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Biodiesel: Latest Perspective on Production Technology and Prospects

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Abstract

Since the previous two decades, biodiesel has gained popularity as a possible alternative to fossil diesel. However, one of the primary issues with the industry's method of producing biodiesel is the inability of homogenous alkali catalysts to be recycled and the waste that is produced as a result of the water washing that follows. Due to their distinctive qualities, including non-volatility, great solubility for a wide range of organic and inorganic compounds, structural tenability, environmental friendliness, and wide liquid temperature range, ionic liquids are one of the finest alternatives to alkali catalysts. However, their use has been constrained by their high viscosity and challenging recovery. To get around these problems, heterogenization of ionic liquids on solid supports has recently been proposed. When it comes to creating sturdy supports with high porosity and specific surface area, nanoporous materials have excelled. The design of ionic liquids deposited on nanoporous materials as catalysts for the manufacture of biodiesel is reviewed in this research. The application of this kind of catalysts for improving reaction conditions was the main focus. Also covered were difficulties and chances for enhancing the entire production process while these catalysts are present. Despite the fact that numerous ionic liquids supported by nanoporous materials produced substantial biodiesel yields, their significantly greater cost in comparison to traditional catalysts remained a considerable obstacle.

Keywords: Biodiesel; nanoporous materials; catalysts; methanolysis

Introduction

Diesel engines are preferred due to heavy duty applications, power generation plants durability and productivity. Dwindling sources of energy and the environmental concerns due to carbon emission rates across different countries has led to identification and use of alternative ad renewable fuels. Biodiesel is one of the alternate fuels that is composed of fatty acids and alkyl esters, and has several chemical properties that make it fit for the use as fossil fuel. Currently biodiesel is produced from the raw materials using different processes primarily the methanolysis of the vegetable oils using basic and acid homogeneous catalysts. In certain conditions the used and left cooking oil and the animal product derived fats are used for the biodiesel production which allows for the production of the more sustainable bio fuel. Ethanol that is derived from the fermentation of the biomass can be used to replace methanol. The sustainability of the biodiesel production can also be improved by opting for the homogeneous catalyzed process. Ramos et al. performed a literature review proclaiming several of the strategies that allows improvement in the biodiesel sustainability [1].

Generally biodiesel is produced by the alcoholysis of the fats and is generally low in the carbon emission when compared to the conventional fuels. Conventionally biodiesel is produced by the methanolysis of the vegetable oils derived from the crops. These oleaginous crops occupy the arable land thus replacing the conventional agricultural food crops. However, the biodiesel production can be made from non-edible animal fats and other waste cooking oils residues. Calcium based catalysts stand excellent in the heterogeneous catalysis reactions and they can thus be tested industrially. However the stability of the calcium based catalysts is less. Additionally the dry washing based refinement of the biodiesel also contributes to the sustainability of biodiesel production as this allows for reduction in the waste water generation along with reduced energy requirement.

Literature Review

Other alternate sources of biodiesel are vegetable oils animal fats, non-edible plant oils, and used and discarded cooking oil. Biodiesel are non-toxic, free of sulfur, aromatics and has several advantages over the conventional petrol and diesel. Biodiesel emits lesser amount of carbon and causes lesser air pollution than the other conventional fuels. High capital investment, the cost of the raw material add to the high cost of the biodiesel production. However, technological improvements can be mad to increase the yield thus reduction the overall production capacity. Therefore, development of economically superior technology, use of the appropriate catalysts and selection of the feed stock alternative increases the profitability of the biodiesel production.

Low cost feedstocks contain higher amount of impurities and need extensive refinement for production of the biodiesel. These impurities are higher FFA and water content necessitating pretreatment. Conventional technologies include acid catalyzed transesterification reaction which is the most cost effective to produce fuel grade biodiesel from cheaper feedstock containing higher FFA content because the acid catalysts has potential to catalyze both esterification and transesterification reactions without feedstock pretreatment. Heterogeneous catalysts have the advantages of the reusability, lesser process steps for separation and purification, high purity glycerol production and with easy catalyst recovery.

There are several cost effective and res8able alternatives that are prepared from discarded materials including the egg shell, Scallop shell, shells of the crustaceans, coconut shell bio-char, Kraft lignin and pyrolyzed sugar. These alternative sources increase the through put per unit time [2]. Biodiesel can be used as the transportation fuel. However biodiesel production is very complex involving processing that requires designing, monitoring and optimization. Artificial neural network technology was identified as the most desirable for biodiesel

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production research. For example modeling for trans esterification process, analyzing the physic chemical properties of biodiesel, and biodiesel combustion in engines in order to enhance the production efficiency, economic viability and environmental sustainability [3].

In one of the recent studies it was found that algae based third generation feedstocks were better due to their high energy content, high oil content, and lesser carbon foot print. Transesterification was found to be most suitable process due to high yield, economical processing [4]. Homogeneous catalysts were found to be more efficient for conversion of biodiesel containing low free fatty acid (FFA) and water with single-origin feedstock. Heterogeneous catalysts provide better activity, good range of selectivity, good FFA, and water adaptability. These properties are controlled by quantity and strengths of active acid or basic sites. Heterogeneous catalysts including zirconia and zeolite-based catalysts can function as both basic and acidic catalyst by certain alteration. Recently the focus shifted to the use of the nano-catalysts. The use of the homogeneous catalysts produces by products, such as soaps and polymeric pigments, which make the purification process and the catalyst reuse very difficult. Homogeneous catalysts are used for feedstocks having high FFA content. However it has certain disadvantages such as relatively slow reaction rate, corrosive nature, difficult catalyst separation from product. Nanocatalysts enable high catalytic efficiency at mild operating conditions due to which it has drawn attention to nanocatalysts. However the major challenge is the development of highly active and selective heterogeneous catalysts, along with economic feasibility for use in the industrial scale [5].

Some of the transesterification process reactors include tubular/plug-flow reactors, rotating reactors, simultaneous reaction-separation reactors, cavitational reactors, and microwave reactors [6]. Recent studies revealed that biodiesel starting material availability depends on the climate, geography, location, soil conditions, agricultural and agronomical practices. The starting material cost accounts for almost 75% for the biodiesel production cost. For commercialization and marketing of biodiesel it should pass either the American Society for Testing and Materials (ASTM) standards or European Standards (EN) to ensure environmental safety. The most suitable and desirable feedstock for biodiesel production should consider that they do not compete with agricultural food crops, do not lead to arable land-clearing, and reduce greenhouse gas emissions. Foe successful public markets, biodiesel should comply with international standards such as the American Standards for Testing Materials (ASTM 6751–3) or the European Union standards (EN 14214). This can also be achieved using hydrocarbon blending, micro-emulsion, pyrolysis, and transesterification. Recent studies focused on the techno-economic studies on various biodiesel production technologies to ensure their viability, sustainability and practicality in industry and the market [7].

Finding alternative energy sources is now necessary owing to the non-renewability of fossil fuels and their detrimental effects on the environment. Since they are cleaner, more environmentally friendly, and may support the sustainable development of society, renewable energy sources have been viewed in this regard as one of the most promising possibilities over the past several decades [8].

Discussion

Biomass, the most prevalent form of renewable energy, makes a considerable economic contribution to the global economy and generates a variety of biofuels and chemicals. Biomass provided around 11% of the energy used by the globe in 2017. However, oil has continued to be the primary energy source in the transportation sector, accounting for 65 percent of global final consumption. To lessen reliance on petroleum and its detrimental effects on the environment, more biofuels must be produced and used, particularly in the transportation sector.

One of the widely used types of biofuel is biodiesel, which is made from animal and vegetable fats and is seen as an appealing replacement for fossil diesel. It may be blended with fossil diesel at any ratio and is renewable, non-toxic, biodegradable, sulfur- and benzene-free. It can also be used in regular diesel engines without any modifications [9]. 36 billion gallons of biodiesel were generated worldwide in 2017 as a result of these advantages. Through 2027, this amount is projected to increase by 9%.

While biodiesel offers many benefits, there are also significant technical, financial, and environmental disadvantages. The oxidative stability and cold flow qualities of biodiesel are weaker than those of fossil diesel, and it has higher viscosity and density as well as higher NOx emissions. The most difficult drawback of biodiesel, nevertheless, is its greater production cost as compared to fossil diesel, which is mostly caused by the high cost of feedstock and ineffective manufacturing methods [10].

Conclusion

Alkali-catalyzed trans esterification of fresh vegetable oils is the most popular and financially viable way of producing biodiesel at an industrial scale. However, using freshly produced edible oils as a feedstock accounts for more than 80% of the cost of producing biodiesel. Therefore, using other, less expensive sources of lipids such used cooking oil, non-edible Jatropha, algae, municipal sewage sludge, and recycled grease trap waste is the greatest approach to lower the cost of producing biodiesel. However, the high free fatty acid (FFA) content of these feedstocks causes saponification and emulsification when homogenous base catalysts are present, which lowers the yield of biodiesel and makes it more difficult to separate it from glycerol. The removal of these catalysts from the reaction mixture by water washing, which generates significant amounts of effluent, is also difficult since they are caustic, difficult to recover, and difficult to reuse.

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Conflict of Interest

No potential conflicts of interest relevant to this article were reported.

References

1. Ramos M, Dias APS, Puna JF, Gomes J, Bordado JC (2019) Biodiesel production processes and sustainable raw materials. Energies 12: 4408.
2. Gebremariam SN, Marchetti JM (2018) Economics of biodiesel production. Energy Convers Manag 168: 74-84.
3. Aghbashlo M, Peng W, Tabatabaei M, Kalogirou SA, Soltanian S, et al. (2021) Machine learning technology in biodiesel research: A review. Prog Energy Combust Sci 85: 100904.
4. Singh D, Sharma D, Soni SL, Sharma S, Sharma PK, et al. (2020) A review on feedstocks, production processes, and yield for different generations of biodiesel. Fuel 262: 116553.
5. Rizwanul FIM, Ong HC, Mahlia TMI, Mofijur M, Silitonga AS, et al. (2020) State of the art of catalysts for biodiesel production. Front. Energy Res 8: 101.
6. Tabatabaei M, Aghbashlo M, Dehhaghi M, Panahi HKS, Mollahosseini A, et

al. (2019) Reactor technologies for biodiesel production and processing: A review. Prog Energy Combust Sci 74: 239-303.

7. Mahlia TMI, Syazmi ZAHS, Mofijur M, Abas AP, Bilad MR, et al. (2020) Patent landscape review on biodiesel production: Technology updates. Renew Sustain Energy Rev 118: 109526.
8. Panwar NL, Kaushik SC, Kothari S (2011) Role of renewable energy sources in environmental protection: a review. Renew Sustain Energy Rev 15: 1513-1524.
9. Mekhilef S, Siga S, Saidur R (2011) A review on palm oil biodiesel as a source of renewable fuels. Renew Sustain Energy Rev 15: 1937-1949.
10. Sirisomboonchai S, Abuduwayiti M, Guan G, Samart C, Abliz S, et al. (2015) Biodiesel production from waste cooking oil using calcined scallop shell as catalyst. Energy Convers Manage 95: 242-247.