AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

USING A BIODIESEL AS ALTERNATIVE FUELS IN DIESEL ENGINES

By

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M.Sc. Mechanical Power Engineering Department, 1996

A Thesis Submitted in Accordance with the

Requirements for the Degree of Doctor of Philosophy

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Ph.D Thesis

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Thesis Title : USING A BIODIESEL AS ALTERNATIVE FUELS IN DIESEL ENGINES

Degree : Doctor of Philosophy

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Statement

This thesis is submitted as partial fulfillment of Requirements for the Degree of Doctor of Philosophy

Mechanical Power Engineering - Faculty of Engineering - Ain Shams University.

The author carried out the work included in the thesis, and no part of it has been submitted for a degree or qualification at any other scientific entity.

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ABSTRACT

USING A BIODIESEL AS ALTERNATIVE FUELS IN DIESEL ENGINES

The experiments on a direct injection diesel engine fuelled by a blend of the petroleum diesel and methyl ester biodiesel produced from waste cooking oils up to B100 indicated a reduction in the exhaust gas emissions rise at full load. The noise levels correspondingly showed biodiesel favorable effects by recording average reduction of 6.5%. There was a corresponding exhaust smoke reduction but was associated with increased NOx emissions at full load in conjunction with the increased in-cylinder gas temperatures. Increasing the engine speed reduced the biodiesel emission levels of CO and HC by respective values of 26 and 42% via the enhanced turbulence effects, while experimentally tuning the injection pressure and the exhaust gas recirculation reduced the NOx emissions. The computational results indicated that the soot peak volume fraction decreased by 15.2%, while the CO and HC average exhaust concentrations decreased by respective magnitudes of 20 and 28.5% upon replacing the petroleum diesel fuel with 100% biodiesel at 75% load and 1400 rpm. The computations also showed that increasing the engine load favorably reduced the ignition delay period where increasing the biodiesel content decreased the physical and chemical delay periods respectively by approximate values of 1.2% and 15.8%. While the peak cylinder pressure decreased with increasing the biodiesel content, the heat release rate was enhanced in the diffusion flame phase. Retarding the injection timing by 5^{o} showed counteracting NOx reduction to those original levels of pure diesel and simultaneously combined respective reduction magnitudes of 10 and 7% in CO and HC emissions at 75% load. In the light of coupling the k-ε model to the wave model, increasing the injection pressure further reduced the CO and HC emissions while the NOx emissions were reduced at an exhaust gas recirculation ratio of 17%.

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