



CIEEMAT` 22

CIEEMAT 2022

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

Book of Abstracts

6-8 July 2022

Bragança, Portugal



**CIEEMAT 2022 - VII Ibero-American Congress on  
Entrepreneurship, Energy, Environment and Technology  
Book of Abstracts**

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**Editors**

Ângela Ferreira, Instituto Politécnico de Bragança  
Carla Sofia Fernandes, Instituto Politécnico de Bragança  
Florbela Fernandes, Instituto Politécnico de Bragança  
Luís Pais, Instituto Politécnico de Bragança

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## **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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# Study of Biodiesel Production from Waste Cooking Oil by Ethyl Transesterification and its Purification Using Adsorption Processes

Gabriel Lamino Camilo<sup>1</sup> [0000-0002-3797-0356], Maria Carolina Sérgio Gomes<sup>2</sup> [0000-0003-2210-0275], Ana Queiroz<sup>1</sup> [0000-0003-4761-0618], António Ribeiro<sup>1</sup> [0000-0003-4569-7887], Paulo Brito<sup>1</sup> [0000-0003-1805-0252]

<sup>1</sup> CIMO, Instituto Politécnico de Bragança, Portugal

<sup>2</sup> Universidade Tecnológica Federal do Paraná, Brasil

glaminocamilo@gmail.com; {amqueiroz, aribeiro, paulo}@ipb.pt; mcarolinaserpigomes@gmail.com

## Abstract

In recent years, a collective effort is made in search of alternative forms of energy through renewable and more friendly to the environment sources, currently, about 80% of the world consumption of energy comes from fossil fuels. The environmental problems associated with the use of these non-renewable fuels include air pollution and global warming, moreover, the uncertain price of a barrel of oil in the current economy also causes economic problems in its dependence. Thus, due to these problems in the dependence on fossil fuels for industry, transport and domestic purposes, research on alternative energy sources has become ever more common [1]. In this scenario, biodiesel presents itself as a renewable fuel, environmentally friendly and with similar characteristics to common diesel.

According to [2] in 2020, global biodiesel production reached 46.45 million tons, with biodiesel from waste cooking oils (WCO) constituting approximately 10% of this total, with Europe accounting for approximately 33% and Brazil 12% of global production. The cost of conventional biodiesel production is higher than the production of diesel from petroleum, since it is produced mainly from high quality virgin oils, it is estimated that 70 to 80% of the total cost of biodiesel production is associated with the cost of their raw materials [3]. With this perspective, biodiesel production from WCO has become an economic opportunity and an environmental strategy to help address global renewable energy challenges and contribute to a sustainable society [4]. Oil with hours of frying at high temperatures results in the loss of its edible properties and nutritional value, the disposal of used cooking oil remains an issue due to its environmental and human health threats, countries are now imposing penalties and restrictions on the disposal of this cooking waste in drainage systems and/or natural water bodies [5]. In this scenario, the collection and destination of these oils for the production of a value-added and environmentally friendly biofuel presents itself as an opportunity to be investigated.

Transesterification is the most used method to reduce the viscosity of vegetable oils through their conversion into biodiesel. It is a process by which alkyl esters are produced from chemical reactions between an alcohol and vegetable oils in the presence of a catalyst. The most accessible and available alcohols for this reaction include methanol and ethanol [6]. Among the purification processes, the wet wash method, which uses water or acidified water to purify the esters, is the most commonly used [7]. Despite being an efficient method, wet washing generates huge amounts of wastewater that need to be treated to be discharged into sewer systems. On average, for each litre of purified biodiesel, the amount of water needed for purification varies from 0.2 to 10 litres [7]. In addition to the environmental inconvenience, wet washing is also energy and time consuming and economically inefficient. The literature indicates that effluent treatment costs between 0.09 and 3.8% of the total cost of production [7]. Adsorption and ion exchange are the most commonly used affinity separation processes worldwide, these methods are also known as dry washing methods. In these processes, an appropriate adsorbent is used to selectively adsorb certain impurities from the liquid phase onto its surface. Dry cleaning offers several advantages over wet cleaning, including ease of integration into an existing plant, shorter purification time, lower water consumption and lower effluent generation [8]. Some cellulosic and

lignocellulosic materials present characteristics of adsorbents for the purification of biodiesel [9]. These materials are abundant in nature, easy to acquire and of low value, in addition to their advantages as renewable and non-toxic materials [10]. Activated Carbon (AC), activated fibre (carbon fibre) and activated alumina are among the most common adsorbents in industrial applications. AC, which has a large porous volume and high surface area, can be manufactured from any organic material rich in carbon, such as: sawdust, petroleum coke, wood, coal, peat, fruit nuts, bituminous coal, lignite, coconut husks and olive stones [8].

In this work, an optimization of the production of biodiesel from a WCO by the ethylic route is sought, through its characterization and purification by adsorption using natural adsorbents, focusing on the removal of glycerine. In the preliminary results, some required conditions for the production were found, such as the minimum concentration of catalyst which was established at 1% (wt/wt) and better yields at lower temperatures. Next step will be the construction of a response surface methodology for the test of 3 parameters: alcohol:oil molar ratio, reaction temperature and catalyst concentration. Subsequently the synthesis of adsorbent materials based on natural sources, such as olive stones, will be carried out for application in the adsorption tests for biodiesel purification.

**Keywords:** Biofuel, Biodiesel, Purification, Adsorbents.

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