Eco-friendly biodiesel production from olive oil waste using solar energy

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ABSTRACT
This study was carried out to produce biodiesel from olive oil waste by transesterification reaction. Several important reaction variables (the weight ratio of oil to methanol, the temperature, and reaction time) were evaluated to obtain a high quality of biodiesel fuel that meets authentic standards. Solar energy was applied for the transesterification reaction and electricity generated by photovoltaic panels was used to power a motor for mixing the reaction solution.

KEYWORDS
Biodiesel; photovoltaic's method; solar energy; waste management

1. Introduction
In recent years, the use of biofuels has become the best alternative of fossil fuels. Storage, transportation, and handling of these fuels are simpler than petroleum-derived diesel fuel due to a higher flashpoint (Ramachandran et al., 2013). Biodiesel is normally produced as fatty acid methyl esters (FAMEs) or fatty acid ethyl esters (FAEEs) by the transesterification of triglycerides and methanol or ethanol (Chopade et al., 2012). Blending of vegetable oils with petroleum diesel, pyrolysis (thermal cracking), emulsification, and transesterification have been evaluated to reduce the viscosity of triglycerides (Strayer et al., 1983).

One of the goals of this study was to develop an eco-efficient method of biodiesel production from olive oil waste/recycling to reduce the cost of biodiesel. A traditional electric heater was not used in the present method. Instead, parabolic trough reflectors were used to concentrate solar energy onto a receiver to generate steam and the captured solar heat was used to heat the transesterification reaction medium. Also, electricity used to power the motor that stirred the reaction was generated by photovoltaic panels. Several important reaction variables such as the weight ratio of oil to methanol, temperature, and reaction time were investigated to obtain a high quality of biodiesel fuel using solar energy.

2. Materials and methods
An amount of 100 g of olive cooking oil was obtained from Roodbar market of Guilan province in Iran and heated at 60°C for 2 h. The anhydrous methanol (99.8% purity), sodium hydroxide in pellet form (≥99% purity), and sodium sulfate in powder form (≥97% purity) were purchased from Sigma-Aldrich and were used without further processing. Photovoltaic panels from Sanyo-HIP-200BA19 model are installed. Electrical specifications of Sanyo model are as rate power 200 W, maximum power voltage 55.8 V, and maximum power current 3.59 A. After heating, the cooking oil waste was collected and filtered by filter paper to remove bits of food residues. The filtered cooking oil was then collected in a clean conical flask and used for the experiment. An appropriate volume of methanol