Journal of Environmental Health and Sustainable Development

Municipal Sewage Sludge to Biodiesel as a Promising Renewable Fuel for the Future of Energy

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ARTICLE INFO

LETTER TO EDITOR

Article History:
Received: 10 August 2018
Accepted: 20 November 2018

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Citation: Hatami B, Sedighi Khavidak S. **Municipal Sewage Sludge to Biodiesel as a Promising Renewable Fuel for the Future of Energy**. J Environ Health Sustain Dev. 2018; 3(4): 616-7.

[Downloaded from jehsd.ssu.ac.ir on 2026-11-20]

[DOR: 20.1001.1.24766267.2018.3.4.1.8]
[DOI: 10.18502/jehsd.v3i4.221]

Due to the global energy crisis caused by the rapid urbanization and industrialization along with a steady increase in energy demand, non-renewable energy sources are becoming increasingly scarce, and petroleum prices are rising. It is expected that the consumption of liquid fuels in the world increases from 87 million barrels per day in 2010 to 122 million barrels per day in 2040 [1]. On the other hand, the environmental considerations of fossil fuels such as air pollutants and excessive emission of greenhouse gases has increased concerns on environmental pollution. Utilizing clean renewable fuel is one convenient way to overcome both problems simultaneously.

In recent years, biodiesel as a renewable and environmentally friendly energy has been introduced to replace conventional fossil fuels. Biodiesel is biodegradable and non-toxic which compared to diesel has three technical (more fluidity, decrease the sediment in the fuel tank), environmental (absence of sulfur and aromatic compounds, fewer emissions of hydrocarbons, CO, particulate matter) and economical (more energy intensity, fuel import costs) advantages. Over the past decade, biodiesel production in the United States increased from 700 to 2,890 million gallons per year.

Chemically, biodiesel is the result of a transesterification reaction of vegetable oils or animal fats with alcohol in the presence of a catalyst. The final product is a mixture of methyl esters of fatty acids (FAME). A variety of base, acid, enzyme and solid catalysts are used for this purpose. More than 80% of biodiesel production costs are related to the feedstock or raw material. Therefore, technical and economical selection of catalyst and feedstock can lead to cost-effective biodiesel production. So far, many studies have been conducted on biodiesel production from wide ranges of edible and non-edible oils such as sunflower oil [2], sesame oil [3], rice bran oil [4], Palm oil [5], soybean oil [6], rapeseed oil [7] etc., animal fats

such as poultry fat [8], pork lard [9] etc. and microalgae [10] . These resources are more valuable than being used to generate energy.

Municipal sewage sludge rich in lipids appears recently as an attractive non-food feedstock for biodiesel production in the future. The lipid of sludge contains specific amounts of triglycerides, phospholipids and fatty acids in the range of C10 to C18 Along with microorganisms are excellent resources. Microorganisms use the organic compounds of sewage to grow and store it as a lipid in their cellular bodies. Therefore, different conditions of microbial growth in a wastewater treatment system can lead to the production of different lipid contents. The amount of lipid in the primary sludge is about 7-35% (base on the dry weight), while this value is about 5-8% (base on the dry weight) for secondary sludge [11].

In Iran, approximately 2.8 million tons of sewage sludge (base on the dry weight) is produced annually by wastewater treatment facilities. This amount is expected to increase as a result of urbanization and economic development. Incorrect management of this waste and incineration or disposal in land led to severe environmental challenges.

Therefore, considering that Iran is among the ten most energy-consuming countries, researches into biodiesel production from sewage sludge should be intensified.

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[DOR: 20.1001.1.24766267.2018.3.4.1.8]

[DOI: 10.18502/jehsd.v3i4.221]