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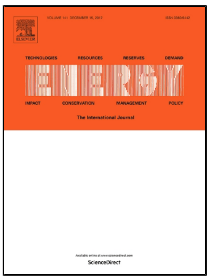

Experimental study on combustion and emissions of dual fuel RCCI mode fueled with biodiesel/n-butanol, biodiesel/2,5-dimethylfuran and biodiesel/ethanol

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Experimental study on combustion and emissions of dual fuel RCCI mode fueled with biodiesel/n-butanol, biodiesel/2,5-dimethylfuran and biodiesel/ethanol

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Abstract: To investigate the effect of biofuel properties on RCCI combustion and emissions, the experimental study was conducted on a single-cylinder diesel engine. Three low reactivity oxygenated biofuels, i.e. n-butanol, 2,5-dimethylfuran (DMF) and ethanol were injected in the intake port and biodiesel was directly injected into the cylinder to realize RCCI operation. Results show that the heat releases are changed from two-stage to single-peak with the increase of EGR rates. Biodiesel/ethanol presents 1 °CA longer ignition delay than the others, which indicates latent heat has significant effect on ignition delay. Under different injection timings, the trends of combustion and emissions are similar for three RCCI modes, meantime, biodiesel/ethanol shows greater potential on reducing NOx and soot emissions simultaneously (soot<0.3 FSN and NOx<1.5 g/kWh at SOI of -8 °CA ATDC) and biodiesel/n-butanol presents the highest ITE of 47.5%, and shows remarkable advantages on improving indicated thermal efficiency of RCCI combustion. Employing 80% fraction of biofuels by port injection results in lower soot emissions (below 0.3 FSN) and higher CO and HC emissions than neat biodiesel, but relatively high cetane number of n-butanol limits the maximum applying fraction. The increase of load highlights the differences on combustion and emissions among three RCCI modes.

Key words: RCCI; dual fuel; oxygenated biofuels; combustion; emissions

1. Introduction

Internal combustion engines have been dominant in power device application for more than 100 years due to the high power output, efficiency and stability. However, in recent two decades, environmental pollution and energy crisis have become two key challenges that must be addressed for the development of internal combustion engines. Enormous efforts have been made to increase the efficiency and decrease the emissions of engines. New combustion modes represented by homogeneous charge compression ignition (HCCI), low temperature combustion (LTC), partially premixed combustion (PPC) and reactivity controlled compression ignition (RCCI), etc., which can be generally called low temperature combustion, have shown great potential to achieve clean and efficient combustion.