AN INVESTIGATION ON THE PERFORMANCE OF PARTIALLY STRATIFIED CHARGE CI ETHANOL ENGINES

Annarita Viggiano and Vinicio Magi

Department of Environmental Engineering & Physics
University of Basilicata
Potenza, 85100
Italy
Email: annarita.viggiano@unibas.it, vinicio.magi@unibas.it

ABSTRACT

The partial fuel stratification, by means of direct fuel injection, is one of the most suitable combustion strategies in order to overcome the limits of ignition control and operating range of HCCI engines. In this work, a multidimensional model, coupled with a detailed kinetic mechanism for ethanol oxidation, is used to investigate the performance of a partially stratified charge CI engine fueled by ethanol. The model, which accounts for turbulence effects on combustion, has been validated in a previous work, against experimental results in terms of both HCCI engine performance and emissions.

In this work, computations have been carried out by varying the fraction of the fuel stratified charge and the injection timing and by considering different flow structures within the cylinder. By increasing the amount of stratified fuel, the rate of the pressure rise and the heat release rate reduce, while the peak of the heat release rate delays, since the zones of the chamber, where the liquid fuel is located, are relatively cold and rich to ignite, thus the combustion process slows down. However, the ignition timing remains nearly constant, since the remaining zones of the combustion chamber are characterized by nearly uniform conditions, in terms of temperature and mixture composition, typical of an HCCI combustion. On the other hand, by increasing the fraction of the directly injected fuel, higher values of the maximum temperature are reached, thus producing an increase of NOx emissions. In order to avoid high values of temperature during combustion, the fuel stratification can be coupled with both swirl and early injection timing since, in both cases, a more uniform distribution of the injected fuel is obtained before ignition. Finally, simulations have been performed by increasing the fuel load up to 30%, thus showing the suitability of direct injection strategy in order to extend the operation range of HCCI engine.


REFERENCES