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Effects of on MnO_2 nanoparticles behavior of a sardine oil methyl ester operated in thermal barrier coated engine

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Abstract

In the present study, an experimental investigation has been carried out with a single-cylinder four-stroke conventional engine using sardine oil methyl ester (SOME) and diesel with MnO_2 nanoparticle at different load conditions. MnO_2 nanoparticles of 25 ppm concentration were mixed with SOME and diesel with the aid of ultrasonication. Because of its long life and low heat conductivity, partly stabilized zirconium with a thickness of 0.5 mm is used as the coating material. Plasma spraying was used to coat the piston top face, as well as the inlet and outflow valves. MnO_2 has a lot of promise, as well as good physical and chemical qualities, and it reduces emissions in diesel engines. The outcome of results showed that the performance was improved while using nanoadditive along with SOME. Break Thermal Efficiency, rate of heat release, and in-cylinder pressure of SOME with 25 ppm of MnO_2 were increased by 7.5%, 9.2%, and 7.2%, respectively, as correlated with diesel, due to the oxygen particle available in the fuel and improved combustion process. The nitrogen oxides, hydrocarbon, and CO of SOME with 25 ppm of MnO_2 were decreased by 11.5%, 42.5%, and 7.4%, respectively, as compared to the baseline fuel, because of low ignition delay and proper atomization during combustion. Hence, it is concluded that 25 ppm of MnO_2 with SOME has improved the performance and significantly reduced the emission.

Keywords Performance · Biodiesel · Combustion · Nanoparticle · Emission · Sardine oil methyl ester (SOME)

Abbreviations

SOME	Sardine oil methyl ester
MnO_2	Manganese oxide
DF	Diesel fuel
DF + Mn	100% Diesel fuel + 25 ppm of manganese oxide
SOME + Mn	100% Sardine oil methyl ester + 25 ppm of manganese oxide
HC	Hydrocarbon
CO	Carbon monoxide
CO_2	Carbon dioxide
BTE	Brake thermal efficiency
BSFC	Brake-specific fuel consumption
NOx	Oxides of nitrogen

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Introduction

Due to their superior performance, greater pulling power, and low cost, diesel engines are extensively utilized in the transportation, industry, and agriculture sectors as prime movers [1]. This step led to an increase in the requirement for petrol-based energizes and natural issues. As a result, to resolve the current fuel issue, an alternate fuel must be sought. Nowadays, diesel engines have become a power source of air pollution like NOx, CO, HC, and noise pollution [2]. A diesel engine emits emissions such as NOx, CO, and HC that degrade the environment. Thus, alternative fuel such as raw oil is required for the engine, producing lower emissions and being renewable. Due to the higher viscosity and density, raw oil cannot be utilized directly in a base engine. It leads to many problems to the engine like knocking, piston damage, and higher emissions. The raw vegetable oil can be mixed with diesel, and the blend