

Abstract

In compression ignition engines, soot-NO_x paradox is extremely challenging issues, which remains to be to be resolve. Homogeneous charge compression ignition is a new combustion concept that gives benefits such as diesel like efficiency and resolves the problem of high level of NO_x and PM simultaneously. In HCCI combustion, homogeneous mixture of air and fuel is supplied to combustion chamber which burns spontaneously throughout the combustion chamber. It gives very high rate of heat release which can not be easily controlled.

This thesis presents the results and discussion of the experimental investigations and development of a diesel-fuelled HCCI engine. Homogeneous mixture preparation is the most critical part of the diesel HCCI combustion concept. Low volatility of diesel is the main obstacle in formation of homogeneous mixture of fuel and air. A dedicated device has been developed for vaporization of diesel, which is known as diesel vaporizer. This diesel vaporizer is connected to the intake manifold of the experimental engine. A large number of modifications and instrumentation has been done to operate the engine in HCCI combustion mode. Exhaust gas recirculation is used to control the HCCI combustion phasing. After successfully achieving of HCCI combustion, experiments are performed for combustion and emission behavior of HCCI combustion. It is found that start of combustion can be controlled by EGR in lean HCCI combustion. EGR controls peak cylinder temperature and peak cylinder pressure, which results in relatively lower NO_x formation. Experiments of combustion and emissions are performed at various EGR rates (0%, 10% and 20%) to investigate its relative effect. The emissions of HCCI combustion are compared with CI combustion mode and a large reduction is found in NO_x and PM emissions. CO and HC emissions are higher for HCCI combustion mode as compared to CI combustion mode.