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Research Article

An Experimental Investigation of Karanja Biodiesel Production in Sarawak, Malaysia

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The application of nonedible feedstock for the production of biodiesel has become an area of research interest among clean energy experts in the past few years. This research is aimed at the utilization of *Pongamia pinnata* (karanja), a nonedible feedstock from the state of Sarawak, Malaysia, to produce biodiesel to be known as crude karanja oil (CKO). A one-step transesterification process utilizing 7 : 1–10 : 1 wt% methanol (CH_3OH) and 0.5–1.2 wt% sodium hydroxide (NaOH) at 65°C for 1.5 hrs has been used for the biodiesel production yielding 84% conversion. The physiochemical properties of the CKO produced revealed that it conforms with EN14214 standards for brake power (BP), brake specific fuel consumption (BSFC), and brake thermal efficiency (BTE) as they are all noted be optimal at B40.

1. Introduction

The diesel engine vehicles are well known as one of the largest contributors to air pollution that produce routine hazardous emissions within cities and along urban traffic routes caused by exhaust emissions [1, 2]. With rapid industrialization and exponential growth of the transport sector, environmental pollution along with global warming that arise in the developing countries faces major challenges of the energy demand as well as increased environmental concerns. Impact of health problems caused by emitted of toxic air and how it is distributed within a city is crucial for sustainable development. Therefore, it has become very essential to explore a renewable energy source that will serve as an alternative fuel that will replace the consumption of petroleum fuels and reduce toxic emissions. Due to the increase in human population and awareness about climate change, attempts have been made to utilize crude karanja oil (CKO) as a feedstock for biodiesel production so as to replace costly and scarce petroleum fuels [3].

Biodiesel has been identified as a cost-effective energy source with less harmful emission and readily availability to be use as substitute fuel in the internal combustion (CI) engines. The chemical name for biodiesel is fatty acid methyl ester (FAME). It has been recognized globally around the world and is continuously been identified for its environmental friendliness and an alternative renewable energy source [4, 5]. Recently, serious efforts are in progress by several researchers to operate CI engines using oil that is made from plant oil and its esters (biodiesel).

The theory of using vegetable oils as substitute for diesel engine is over a past decade. In 1910, Dr. Rudolf Diesel was the first researcher to invent a compression ignition (CI) engine using peanut oil [5]. He observed that vegetable oils are not suitable for use directly as diesel engine oil due to their high viscosity and incomplete combustion that triggers higher smoke density when compared to fossil fuel which leads to poor fuel atomization [6]. This phenomenon has been identified as potential cause of engine failure such as sticking in ring piston, choking of injectors, and formation of carbon deposits [7]. In order to minimize these problems, techniques such as oxidation process, pyrolysis, dilution, microemulsion, and transesterification have been used for production of biodiesel [5, 8]. Among all these techniques, transesterification is the most viable and effective [9]. Biodiesel production from vegetable oils has given rise to debate of “food” versus “fuel” demand. Consequently, the demand for vegetable oil for biodiesel production has led to increase in price of the