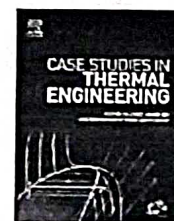




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# Case Studies in Thermal Engineering

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## A neem oil-based biodiesel with DEE enriched ethanol and $\text{Al}_2\text{O}_3$ nano additive: An experimental investigation on the diesel engine performance

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### ABSTRACT

In this paper, an effort has been made to produce biodiesel from Neem oil (*Azadirachta Indica*) and to perform a comparative analysis on various blends with diethyl ether (DEE) and alumina nanomaterials at different volume fractions. The fraction of alumina oxide ( $\text{Al}_2\text{O}_3$ ) nanomaterials with the blend (Pure Diesel 40% + Neem BD 40% + Ethanol) is varied in the range of 25, and 50 ppm. Experimental outcomes displayed that the physical and chemical properties of the biodiesel enhanced with the dispersion of alumina nanomaterials. The performance characteristics of the biodiesel blend such as brake thermal efficiency were increased up to 7.2% and brake specific fuel consumption was reduced up to 6.7% by adding the adding nanomaterial at 25 ppm of alumina nanomaterials compared with the pure diesel fuel. This is because of the higher surface area of the nanomaterial, which acts as the positive catalyst and increases the reaction rate. The  $\text{Al}_2\text{O}_3$  positively altered the critical parameters like the ignition temperature and the ignition delay of a DE. Moreover, the addition of alumina nanomaterials gave better emission characteristics on the account of reduction in the HC, CO, and smoke emissions at higher loads compared to NDB.  $\text{Al}_2\text{O}_3$  enhances the performance and the anti-knocking ability of the fuel. At 100% load conditions, the nitrogen oxide (NOx) emissions of NBD2 (Diesel 40% + Neem BD 40% + Ethanol 20% (90% volume + DEE 10%)) are lower than NBD by 17.5%.

### 1. Introduction

Fossil fuels are the primary sources of energy (~80%) that drive the modern industrial world [1]. Energy is also an important concern for the development of every part of the world. Due to the rise in crude oil price and its associated emissions in the world, the market makes an alert to move toward sustainable fuel for the future generation. The requirement for energy increases due to constant

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