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Emission study on the outcome of DMC on neem bio-diesel-ignited diesel engine

Mathalai Sundaram C[a], Balan K.N[b], Arunkumar T[c], Ganesan S[d], and Rameshbabu A[e]

[a]Department of Mechanical Engineering, Nadar Saraswathi College of Engineering and Technology, Vadapudhupatti, Theni, India; [b]Department of Automobile Engineering, Hindustan Institute of Technology and Science, Chennai, India; [c]Department of Mechanical Engineering, CMR Institute of Technology, Bengaluru, India; [d]Department of Mechanical Engineering, Sathyabama Institute of Science and Technology, Chennai, India; [e]Department of Mechanical Engineering, Jeppiaar Educational Trust, Chennai, India

ABSTRACT

This work aims to reduce the emissions of neem biodiesel in a single-cylinder CI engine. Ignition enhancement by blending di-methyl carbonate (DMC) at 5% to 10% (volumetric basis) with neem biodiesel is tested at different conditions at ambient conditions. DMC is blended at 5% and 10% on volume basis to neem biodiesel (BD100) and represented as DMC5BD95 and DMC10BD90. The complete emissions results were compared with diesel. Study revealed that the HC emissions from BD100, DMC5BD95, and DMC10BD90 are 7.3%, 8.1%, and 12.5% lower than diesel. Further, NO emissions from BD100, DMC5BD95, and DMC10BD90 are 9.81%, 8.43%, and 6.43% higher than diesel. However, upon adding DMC in DMC/BD blends result in better combustion and lower NO emission. Adding DMC (5-10%) to BD100 reduces the CO emissions by 4.1–12.7%. Additionally, the presence of DMC in DMC/BD blends produces an oxygen entertainment during combustion which lowers smoke opacity by 2.1–6.8%.

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KEYWORDS
Bio-diesel; DMC; smoke; CO; NO; HC

Introduction

Surplus usage of fossil fuel has resulted in global warming and reduction in air quality. The engine manufactures and researchers were forced to find an alternate due to the strict emissions norms. Biodiesel derived from agricultural waste, animal fats, and seeds are found to be the favorable substitute to diesel (Sitharthan et al. 2019a, 2019b). Many works were attempted with different source of bio-oil such as lemon peel oil (Yuvarajan, Venkata Ramanan, and Christopher Selvam 2016), pine oil (Sudalaimuthu et al. 2018), mustard oil (Siva, Munuswamy, and Devarajan 2018), palm oil (Rathinam, Justin Abraham Baby, and Devarajan 2018), orange peel oil (Ramakrishnan et al. 2019), rapeseed oil (Mahalingam et al. 2017), waste cooking oil (Justin Abraham Baby, Suresh Babu, and Devarajan 2018), almond seed oil (Devarajan 2019), cashew shell oil (Joy, Yuvarajan, and Beemkumar 2019). Devarajan et al. (2016) used transesterified mustard biodiesel as a complete replacement of diesel. He found 2.1%, 2.4%, and 3.6% reductions in smoke, HC and carbon monoxide (CO) emissions. However, 4.4% increase in NO emissions was observed. Appavu (2018) employed transesterified palm biodiesel as a whole surrogate of diesel. He found 4.7%, 6.1%, and 4.8% reductions in smoke, HC, and CO emissions with 5.7% increase in NO emissions. Yuvarajan et al. (2017) performed an investigation using transesterified mustard biodiesel as a complete replacement of diesel. He found 1.1%, 1.4%, and 3.7% reductions in smoke, HC, and CO emissions. However, 3.7% increase in NO emissions was observed. Radhakrishnan et al. (2018a) studied the usage of cashew oil and lower emissions than petro-diesel. But NO emissions

CONTACT Rameshbabu A raghugavaskarr@gmail.com Department of Mechanical Engineering, Jeppiaar Educational Trust, Chennai, India

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