealed that all quality parameters are inside the extent pointed out aside from acid value. Also, the strong waste staying after oil extraction was researched for conceivable use as a feedstock for the generation of bioethanol and brought about a bioethanol yield of 8.3 %v/v. Moreover, the solid waste staying after bioethanol generation was assessed for solid fuel (20.8 MJ/Kg) applications.

The recent issue of peak oil and environmental concerns has prompted deeper research into the area of alternative fuels, particularly biofuel. Two types of feedstock for biodiesel production was researched in this project, namely waste cooking oil (WCO) and Refined-Bleached-Deodorized (RBD) palm oil. The performance of the alkaline catalyst potassium hydroxide was investigated towards the methyl ester purity of the product produced using ultrasonic transesterification. The methanol oil molar ratio used in this research was 6:1. The best conditions for biodiesel production were determined in terms of reaction time and catalyst concentration. The range of catalyst concentration and reaction time studied were 0.75 to 1.75 weight percent and 20 to 50 minutes respectively. Catalyst concentration and reaction time played a significant role in the purity of the product produced. The results show that the best catalyst concentration to produce methyl ester of high purity is at 1.75 weight percent, while the best reaction time necessary is 50 minutes. The resulting conditions were then used to synthesize the final product that was then subjected to a combustion test to determine the quantity of carbon monoxide and carbon dioxide emitted. WCO biodiesel was found to have 19.1% lower carbon monoxide emissions than RBD palm oil biodiesel. In terms of the amount of carbon dioxide released, WCO biodiesel had emissions higher than that of RBD palm oil biodiesel by 2.3%. In conclusion, WCO biodiesel was found to be more environmentally friendly compared to RBD palm oil biodiesel upon combustion.

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This book explores a novel technique for processing biodiesel using lipase immobilization by encapsulation and its physical properties, stability characteristics, and application in stirred tank and re-circulated packed bed immobilized reactors for biodiesel production. The enzymatic processing of biodiesel addresses many of the problems associated with chemical processing. It requires only moderate operating conditions and yields a high-quality product with a high level of conversion and the life cycle assessment of enzymatic biodiesel production has more favorable environmental consequences. The chemical processing problems of waste water treatment are lessened and soap formation is not an issue, meaning that waste oil with higher FFA can be used as the feedstock. The by product glycerol does not require any purification and it can be sold at higher price. However, soluble enzymatic processing is not perfect. It is costly, the enzyme cannot be recycled and its removal from the product is difficult. For these reasons, immobilized enzymatic process has been developed which retains the advantages of the soluble enzymatic process and reuse of the enzyme is possible which decreases the enzyme cost, the biodiesel produced does not contain any enzyme residue and the activity of the enzyme can be increased by immobilization. The drawbacks of the immobilized enzyme process are mass transfer limitation, enzyme leakage, the lack of a versatile commercial immobilized enzyme and some of immobilization methods involve toxic chemicals. To overcome the drawbacks of the immobilized enzyme, an attempt is made to use a degradable biopolymer (?-carrageenan) as a carrier for lipase immobilization.

The search for alternative sources of energy to offset diminishing resources of easy and cost-effective fossil fuels has become a global initiative, and fuel generated from biomass is a leading competitor in this arena. Large-scale introduction of biofuels into the energy mix could contribute to environmentally and economically sustainable development on a global scale. The processes and methodologies presented in this volume will offer a cutting-edge and comprehensive approach to the production of biofuels, for engineers, researchers, and students. Amongst concerns about climate change, energy security decline and depletion of fossil fuels, this book explores the high importance of and interests in alternative energy resources. Many studies have shown that biomass fuels are sustainable, environmentally friendly and can be the most appropriate replacement to the depleting crude oil. Additionally, they can expand green landscapes, create new job opportunities, be directly utilized in standard power systems and improve combustion performance. Biomass fuels can be limited due to production cost and competition with food. Therefore, plant and food wastes play an important role in reducing these costs and recycling dump bio-materials. Production of biofuels from non-food biomass has emerged as a sustainable option to tackle the problems associated with growing demands for energy.

Doctoral Thesis / Dissertation from the year 2017 in the subject Environmental Sciences, grade: A, Andhra University (College of engineering), language: English, abstract: Biodiesel as an alternative fuel for diesel engines is becoming increasingly important due to diminishing petroleum reserves and the environmental consequences of exhaust gases from petroleum-fueled engines. Biodiesel, which is made from renewable sources, consists of the simple alkyl esters of fatty acids. As a future prospective fuel, biodiesel has to compete economically with petroleum diesel fuels. A two-step transesterification process (Sequential esterification and transesterification process) was used to prepare methyl ester (biodiesel) from high free fatty acid (FFA) content oils. For the yield of high FFA, two-step acid-base catalyzed method has been developed which consists of acid-catalyzed pretreatment/esterification step to reduce the FFA to less than 1% using H2SO4 as an acid catalyst and transesterification of pretreated oil to biodiesel using alkali catalyst. In the present study, the main focus is being placed to explore the non-edible oil resources like Used Cooking Oil (UCO), Cottonseed oil, Jatropha (Jatropha curcas) oil, Neem(Azadirachta indica) oil as a potential source for biodiesel. Experimental results from enzyme (lipase) catalyzed method for selected oils using influencing parameters such as reaction time and catalyst weight, experimental results from acid-alkaline catalyzed methods using common influencing parameters such as
methanol to oil molar ratio, catalyst weight, reaction temperature and reaction time for above-mentioned oils were compared using batch mode. Methyl ester (biodiesel) yield range of 66.20-71.6% was attained for an enzyme-catalyzed method, whereas for acid-alkaline the yield range was 84.4-91.6%. This gives the indication of further refinement in the enzyme-catalyzed transesterification process. However, enzyme-catalyzed biodiesel production has some limitations especially when implemented in industrial scale because of the high cost of enzyme, low reaction rate and enzyme deactivation. As the catalyst, an enzyme is restricted to rigorous reaction condition and the activity loss of lipase. The influencing parameters and absolute results of the analysis give the impression of the superiority of acid-alkaline transesterification method for methyl ester production. In this study, we have selected Used Cooking Oil Methyl Ester (UCOME) and Jatropha Methyl Ester (JME) among the methyl esters of four oils. The transportation industry is still largely reliant on fossil fuels, whose use and extraction have significant environmental costs. Biofuels produced from renewable resources biomass offer a more sustainable alternative. However, it is important that production methods should be energy efficient and that feedstocks should not compete with food sources. Biofuels that meet these criteria are sometimes referred to as second-generation biofuels. The new edition of this book provides updates on the three previously discussed non-conventional pathways for second-generation biofuels, including new experimental results and pilot plant studies. It also includes a completely new chapter looking at developments in combining renewable electricity with fuel production and possible future directions for the transportation industry. It is a useful read for researchers and industrialists working in biofuel development as well as postgraduate students studying fuel alternatives.

Food Waste to Valuable Resources: Applications and Management compiles current information pertaining to food waste, placing particular emphasis on the themes of food waste management, biorefineries, valuable specialty products and technoeconomic analysis. Following its introduction, this book explores new valuable resource technologies, the bioeconomy, the technoeconomical evaluation of food-waste-based biorefineries, and the policies and regulations related to a food-waste-based economy. It is an ideal reference for researchers and industry professionals working in the areas of food waste valorization, food science and technology, food producers, policymakers and NGOs, environmental technologists, environmental engineers, and students studying environmental engineering, food science, and more. Presents recent advances, trends and challenges related to food waste valorization Contains invaluable knowledge on of food waste management, biorefineries, valuable specialty products and technoeconomic analysis Highlights modern advances and applications of food waste bioresources in various products' recovery Conversion of biomass into chemicals and biofuels is an active research and development area as trends move to replace traditional fossil fuels with renewable resources. By integrating processing methods with ultrasound and microwave irradiation into biorefineries, the time-scale of many operations can be greatly reduced while the efficiency of the reactions can be remarkably increased so that process intensification can be achieved. “Production of Biofuels and Chemicals with Ultrasound” and “Production of Biofuels and Chemicals with Microwave” are two independent volumes in the Biofuels and Biorefineries series that take different, but complementary approaches for the pretreatment and chemical transformation of biomass into chemicals and biofuels. The volume “Ultrasound” provides current research advances and prospects in mechanistic principles of acoustical cavitation in sonochemistry, physical and chemical mechanisms in biofuel synthesis, reactor design for transesterification and esterification reactions, lipid extraction from algal biomass, microalgae extraction, biodiesel and bioethanol synthesis, practical technologies and systems, pretreatment of biomass waste sources including lignocellulosic materials, manures and sludges for biogas production, vibration-assisted pelleting, combined chemical-mechanical methods, valorization of starch-based wastes and techno-economic methodology. Each of the 12 chapters has been peer-reviewed and edited to improve both the quality of the text and the scope and coverage of the topics. Both volumes “Ultrasound” and “Microwave” are references designed for students, researchers, academicians and industrialists in the fields of chemistry and chemical engineering and include introductory chapters to highlight present concepts of the fundamental technologies and their application. Dr. Zhen Fang is Professor in Bioenergy, Leader and founder of biomass group, Chinese Academy of Sciences, Xishuangbanna Tropical Botanical Garden and is also adjunct Professor of Life Sciences, University of Science and Technology of China. Dr. Richard L Smith, Jr. is Professor of Chemical Engineering, Graduate School of Environmental Studies, Research Center of Supercritical Fluid Technology, Tohoku University, Japan. Dr. Xinhua Qi is Professor of Environmental Science, Nankai University, China.

Fuel is the main factor for the economy of a country. And demand of fuel is increasing rapidly day by day. Petrol & diesel are the main fuel used in worldwide. But all of these are non-renewable sources of energy and are very harmful for our environment. Combustion of these types of fuel produces different types of toxic gases which pollute air and at the same time, sources of this type of energy are limited. So, alternative fuel must be searched to solve our energy problem and to make free our environment from pollution. For these reasons, I proposed a method for producing biodiesel from vegetable oil which is environment friendly and quality was also tested. Though the price of biodiesel will be greater than that of fossil fuel but for large scale production it will be less. If we can increase the production of vegetable oil in our country in large scale then production of biodiesel will save our foreign currency which is used for importing fuel from other countries. And it will be helpful to solve our energy demand. So, I tried my best to make the process economical and easy, so that everybody can produce in their home. Academic Paper from the year 2020 in the subject Chemistry - Materials Chemistry, , language: English, abstract: Biodiesel or in general biofuels can be produced in a complex process of transesterification or in hydrotreatment of oil. To do this a catalyst is required. The conversion process of used oil is the aim of this paper. This paper identifies clay or zeolite as catalyst material which is required to convert used cooking oil into useful chemicals. The information presented forward offers a deep insight of products that are obtainable from the conversion of waste cooking oil. Handbook of Biofuels Production, Second Edition, discusses advanced chemical, biochemical, and thermochemical biofuels production routes that are fast being developed to address the global increase in energy usage. Research and development in this field is aimed at improving the quality and environmental impact of biofuels production, as well as the overall efficiency and output of biofuels production plants. The book provides a comprehensive and systematic reference on the range of biomass conversion
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processes and technology. Key changes for this second edition include increased coverage of emerging feedstocks, including microalgae, more emphasis on by-product valorization for biofuels' production, additional chapters on emerging biofuel production methods, and discussion of the emissions associated with biofuel use in engines. The editorial team is strengthened by the addition of two extra members, and a number of new contributors have been invited to work with authors from the first edition to revise existing chapters, thus offering fresh perspectives. Provides systematic and detailed coverage of the processes and technologies being used for biofuel production Discusses advanced chemical, biochemical, and thermochemical biofuels production routes that are fast being developed to address the global increase in energy usage Reviews the production of both first and second generation biofuels Addresses integrated biofuel production in biorefineries and the use of waste materials as feedstocks

Biodiesel Production from Waste Cooking Oil.

Project Report from the year 2017 in the subject Engineering - Industrial Engineering and Management, , language: English, abstract: The conventional approach of biodiesel production is transesterification, using oil and alcohol in the presence of a catalyst with glycerol as a by-product of the reaction. Product quality is dependent on the type and amount of catalyst, type of oil feedstock, alcohol-to-oil ratio, etc. In terms of the best process, currently the alkali catalyzed process is the most profitable while the enzymatic based one is even more promising due to the lower consumption of energy and water; however it requires that the enzyme cost is reduced. The reason that biodiesel is not utilized widely around the world is due to the high cost of raw materials. To overcome this, one can use lower quality oils, such as Waste Cooking Oil (WCO). A lot of research has been carried out on the production of biodiesel from fresh vegetable and animal oil sources but the use of Waste Cooking Oil, such as palm oil, etc. has not been well documented. Then the aim of this current project is to analyze and optimize the conditions for biodiesel production from Waste Cooking Oil, by investigating interaction effects among process variables (temperature, oil-to-methanol molar ratio and catalyst loading) using SPC and other tools. Thus this project focuses on making biodiesel processes better and more efficient. The edited volume presents the progress of first and second generation biofuel production technology in selected countries. Possibility of producing alternative fuels containing biocomponents and selected research methods of biofuels exploitation characteristics (also aviation fuels) was characterized. The book shows also some aspects of the environmental impact of the production and biofuels using, and describes perspectives of biofuel production technology development. It provides the review of biorefinery processes with a particular focus on pretreatment methods of selected primary and secondary raw materials. The discussion includes also a possibility of sustainable development of presented advanced biorefinery processes.

Biodiesel Basics and Beyond aims to separate fact from fiction and to educate potential home, farm, and cooperative manufacturers on the economic production of quality biodiesel from both waste and virgin oil feedstock. The book includes: detailed processes and equipment required to produce biodiesel fuel that meets North American standards how farmers can use excess oilseed as a feedstock for biodiesel production the use of the co-product glycerin in the making of soap a guide to numerous reference materials and a list of supplier data This is North America's definitive guide to responsibly producing biodiesel from waste vegetable oil while minimizing your environmental footprint in the process. Biofuels are one of the most sustainable options when it comes to renewable energy sources to replace fossil fuels. Biotechnological processes, such as microbial fermentation, are used to produce energy from waste biomass by converting organic substrates into biofuels. This book discusses practices to improve and enrich various microbial communities in order to enhance sustainable and economical biofuel production. It also evaluates various strategies to develop potential microorganisms and microbial consortia to produce highly efficient biofuels at a relatively low cost. This book highlights the latest developments and growing trends in the field of biodiesel production. The beginning few chapters deal with feedstocks required for the production of biodiesel. It also encompasses issues related to the use of inexpensive inedible raw materials and production of biomass feedstock with properties that may help it to produce biodiesel. Waste vegetable oils, animal fats, algae etc. are some sources of oil to produce biodiesels. This book would be a rich source of information to the scientists, students and professionals who are engaged in biodiesel production.

This volume is fourth part of the five-part set on bioenergy research. This volume covers biomass to bioenergy production concept. The book is focused on the possible and versatile biomass options available for the generation of bioenergy. Additionally, the book also explores different types of biomass for bioenergy generation at a commercial level. Further, the book elaborates on different kind of cellulose and sugar rich waste which can also be utilized for bioenergy production. It covers other relevant issues such as recent technological advancement in biomass to bioenergy conversion, waste management in the context of biomass to biofuels production technologies, green methods of energy production, alternates of fossil fuels in the near future. It also explores biomass waste valorization, utilizing microbial processes in bioenergy production. This is a useful reading material for students, researchers, industry and policy experts. Other four volumes of this set explore basic concepts, latest progress, commercial opportunities and integrated solution for bioenergy concerns. "Transesterification is a process that converts triglycerides, like vegetable oil, into fatty acid methyl esters, commonly known as biodiesel. This conversion reaction requires the triglyceride feedstock, an alcohol, and an alkali-catalyst to produce the biodiesel. Biodiesel is a versatile biofuel that is renewable, biodegradable, and environmentally beneficial in the sense that combustion adds only biogenic carbon to the atmosphere. The main limitation of commercialization of biodiesel is cost. However, developing closed-loop systems that have an available triglyceride supply, such as waste cooking oil, as well as demand for diesel based fuels, can achieve substantial emissions reductions and energy avoidance, while simultaneously solving a waste disposal issue. Thus, an analysis of the development of a closed-loop waste cooking to biodiesel fuel production process is warranted. A waste-to-energy (WIE) system like this offers great potential to institutions. Thus, this analysis includes the development of a waste cooking oil to biodiesel fuel program utilizing the available waste cooking oil of a university, the production of the fuel, the internal use of the fuel, and subsequent analysis of the fuel characteristics, emissions, and the life cycle environmental and energy impacts of the production process and ultimate use. The results show that the waste cooking oil derived biodiesel meets the required American Society for Testing and Materials (ASTM) standard specifically for biodiesel, ASTM D6751. The produced biodiesel was blended with commercially available fuel oil, which met the ASTM specification D396-13b. Therefore, a blend of these two ASTM compliant fuels also met the required ASTM standards. The ASTM standards require high quality fuel characteristics and ensure proper utilization and combustion. Biodiesel blended heating fuels were utilized in two distinct heating facilities, both showing comparable emissions to conventional fuel oil. Small (500 mL) and large (1L) volume biodiesel blends were utilized in a conventional residential furnace. Emissions data were obtained through the exhaust ducting with a combustion gas analyzer. The same fuel blends were utilized in a lab-scale burner apparatus without a heat exchanger, which enabled near-flame interrogation and visualization of the combustion process. The emissions of both heating facilities were comparable to the incumbent fuel oil. The life cycle assessment results demonstrate the benefits of increasing the approved blends of biodiesel heating fuels. Currently, most oil burners are only approved up to a B5 blend (5% biodiesel, 95% fuel oil). The results show higher blends achieve substantial life cycle reduction in global warming potential and cumulative energy demand,
as well as an energy return on investment of above 4, indicating more energy is obtained from the fuel than required to produce it."--Abstract.

Up-scale for the production of biodiesel from waste cooking oil (WCO) and Refined-Bleached-Deodorized (RBD) under ultrasonic condition was studied. The effects of sodium hydroxide as a catalyst and time on the biodiesel conversion were investigated. Experiments have been performed to determine the optimum condition for this alkali-catalyzed transesterification process where the temperature is fixing at 40°C and the stirring rpm are 1000 rpm. The results showed that transesterification process under ultrasonic condition was proved to be time and energy saving. Gas Chromatography (GC) is used to study the formation of methyl ester of waste cooking oil and combustion test to study the combustion characteristic of biodiesel. The optimum experimental condition for catalyst concentration is 1 wt% sodium hydroxide (NaOH) and the reaction time is 40 minutes for WCO while 0.75 wt % sodium hydroxide (NaOH) and the reaction time is 30 minutes for RBD. The level of carbon dioxide (CO2) and carbon monoxide (CO) in biodiesel from WCO are low compare to the RBD and diesel fuel.

Homogeneous catalysts have several disadvantages in biodiesel production such as large amount of soap production, it is corrosive to equipment, cannot be reused, produces large amount of wastewater for purification steps, hence increasing the overall cost of biodiesel production. To overcome these problems in production of biodiesel this study looks into alternatives of employing heterogeneous catalyst from waste resources. The waste food material namely crab shell, egg shell and fish bone is selected as heterogeneous catalysts, for biodiesel synthesis by transesterification reaction to determine the source providing the highest biodiesel yield. The solid oxide materials were calcined at 900°C for 2-4 hrs to convert CaCO3 to CaO species. Transesterification was carried out at 65°C for 4 hrs with varied methanol to oil ratio. The optimum calcination time and methanol:oil ratio for transesterification reaction was 3hrs and 12:1 respectively. It was found that although egg shell and crab shell gave average biodiesel yields, fish bone provided the highest yield of the three catalysts. Fish bone catalyst was further chemically treated with Al(NO3)3.9H2O to develop a support for the catalyst in order to enhance the yield and quality of biodiesel. The experiment is designed by face-centered central composite design (FCCCD) under response surface methodology (RSM). The input parameters for process conditions were CaO loading, calcination time for chemically treated catalyst and catalyst wt%. The highest yield of 94.30% was achieved with the optimum conditions at calcination time of 6.11hrs, catalyst wt% of 4.02w/w% and CaO loading of 34.49w/w%. estimated by RSM. This research signifies successful application of waste resources as an emerging prospective for economical preparation of heterogeneous catalyst, developing an unconventional avenue for reusing of this solid waste.

Biodiesel production is a rapidly advancing field worldwide, with biodiesel fuel increasingly being used in compression ignition (diesel) engines. Biodiesel has been extensively studied and utilised in developed countries, and it is increasingly being introduced in developing countries, especially in regions with high potential for sustainable biodiesel production. Initial sections systematically review feedstock resources and vegetable oil formulations, including the economics of vegetable oil conversion to diesel fuel, with additional coverage of emerging energy crops for biodiesel production. Further sections review the transesterification process, including chemical (catalysis) and biochemical (biocatalysis) processes, with extended coverage of industrial process technology and control methods, and standards for biodiesel fuel quality assurance. Final chapters cover the sustainability, performance and environmental issues of biodiesel production, as well as routes to improve glycerol by-product usage and the development of next-generation products. Biodiesel science and technology: From soil to oil provides a comprehensive reference to fuel engineers, researchers and academics on the technological developments involved in improving biodiesel quality and production capacity that are crucial to the future of the industry. Evaluates biodiesel as a renewable energy source and documents global biodiesel development The outlook for biodiesel science and technology is presented exploring the challenges faced by the global diesel industry Reviews feedstock resources and vegetable oil formation including emerging crops and the agronomic potential of underexploited oil crops

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