Effects of second injection timing on combustion characteristics of a two stage direct injection gasoline–alcohol HCCI engine

Ali Turkcan, Ahmet Necati Ozsezen, Mustafa Canakci

Department of Automotive Engineering, Kocaeli University, 41380 Izmit, Turkey
Alternative Fuels R&D Center, Kocaeli University, 41275 Izmit, Turkey

A R T I C L E   I N F O

Article history:
Received 5 March 2013
Received in revised form 5 April 2013
Accepted 16 April 2013
Available online 30 April 2013

Keywords:
HCCI
Two stage direct injection
Ethanol
Methanol
Gasoline

A B S T R A C T

In this study, the effect of second injection timing on the combustion and emissions characteristics of a direct injection HCCI gasoline engine was investigated by using ethanol and methanol blended gasoline fuel. For this aim, a diesel engine was converted to an electronically controlled HCCI gasoline engine. The injection timings and fuel quantity for each injection were adjusted to get desired mixture formation in the cylinder. Five different fuels (gasoline, E10, E20, M10 and M20) were studied at the same energy input condition. The tests were conducted at high and low equivalence ratios and constant engine speed. The test results show that the combustion and emissions characteristics can be directly controlled and HCCI operating range can be extended by the second fuel injection timing. The maximum cylinder gas pressure and rate of heat release significantly decreased and the start of combustion delayed with the retarding of the second fuel injection. Using optimal second fuel injection timings, better combustion characteristics, lower NOx, UHC and CO emissions, and higher IMEP and indicated efficiency values were obtained for the alcohol–gasoline fuel blends compared to the gasoline case at low equivalence ratio. At the same time, the dilemma between NOx and smoke emission was controlled with changing of the second fuel injection timing by keeping the IMEP and indicated efficiency almost constant for all test fuels.

1. Introduction

The increasing number of vehicle causes environmental problems such as greenhouse effect and acid rains. These environmen-