Enabling dual fuel reactivity controlled compression ignition mode by means of Methanol and Diesel fuel in an Automotive light duty diesel engine

Ganesh Duraisamy, Murugan Rangasamy*, Nagarajan Govindan

Internal Combustion Engineering Division, Department of Mechanical Engineering, College of Engineering Guindy, Anna University, Chennai – 600 025. Tamilnadu, India.

** Corresponding author:* rmurugan45@gmail.com

Abstract

Previous research works has shown that fuel reactivity controlled compression ignition is a promising approach to breakdown the trade-off relationship between NOx and soot emissions with better thermal efficiency. However, less efforts have been dedicated to achieve dual fuel RCCI operation for entire load and speed range conditions. On other hand, higher CO and HC emissions in reactivity controlled compression ignition mode decreases the combustion efficiency. To mitigate this issue, an investigation on reactivity controlled compression ignition combustion has been performed using a renewable oxygenated alternative methanol fuel as a low reactivity fuel and diesel as a high reactivity fuel at different ESC cycle points. For the implementation of RCCI combustion in an on-road vehicle it is essential to understand the effect of each operating parameters on combustion and emission characteristics. Hence, in the present work, an experimental parametric study was performed by sweeping different operating parameters for a particular speed and load conditions. Later, based on the results, experiments were conducted at different ESC points and the results are compared with the conventional diesel combustion. A three-cylinder light duty diesel engine was suitably modified for this purpose and tested. Use of higher methanol percentage and EGR rate was helpful in extending the load range by reducing the maximum rate of pressure rise. The experimental results reveal that, methanol/diesel reactivity controlled compression ignition mode exhibited near zero NOx and soot emission reductions at all load and speed conditions compared to conventional diesel operation which may eliminate the use of after treatment systems. However, marginally higher HC and CO emissions were observed in RCCI combustion compared to conventional operation predominantly at lower load and higher speed conditions. It can be reduced by the existing diesel oxidation catalyst system without compromising the fuel consumption. In addition, the stable operation was seen in low speed condition as compared to high speed conditions. Furthermore, a maximum increase of 8.1% brake thermal efficiency is observed in RCCI mode compared to conventional diesel combustion mode.