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A Study on the Effects of Combustion Duration on Engine Behavior, Emissions, and Residual Gas in a Propane-Fueled Spark-Ignition Engine under Varying Loads

Quach Nhu Y [1)] · Ock-Taeck Lim [*2)]

[1)]*Graduate School of Mechanical Engineering, University of Ulsan, Ulsan, 680-749, Korea,*
[2)]*School of Mechanical Engineering, University of Ulsan, Ulsan, 680-749, Korea*

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* Corresponding author, E-mail: otlim@ulsan.ac.kr

This study examines the effects of combustion duration on combustion behavior, pollutant formation, and residual gas fraction (RGF) in a propane-fueled spark-ignition engine across different load regimes. Experiments were conducted on a twin-cylinder research engine equipped with a dynamometer, varying the combustion duration between 40 and 80 degrees. Engine performance, emissions, and RGF were analyzed at engine loads of 25%, 50%, and 100%.

The findings demonstrate distinct trends in combustion dynamics, emissions, and RGF as combustion duration and engine load change. At lower loads (25% and 50%), RGF fluctuations remain moderate, with peak values at specific combustion durations. In contrast, at 100% load, RGF shows significant deviations, indicating complex interactions between combustion and load. Additionally, variations in effective release energy (ERE), brake mean effective pressure (BMEP), and brake specific fuel consumption (BSFC) were observed, with longer combustion durations generally increasing ERE and BMEP but also leading to higher BSFC, suggesting a balance between combustion efficiency and fuel consumption. Pollutant emissions, including hydrocarbons (HC), carbon monoxide (CO), and nitrogen oxides (NOx), were sensitive to combustion duration and load, with optimal durations varying by load condition, highlighting the intricate relationship between combustion dynamics and emissions control.

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