Chapter I

INTRODUCTION

Diesel engines operating at different fuel/air ratios depend upon the power required. There is no throttle therefore, theoretically, air consumption per stroke never varies. Thus a weak mixture produces low power output whereas a rich mixture produces high power output. For conditions requiring maximum power, such as pulling under heavy loads or heavy acceleration, thick exhaust smoke is generated as a result of incomplete combustion. In order to achieve complete combustion, the fuel injected in the form of highly atomized droplets must have sufficient air available for reaction to complete and this can easily be achieved at part load when there is considerable excess amount of air. At maximum power it is necessary to burn all the available air and thus there is no excess air left over. If perfect mixing does not take place, there are some areas in the combustion chamber with richer, and others weaker than stoichiometric mixture. The rich areas burn fuel incompletely and this causes smoke, carbon monoxide and unburnt hydrocarbon to be emitted in the exhaust. Practically perfect mixing is impossible, this is because the time available for mixing is so short. Consequently, the diesel engine, especially in commercial vehicles are known as a source of environmental air pollution. Smoke and exhaust emissions, namely carbon monoxide, unburnt hydrocarbon and oxides of nitrogen are primary targets of public objection to the diesel.

The interest in reducing diesel engine smoke and exhaust gas emissions comes from the fact that the exhaust smoke is highly sensible and troublesome, while the exhaust gas emissions are among the most physiologically dangerous ones. Therefore many investigators in this field have attempted to find ways to reduce smoke and exhaust gas emissions.

Lyon, Tims and Muller[1] have reviewed many methods for reducing exhaust emissions and concluded that mechanical modifications to engines are effective in reducing one component of the emissions but the other pollutants are often increased at the same time. Decreasing overall fuel/air ratio can reduce smoke level to near zero but at the expense of increased unburnt hydrocarbon and oxides of nitrogen. The use of precombustion chamber design in place of direct injection can reduce hydrocarbon and oxides of nitrogen, but fuel economy is also reduced. Retardation of fuel injection can reduce gaseous emissions but increases smoke and decreases engine efficiency. However, the use of liquefied petroleum gas replacement of upto 30 % of diesel fuel charge at heavy loads give reduction in smoke without adversly affecting gaseous emissions[2].

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[1] D. Lyon, J.M. Tims and K. Muller, "Techniques for Reducing Exhaust Emissions from Diesel Engines" <u>14th International Automobile Technical Congress of Fisita.</u> (London, 1972)

[2] "Diesel Exhaust Emissions Reduction by L.P.G. Supplementary Fuelling" <u>Clean Air.</u> (Vol.3, No.10, Summer 1973), p. 45.

Martini and Oggero[3] had investigated urban bus diesel engines by introducing liquefied petroleum gas into the conventional intake manifold and limiting diesel oil delivery to about 70 % of full load. Results obtained showed greatly reduced exhaust smokiness. Moreover with regard to engine performance utilizing liquefied petroleum gas, investigation by Lyon, Howland and Lom[4] with direct injection engine, confirmed improvement in thermal efficiency over normal diesel fuel operation under heavy load, at part load operation the engine failed to show any improvement in thermal efficiency.

In this thesis, the investigation was concentrated on the benefit of using commercial butane gas as a supplementary fuel. Both the engine overall performance and exhaust emissions are studied. The experiments were conducted using two engines, a single cylinder and a multicylinder engine. Results obtained were then correlated with the aforementioned works.

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[3] C. Martini and M. Oggero, "Diesel Oil and L.P.G. Fuel Feed of I.C. Engines to Reduce Urban Bus Smokiness" 14th International Automobile Technical Congress of Fisita. (London, 1972)

[4] D. Lyon, A.H. Howland and W.L. Lom, "Controlling Exhaust Emissions from a Diesel Engine by LPG Dual Fuelling" Air Pollution Control in Transport Engines. (London: I. Mech. E., 1972), p. 45.