MARA INSTITUTE OF TECHNOLOGY

FINAL YEAR PROJECT REPORT
BACHELOR (HONS) IN MECHANICAL ENGINEERING
FACULTY OF MECHANICAL ENGINEERING
MARA INSTITUTE OF TECHNOLOGY
SHAH ALAM

RADICAL COMBUSTION IN TWO STROKE ENGINE

PREPARED BY :

ABDUL RAHIM BIN ABDUL RAHMAN
AND
MUHAMAD SUWAID BIN SAAD

MARCH 1998

ABSTRACT

Stringent legislation concerning the pollution of atmosphere by engine exhaust gases have been tightened recently and hence placed an extensive pressure on engine manufacturers to meet these emission standards. Two-stroke engines are known for their high emission levels in particular unburnt HC and NOx. Different research and development programmes were initiated in order to eliminate this fundamental weakness of two-stroke engines. Hence a number of techniques have been studied and used to achieve improvements in fuel economy and emission levels of two-stroke engines. Most recently, the use of radical combustion process in two-stroke engines has been reported as a promising way to achieve these improvements.

The hot residual gases excessively present in two-stroke engines seems to have a major role on the onset of abnormal combustion especially at light loads where there is excessive cyclic variation and irregular combustion. The variation of residual gas distribution at the vanicity of the spark plug due to improper local scavenging is the main factor that affect the initial period of combustion. The divergent effect of the residual gases on the abnormal and knocking combustion and the irregular combustion and misfiring are the most important aspects of combustion process in two-stroke engines

A new combustion process initiated by the generation of a radicals from the previous combustion cycle could be of potential influence on the emission levels and fuel consumption of two-stroke engines. These radicals are used as local energy spots during the mixing process with the fresh charge. The establishment of such combustion process required a certain running conditions. These conditions included the amount of the residual gases to be trapped each cycle and recirculated to the next cycle, the mixing process of the fresh air-fuel charge and the residual gases to form a stratified mixture, the combustion chamber and piston geometry, the air-fuel ratio, the compression ratio, and the exhaust gases temperature.

In this study, a two-stroke SI engine was modified in order to achieve radical combustion process. A new exhaust throttling system was designed and used for this purpose. Engine power, fuel combustion, and exhaust emissions were the parameters studied. The effects of the radical combustion process on these parameters were studied at different engine running conditions. The various factors that taken in consideration were the engine speed and load, air-fuel ratio, and exhaust port throttling. A significant improvements in fuel consumption, exhaust emission levels in particular NOx, and exhaust temperature were achieved when the engine was running on radical combustion.

The radical combustion shows a significant improvement in most parameters studied. The exhaust temperature decrease by 16% to 22.5% at all engine speeds and loads. Significant reduction in the fuel consumption which is 11.1% to 49.8% was achieved. A considerable reduction in the hydrocarbon emission of about 60.8% was achieved. This reduction means that the losses in the fresh air-fuel change is less and the combustion process is complete. The oxygen percentage in the exhaust emission was observed to be lower by 41.7%. Also, it is observed that carbon dioxide percentage is higher. This also could be an indication that a complete combustion was achieved. The nitrogen oxide, carbon dioxide emissions were found to be variable at different loads. A comprehensive study also conducted for the effect of the exhaust port throttling on the radical combustion characteristic. There should be a certain value of exhaust port throttling required for each speed and load. This is an important point for the commercialize design of this system.

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