International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.9, No.07 pp 587-595, 2016

Simulation analysis of hydrogen fuelled homogeneous charge compression ignition (HCCI) engine

Chaitanya Jakati, Aditya Patil, Amol Kulkarni and M. Mohamed Ibrahim*

Department of Automotive Engineering, School of Mechanical Engineering, Vellore Institute of Technology, VIT University, Vellore - 632014, Tamil Nadu, India.

Abstract : A single-zone zero dimensional model was developed to study the effect of intake charge temperature (ICT) and equivalence ratio on start of combustion (SOC) of homogeneous charge compression ignition engine, which used hydrogen as a fuel. Considering that when 99.99% of hydrogen is burned then it is said to be auto ignited the intake charge temperature range was chosen from 360-400K. For this range of temperature the equivalence ratio was varied from 0.1-1.0, and the results were plotted. It was observed from the results that there was no ignition at ICT of 361 K at equivalence ratio of 1 but the combustion initiated when the ICT was increased by 1K. It was seen from the results that as ICT increases, the combustion advances well before top dead centre (TDC) but the indicated mean effective pressure (IMEP) is reduced due to lesser utilization of heat from the fuel. The SOC combustion did not varied significantly at different equivalence ratios. Thus the SOC of combustion was more sensitive to the ICT as compared to the equivalence ratio. A single-zone model helps to predict this auto ignition point, although the estimated peak and mean effective pressures are over estimated by this model because of the assumptions of total homogeneity of the inducted charge.

Keywords: Homogeneous charge compression ignition (HCCI), single zone zero dimension, chemical kinetics, intake charge temperature, equivalence ratio, alternate fuels and emissions.

M. Mohamed Ibrahim *et al* /International Journal of ChemTech Research, 2016,9(7),pp 587-595.

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