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Experimental Investigations of Particulate Emitted by an Alcohol-Fuelled HCCI/CAI Combustion Engine

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Abstract

Environmental concerns have increased significantly world over in the past decade. To fulfill the simultaneous emission requirements for near zero pollutant and low CO_2 levels, which are the challenges of future powertrains, many research studies are currently carried out world over on new engine combustion process, such as Controlled Auto Ignition (CAI) for gasoline engines and the Homogeneous Charge Compression Ignition (HCCI) for diesel engine. These combustion processes have potential of ultra-low NO_X and particulate matter (PM) emission in comparison with a conventional gasoline or diesel engine. Regulatory agencies are becoming increasingly concerned with particulate emissions as the health and environmental effects are getting understood better due to rapid developments in instrumentation. In this paper, combustion and emission characteristics of a HCCI engine fuelled with methanol were investigated on a modified two-cylinder, four-stroke engine. In this investigation, port injection technique is used for preparing homogeneous charge. The experiment is conducted with varying intake air temperature of 120, 130 and 150^0C at different air-fuel ratios, for which stable HCCI combustion is achieved. The experimental results indicated that the engine load or air-fuel ratio have significant effects on the maximum cylinder pressure and its position relative to TDC, the shape of the pressure rise curve and the heat release rate. The engine exhaust particle sizer (EEPS) was used for size, surface area and mass distributions of soot particles emitted under different operating conditions under different combustion modes. EEPS measures particle size ranging from 5.6 to 560 nanometers. It was found that number and size distribution of soot particles depends on engine load and the width of the size distribution increased with increasing engine load. The number distributions were found to obey log-normal distribution.