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MATERIALS AND METHODS: PREPARATION OF METHYL ESTERS OF KARANJ OIL

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ABSTRACT

Dual fuel operation normally poses problems of low efficiency when the concentration of the inducted pilot fuel is low. This is because the lean mixture of the inducted fuel with the air does not burn well. Use of gaseous fuels with wide flammability limits and high flame velocity can overcome such problems in the dual fuel engine. Since the vegetable oils produce high smoke emissions, dual fuel approach can be a viable option for improving their performance. Transesterification is a chemical process by which the viscosity of vegetable oils and other fats is reduced to make them compatible as fuels in CI engine.

Keywords: *Dual Fuel, Pilot Fuel, Lean Mixture, Gaseous Fuels, Flammability Limits, Smoke Emissions.*

Introduction

Methyl esters of karanj oil were prepared in batches with the help of transesterification process. The following materials and equipment were used during the course of transesterification.

Reactants: Karanj oil and Methanol

Catalyst: Sodium Hydroxide (NaOH)

Equipment

Reactor: Glass jar (4 l), Plastic (HDPE) container (5 l)

Electric heater to heat the oil.

Stirrer: A desert cooler's pump motor was modified to act as an electric stirrer (Plate 1)

- Digital scale to accurately weigh the quantity of catalyst (Plate 2)
- Air tight glass flask to mix methanol and NaOH
- Separating funnel
- Stand with clamp to hold stirrer
- Utensil and stove to heat oil
- Thermometer
- Cloth for filtering oil
- pH Paper

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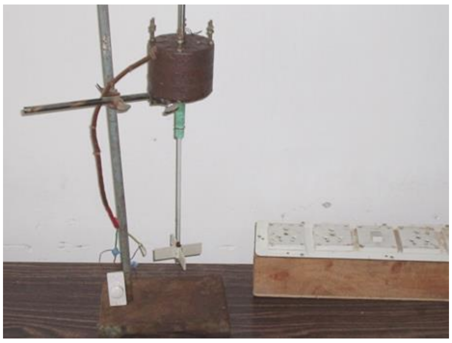

Plate 1 Electric Stirrer

Plate 2: Digital weighing scale

Procedure

The procedure for obtaining methyl esters from karanj oil involved the following steps:

- As per the capacity of the reactor, known quantity of karanj oil was filtered and heated to a temperature of 55º C to remove moisture and to reduce its viscosity so that it mixed better. Care was taken not to overheat the oil. The oil was then poured into the reactor.
- The quantity of methanol and NaOH (Plate 3) used was calculated from the amount of oil used. On trying out various combinations, 250 ml of methanol and 4 g of NaOH per liter of oil resulted in successful transesterification at all times.
- Derived quantities of methanol and NaOH were put in a glass flask. After putting on the cap the flask was vigorously shaken in circles manually until the NAOH granules had dissolved completely. The flask warmed slightly as the reaction was exothermic.
- The mixture now known as sodium methoxide was carefully poured in the reactor on top of the oil, with the help of a funnel. Care was taken to avoid body contact or sniffing the fumes from the mixture.
- The cap of the reactor was replaced and the resulting mixture was vigorously stirred with the help of electric stirrer for 4 to 6 hours continuously (Plate 4).
- The mixture was then transferred to a separating funnel and allowed to settle for at least eight hours.
- During settling, the free fatty acids (glycerin), sank to the bottom forming a dark cloudy layer, while golden brown colored biodiesel (methyl ester) remained at the top (Plate 5).
- Glycerin was drained out completely from the bottom leaving only methyl ester in the separating funnel.
- Water was then added to methyl ester in the separating funnel. After capping the funnel, it was gently shaken in circles and was inverted several times manually. The funnel is then left undisturbed, on which the water with other impurities settles down at the bottom. It is then drained out. This washing procedure was repeated until the pH of rinse water that was being drained out reached a level of 6 to 7 and contained no soap bubbles.

Plate 3: Sodium Hydroxide and Methanol Containers

Plate 4: Stirring of Karanj oil and Sodium Methoxide Mixture

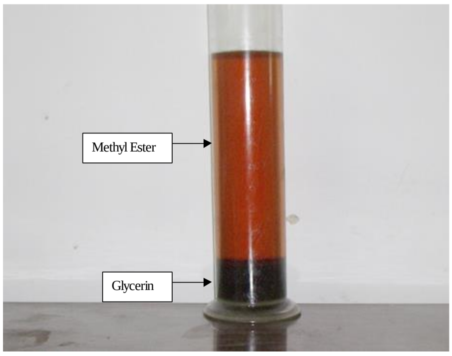

Plate 5: Separation of Karanj Methyl Ester and free Fatty Acids (Glycerin)

Plate 6: Visual Comparison of Diesel, Karanj Oil and Karanj Methyl Ester

Finally, the methyl ester (biodiesel) was heated to 70 ºC in an open container to remove excess moisture.

The biodiesel thus prepared, was then stored in HDPE containers after confirmation tests. Plate 6 depicts the visual comparison of high-speed diesel, karanj oil and karanj methyl ester (biodiesel).

Confirmation Tests

After transesterification and the washing process were complete, the methyl esters so prepared were qualitatively analyzed by the following confirmation tests;

- **Visual Confirmation**

The biodiesel was light golden in color when ready. The amount of methyl esters produced after transesterification was about 80 to 90% of the original oil.

- **Smell**

The karanj oil had raw and offensive smell while its methyl esters had sweet and pleasant smell.

- **Chemical Test**

Iodoform test was used to confirm the formation of methyl esters after transesterification. A solution was taken in a test tube to which small amount of methyl ester was added. On addition of a few drops of Iodoform (NaOI) a sweet fruity smell emerged confirming the presence of methyl ester.

Conclusion

On the basis of the experimental investigations carried out, following salient conclusions can be drawn;

It was found that while more or less all edible oils have been researched for their suitability to run in C.I. engines, there is very little data available on non-edible oils, which are more suitable for use in Indian conditions.

This justifies present investigations into the use of karanj oil (non edible) as fuel in C.I. engines. Also, the use of vegetable oils and their derivatives in dual fuel engines have not found much attention of the researchers and scientists.

Heating the karanj oil to about 55 °C improves the chances for its successful transesterification. But, if the oil is heated too much it will adversely affect the transesterification process.

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