AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

EXPERIMENTAL STUDY OF RECYCLING LUBRICATING OIL TO BE USED AS A DIESEL ENGINE FUEL

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A Thesis submitted in accordance with the Requirements for the Degree of Doctor of Philosophy

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STATEMENT

This dissertation is submitted to Ain Shams University in fulfilment of the requirements degree of Doctor of Philosophy.

The work included in this thesis was made by the author during the period from February 2015 to July 2018 at the Mechanical Power Engineering Department, Ain Shams University.

No part of this thesis has been submitted for degree or qualifications at any other university or institute.

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ABSTRACT

The comparative spray characteristics of petroleum diesel, RWLO (Recycled Waste Lubricating Oil)-diesel and RWLO-diesel-kerosene blends were reported by using diesel fuel injector and tested inside a pressurized injector chamber. Spray penetration increased by about 30 % and spray angle decreased by about 47 % when compared to W0 upon using 40 % by volume RWLO (W40). Using kerosene as an additive showed an opposite behaviour on the spray characteristics. The percentage by which kerosene was added as an additive was determined according to the spray behavior by adding kerosene gradually until reaching to the right mixture

Using RWLO as a fuel up to 40 % of the mixture reduced the brake thermal efficiency by about 12 % while the brake specific fuel consumption, unburned hydrocarbons emissions and carbon monoxide emissions increased by about 21, 52 and 22 % respectively when compared to pure diesel.

. Increasing the content of kerosene up to 30% in the mixture reduced the brake specific fuel consumption, unburned hydrocarbons and carbon monoxide emissions by about 12, 13 and 18% respectively while the brake thermal efficiency increased by about 12 % when compared to W40.

The injection pressure was raised from 165 bar to 193 bar in order to eliminate the undesirable effect of RWLO when used as a fuel and it was not possible to raise the injection pressure further more due to technical difficulties regarding the engine. Increasing the injection pressure to 193 bar enhanced the engine performance by increasing the BTE by about 10 % and reducing BSFC, CO and HC emissions by about 9, 15, 19 % respectively when compared to 165 bar injection pressure.

Cerium oxide nanoparticles were dispersed in a mixture of RWLO and diesel fuel. The BTE improved by about 5% with a reduction in BSFC, carbon monoxide emissions (CO) and unburned hydrocarbons emissions (HC) by about 5, 4, 5 % respectively while adding cerium oxide nanoparticles as an additive to when compared to W40.

Keywords: Recycled Waste Lubricating Oil – Kerosene - Cerium Oxide – Injection pressure

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