

Spent Coffee Ground as an Alternative Energy Feedstock for Biodiesel Production

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Introduction

Spent coffee grounds contain approximately 15% oil that can be converted into similar amounts of biodiesel. The purpose of this Masters project is twofold: first, to develop the process for the extraction of oils from spent coffee grounds, and, second, to convert extracted oils to biodiesel.

Europe produces large amounts of spent coffee grounds (SCGs) which is a vast resource of oils (approximately 15%) and lignocellulosic material (approximately 80%). SCGs oils can be converted to biodiesel while lignocellulosic part can be used as energy source in the form of fuel pellets. At present, SCGs is discarded directly to the landfill as solid waste, without commercial value. Consequently, the use of these low-cost residues can have a significant effect on the economy and the environmental impact of biodiesel production.

Objectives of this project are: i) to develop the extraction of oils from SCGs; ii) to develop the conversion of triglycerides to biodiesel; and, iii) to characterize the produced biodiesel.

To achieve the objectives of the project, the work will be divided into three Tasks:

Task 1: Extraction of oils (triglycerides) from spent coffee grounds

Kinetics of extraction of oils from solid matrix (SCGs) have been studied as function of water content, temperature, particle size, the nature of solvent and its recovery rate.

Task 2: Conversion of triglycerides to biodiesel

The biodiesel production from the oils extracted in Task 1 will be performed in the presence of potassium hydroxide as catalysts. Influence of the following parameters on the reaction conversion and yield will be studied: reaction temperature, catalyst concentration, and methanol/oil molar ratio. Also, possibility to couple extraction and transesterification in one-pot process will be assessed.

Task 3: Characterization of the produced biodiesel

The produced biodiesel will be characterized in accordance with the ASTM standards: viscosity, density, thermal and oxidation stabilities of the produced biodiesel, free fatty acid content and unsaturation.

This Master project aims to promote and increase focus on the topic of sustainability by generating energy from non-recyclable residues into useable fuel source, avoiding environmental concerns associated with disposal of by-products. Therefore, the project truly integrates sustainability and environment, themes relevant to the DTU Green Challenge. The direct beneficiary of this research is an industrial partner associated with this project – Biosel, biodiesel producer using waste vegetable oils with interest to expend feedstock.

This work will pave the way for developing methods for new ways of processing waste food rather than composting and anaerobic digestion. As such, the work will contribute to change the perception of waste as a problem. It should be perceived as a resource to produce valuable chemicals and biofuels.