CIEEMAT`22

CIEEMAT 2022
VII Ibero-American Congress on Entrepreneurship, Energy, Environment and Technology

Book of Abstracts

6-8 July 2022
Bragança, Portugal

ipb INSTITUTO POLITÉCNICO DE BRAGANÇA

CEFET/RJ

CeDRI

CIMO Centro de Investigação de Montanha

SUSTEC Associate Laboratory for Sustainability and Technology in Inland Regions

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Instituto Politécnico de Bragança – 2022
Campus de Santa Apolónia
5300-253 Bragança, Portugal

ISBN: 978-972-745-305-4

Book Cover: Soraia Maduro, Instituto Politécnico de Bragança

ABOUT THE EVENT

The VII Ibero-American Congress on Entrepreneurship, Energy, Environment and Technology (CIEEMAT 2022), coordinated by the Federal Centre of Technological Education from Rio de Janeiro (CEFET/RJ), was held for the third time in Portugal, and for the second time in the city of Bragança, under the organization of the Polytechnic Institute of Bragança (IPB), the Research Centre in Digitalization and Intelligent Robotics (CeDRI), the Mountain Research Centre (CIMO) and the Associated Laboratory for Sustainability and Technology in Inland Regions (SusTEC). The event aims to consolidate the Luso-Brazilian and Ibero-American cooperation in those areas, gathering the multinational contribution and enhancing collaboration in academic and scientific fields.

The CIEEMAT 2022 took place on July 6-8 2022 and had the Energy Transition as its specific theme.
The current energy context and the transition of energy generation and consumption typologies are unavoidable in defining the profiles of national and international societies and energy policies. The dynamism to which the energy sector is currently subjected is imposed by environmental and safety concerns, the fluctuation of the fossil fuels price and shifting technologies, which translates into challenges and opportunities across various sectors as research and innovation, education, policy and environmental governance. The opportunities and challenges of the energy transition are outlined, for instance, in the exploitation of natural assets, the decarbonisation of the economy and the transport sector and the flexibility of energy infrastructure through smart grids.

The CIEEMAT 2022 followed a program addressing various perspectives of action of higher education institutions and R&D units and their cooperation with society: i) the academic perspective (why, what and how to teach the challenges of energy transition); ii) the perspective of international cooperation, defining new cooperation programs between Portugal and Brazil in the energy field, with emphasis on the Brazilian EnergIF program and its potential for international cooperation with Portugal; iii) and the research and innovation perspective, with the contribution of academic experts and the business sector regarding the challenges that the necessary and emerging energy transition poses.

At the same time, the CIEEMAT 2022 provided also a forum to disseminate and share ongoing research in various academic and scientific institutions, through oral communications in the areas of sustainable urban mobility, energy generation and self-consumption, environmental challenges, decarbonisation and climate change.

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CONTENTS

Biodiesel Production from Residual Cooking Oils and Purification by Adsorption Processes Based on Adsorbents of Natural Origin

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Abstract

Total global energy consumption has increased significantly in recent decades. International Energy Agency predicts that from 2012 to 2040, and also the International Energy Agency (IEA), by 2030, the world's demand for energy will increase by 50%. Nowadays, the main sources of energy supply in the world are oil, coal and natural gas. In addition to the environmental problems, the supply of fossil fuels is limited, which makes many researchers increasingly interested in exploring alternative energy sources [1].

In this pursuit, biofuels are promising renewable energy sources with lower carbon emissions, besides the possibility of being made from a variety of resources, including residues such as waste cooking oil (WCO), oily sludge from factories, and discarded animal fats [2]. In contrast to petroleum-derived diesel, biodiesel is renewable, biodegradable, non-toxic, sulphur-free and aromatic carcinogen-free [3].

The cost of biodiesel is now 10% to 50% higher than petroleum diesel. A more possible way to increase biodiesel production is to use WCO as a feedstock, which is 25% to 40% of the price of edible oil. This way, WCO gets a better destination than its discard [3].

Biodiesel is produced through transesterification/esterification which are reactions that convert oils or free fatty acids into alkyl esters. Through transesterification, the triglycerides react with small chain alcohol in order to obtain methyl or ethyl esters of fatty acids and glycerol. The process occurs in three reversible and consecutive reactions, which produce molecules of diglycerides and monoglycerides as intermediates [4].

The properties of biodiesel will depend on the feedstock used in its production, and it should be similar to petroleum diesel in order to be functional in motors without any changes. All parameters, such as cetane number, fatty acid methyl esters content, density, and acid value, are defined by standards and vary depending on the location. For example, in Europe, they are defined by the European Biodiesel Standard EN 14214, whose last version was published in 2008. It is set to specify characteristics that define the behaviour of biodiesel combustion in an engine and also the methods that have to be used to determine those parameters [5].

In order to attend to all the specifications presented at EN 14214, the produced biodiesel has to pass through a purification process. The purification process is important to remove the impurities present in the final product, such as the alcohol excess, glycerol, among others.

In this work, the chosen process to purify the produced biodiesel is adsorption, the phenomenon in which a solute is attached to a solid surface. It is widely used in chemical and biochemical processes to recovery or removal of certain substances. The solid surface where the adsorption takes place, the adsorbent, is usually a porous material with high surface area, and the substance that is been recovered is called adsorbate [6].

Several studies have been made related to biodiesel purification by adsorption. Materials like silicates,

clays, polymers among others are widely used as adsorbents. They have acid or basic adsorption sites that have a strong affinity with polar compounds such as ethanol, glycerol, metals and soap [7].

Combining the need for purification of biodiesel and the proposal of reuse of waste oils, cork residues will be studied as a potential adsorbent, as it is a porous material with a large surface area. For the purpose of comparing efficiency, a commercial adsorbent will also be tested, since previous studies proved its high efficiency in the purification of liquid effluents.

The first stage of the research is the optimization of biodiesel production. The influence of factors like oil:alcohol proportion, catalyst load and reaction temperature, in the transesterification of a WCO sample with ethanol have been studied.

The first parameter, oil:alcohol proportion, was studied at the values of 1:6 and 1:9. The results obtained show that 1:6 is favoured at lower temperatures, in a range of 30-35°C. When the temperature is higher, above 45°C, the process needs a higher proportion of oil:alcohol in order to allow the separation of the two phases, otherwise, it will form only one phase since the biodiesel does not separate from glycerol.

For the catalyst load, it was studied at 0,5% and 1% (wt/wt) in relation to the oil mass. At lower temperatures, both tests provide satisfactory results, but at higher temperatures, the best result was obtained at the higher catalyst load.

Hereafter, it is intended to produce activated carbons from cork residues samples in order to study the efficiency of glycerol removal non-activated from different samples of crude ethylic biodiesel, synthesized with the optimal conditions of oil:alcohol proportion, catalyst load and reaction temperature. A commercial adsorbent and granulated cork will also be studied, for the comparison of the adsorption performance with the previous materials and literature data.

Keywords: Biodiesel, Biodiesel purification, Adsorption.

Acknowledgments: The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) and FEDER under Programme PT2020 for financial support to CIMO (UIDB/0690/2020).

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