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Evaluation of municipal sewage sludge as an alternative feedstock for biodiesel production

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ABSTRACT

Urbanization and industrialization have resulted in an increase in the world's primary energy consumption over the previous 40 years. Transportation and oil are the primary contributors, with non-renewable resources such as coal and petroleum providing the majority of the energy required to meet the world's population's energy needs. Combustion of these materials increases greenhouse gas emissions, which are pollutants that have a negative impact on the environment and human health. Biodiesel has received the most attention in the last two decades as a source of alternative energy. Biodiesel is a viable alternative to petroleum-based diesel fuels since it emits less pollutants into the atmosphere and hence has a lower environmental impact when utilized. The high cost of raw materials, on the other hand, is a key disadvantage to biodiesel production. Frequently, feedstock accounts for between 70% and 85% of the cost of producing biodiesel. Numerous different feedstocks have been investigated in order to reduce the unit cost of biodiesel, increase its energy efficiency, and secure its long-term production.

Non-edible oils, edible oils (soybeans, sunflower, etc.), algae, and waste material are all examples. Sewage sludge has been reported as a suitable feedstock for biodiesel production, containing at least 7% lipids in the dry sludge. One notable advantage is that sewage sludge is readily available in wastewater treatment plants, and a steady supply is provided by urbanization and industrialization. On the other hand, sewage sludge continues to be a financial strain for many South African local municipalities due to the high cost of disposal. In this project, biodiesel was produced from sewage sludge from Johannesburg's municipal wastewater treatment plant (WWTP). Primary sludge produced the most lipids and biodiesel, followed by blended sludge and finally secondary sludge, according to the findings of this study. Pretreatment of sludge samples with hydrochloric acid improved lipid extraction from all types of sludge investigated. Although ionic liquids were shown to be capable of extracting lipids from a variety of sludge samples, the Bligh and Dyer process extracted substantially more lipids. Additionally, the gas chromatography analysis of the various sewage sludge FAMEs indicates that the fatty acid content of all analyzed sludge samples is comparable. The fatty acid content of sludge samples was unaffected by various extraction procedures or acidification. All sludge samples contained myristic (C14:0), pentadecyclic (C15:0), palmitic (C16:0), stearic (C18:0), oleic (C18:1), and linoleic (C18:2) acids, which are typical fatty acids for biodiesel production. The fatty acid composition of primary sludge FAMEs was compared to that of typical biodiesel feedstocks to assess whether primary sludge can be used to produce biodiesel.

Keywords: Sewage sludge, Biodiesel Synthesis and Characterization, lipids, ionic liquid, lipid extraction, pre-treatment