

Single-zone zero-dimensional model study for diesel-fuelled homogeneous charge compression ignition (HCCI) engines using Cantera

ABSTRACT

Homogeneous charge compression ignition (HCCI) engine technology is relatively new and the combustion behavior in an HCCI engine is difficult to predict. The combustion is fully controlled by the chemical kinetics and the chemical reaction of the mixture is influenced by changing input parameters. A zero-dimensional single-zone model was used to investigate the combustion behavior of a diesel engine operating in HCCI mode. An open source chemical kinetics package from Cantera was used in this study. The combustion behaviour can be observed, where H₂O₂ was fully decomposed during the main combustion event. The time for H₂O₂ to completely decompose into OH radicals was very short, which was about 5°CA. The combustion phasing was predicted in accordance with the experiment. The auto-ignition can be controlled by controlling the intake temperature or AFR. The start of combustion was advanced by increasing the intake temperature from 20 to 70°C and reducing the AFR from 58 to 29. However, reducing AFR will increase the in-cylinder peak pressure. In general, a zero-dimensional model is a useful and faster tool to predict the combustion phasing. When coupled with chemical kinetics, it provides more accurate results.

Keyword: Diesel; HCCI; Cantera; N-heptane; Single-zone; Zero-dimensional