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Editorial

Special Issue on "Biodiesel Production Processes and Technology"

Juan Francisco García Martín [1,*], Miguel Torres García [2] and Paloma Álvarez Mateos [1]

[1] Departamento de Ingeniería Química, Facultad de Química, Universidad de Sevilla, 41012 Sevilla, Spain
[2] Escuela Técnica Superior de Ingenieros Industriales, University of Seville-Thermal Power Group, Camino de los Descubrimientos s/n, 41092 Sevilla, Spain
* Correspondence: jfgarmar@us.es; Tel.: +34-954557180

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Raw oils and fats cannot be directly used in modern diesel engines, as their viscosity is too high. Therefore, they must be transformed into biofuels. Biofuels are sustainable and renewable energy sources derived from biological waste materials. The biochemical composition of the harvested biomass is rich in energetic compounds, which allows high conversion yields to biofuels. The production and consumption of biofuels is continuing to increase for a number of reasons: (1) the growing attention paid to environment protection; (2) the rapid rate of growth of worldwide energy requirements, mainly in developing countries; and (3) the depletion of conventional fossil fuel sources. Thus, the utilization of biofuels in combustion processes has the great advantage of not depleting these limited fossil fuel resources while leading to emissions of greenhouse gases and smoke particles similar to the combustion of fossil fuels.

Biodiesel is a fuel produced from edible and non-edible vegetable oils (for example, jojoba oil, palm oil, soybean oil, canola oil, rice bran, sunflower oil, coconut oil, rapeseed oil, and *Jatropha curcas* oil), including waste cooking oils or animal fats such as tallow and fish oil. The resulting biodiesel products obtained from these raw materials are regarded as first- and second-generation biodiesel, respectively. So-called third-generation biodiesel is a term that is mostly used to refer to biodiesel obtained from algae, bacteria, filamentous fungi, and oil yeasts. This Special Issue entitled "Biodiesel Production Processes and Technology" contains seven high-quality studies (five research papers and two review papers) regarding new technologies for biodiesel production, purification, and combustion in engines.

There are numerous processes that have been studied for the production of biodiesel, both for first-, second-, and third-generation biodiesel. As stated by Sánchez-Borrego et al., the esterification/transesterification process using homogeneous and heterogeneous catalysis is the most commonly used method at the industrial scale due to its less expensive operation and high product yield [1]. Notwithstanding, most processes are not economically feasible. For that reason, the search for new alternative, profitable processes to produce biodiesel is mandatory. One of these alternatives could be the hydrocracking of bio-oils produced from the fast pyrolysis or catalytic fast pyrolysis of lignocellulose residues, as pointed out in the available literature [1].

With regard to the production of first-generation biodiesel, Zabaruddin et al. studied the continuous transesterification of refined palm oil by using radiation-induced kenaf, denoted as an anion exchange kenaf catalyst in a packed-bed reactor [2]. The study was carried out using a full factorial design and response surface methodology based on the central composite design. The optimum conditions determined by the factorial design were a 9.81 cm packed bed height, a 1:50 oil to ethanol molar ratio, and a volumetric flow rate of 0.38 cm^3/min. Under these conditions, the predicted and actual values of the molar conversion of refined palm oil into fatty acid ethyl esters were 97.29% and 96.87%, respectively.

Subsequently, Silva et al. analysed the technical feasibility of applying biodiesel/diesel blends with high concentrations of biodiesel from soybean oil in diesel cycle engines with a focus on the thermal and oxidative properties of the blends [3]. The oxidation stability of pure biodiesel is low, and it decomposes over time into undesired compounds, thus decreasing the fuel quality and forming deposits in various components of the engine. However, biodiesel stability improves by adding diesel. As a result of their research, Silva et al. found that the thermal and oxidative stability of diesel/biodiesel blends decreased with the addition of biodiesel from 5 to 50% v/v.

Waste cooking oils (WCOs) are one of the most studied raw materials for second-generation biodiesel production. Barrios et al. assessed the effect of the addition of an oxygenated fuel additive to diesel/biodiesel blends on the specific fuel consumption and exhaust emissions of a bus equipped with a EURO 3 diesel engine during its daily route through Seville city (Spain) [4]. The oxygenated additive used was a mixture of mono-, di-, and triacetylglycerol manufactured from the glycerine obtained as a by-product in the production of the biodiesel used in this research via the transesterification of WCO. The addition of the oxygenated additive decreased the exhaust emission levels and the specific fuel consumption. Notwithstanding, it must be taken into account that these authors had to add heptanol as a co-surfactant to the diesel/biodiesel blend because of the low miscibility of the oxygenated additive in diesel.

Within the field of the production of third-generation biodiesel, Belaiba et al. studied the feasibility of using cultures of the green microalga *Chlorella vulgaris* (concentrations up to 3.5 g/dm^3) as a secondary treatment instead of, or in parallel with, the traditional aerobic biological reactor currently used in wastewater treatment plants [5]. At the end of the process, these authors obtained a biomass composed mainly of carbohydrates (63.3–82.8%) and proteins (8.1%–21.9%), which could be transformed into biofuels, including biodiesel.

Finally, it is very important to purify the produced biodiesel before using it in diesel engines, as impurities can corrode fuel tubes and damage the injectors. Hence, Jariah et al. compared and discussed the advantages and disadvantages and the technological advancements in efficient biodiesel purification and glycerol refinement among the different available technologies: wet washing, dry washing (activated compounds, biomass-based adsorbents, and silica-based adsorbents), membrane separation, and ion exchange [6]. In this context, Arenas et al. assayed organic residues, such as nutshells, sawdust, rice husks, coconut fibres, and water hyacinth fibres, as bioadsorbents [7]. Specifically, these authors used these bioadsorbents for the dry washing purification of the biodiesel obtained from WCO. Among these organic residues, sawdust led to the highest adsorption of impurities from WCO biodiesel. What is more, the performance of sawdust in removing impurities, such as free fatty acids, glycerine, and water, was similar to and, in some cases, better than conventional purification methods, including the use of Amberlite BD10DRY. Therefore, Arenas et al. concluded that sawdust can be used as a bioadsorbent in the dry purification of biodiesel, with the advantage of generating less environmental impact.

These various enhancements in the raw material selection, production processes, purification, and storage stability of biodiesel, along with the successful tests (in terms of the reductions in exhaust gases and fossil fuel consumption) of diesel/biodiesel blends in vehicles equipped with diesel engines under real driving conditions, will elucidate the actual potential of biorefineries. In the current economic scenario of the severe ongoing energy crisis, these advanced biofuels that comply with the latest policies and regulations will have a high impact on the European and worldwide biofuel markets and will increase the useful life of diesel engines, which are still the most common engines installed in most private cars, public and school buses, and agricultural and construction machinery.

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