ABSTRACT

The internal combustion engine is the key to the modern society. Without the transportation performed by the millions of vehicles on road and at sea we would not have reached today’s living standard. There are two types of internal combustion engines, namely, the Spark Ignition (SI), and the Compression Ignition (CI). Petrol and diesel are at present the principal fuels for SI and CI engines, respectively. These fuels are on the verge of getting extinct, and during combustion, these fuels release substantial amount of pollutants into the atmosphere and create environmental related problems. The internal combustion (IC) engine is known to be one of the major sources of air pollution in the environment. The fuel oxidation process in the engine generates not only useful power, but also a considerable amount of pollutant emissions including Carbon Dioxide (CO$_2$), Carbon Monoxide (CO), Unburned Hydrocarbon (HC), Nitrogen Oxides (NOx), and Particulate Matter (PM). CO$_2$ is mainly responsible for the global warming issue as it creates a reflective layer in the atmosphere that reflects heat from the earth back to the earth surface, increasing the earth’s average temperature over time. CO is a very dangerous substance, since it reduces the oxygen-carrying capacity of the blood stream. At low concentrations, CO inhalation can cause dizziness and nausea, while at higher concentrations it can be deadly. Unburned hydrocarbon emission, a result of an incomplete combustion process, is a common source of respiratory problems. Particulate emissions or soot also cause some respiratory problems. Both unburned hydrocarbon and soot emissions have been linked to diseases like cancer. The high flame temperature generated during the combustion process is responsible for NOx formation, which causes various health problems in addition to contributing to acid rain and global warming
issues. The advent of stringent emission norms and depletion of fossil fuel resources led engineers to work out new combustion technologies to substantially reduce harmful emission and improve the overall efficiency of an IC Engine. The factors to be considered while designing a new combustion process are, higher compression ratio, lean homogeneous air fuel mixture, complete and instantaneous combustion, which lead to Homogeneous Charge Compression Ignition (HCCI). HCCI is a clean and efficient combustion process. In this research work an attempt is made to experimentally analyze the performance and emission characteristics of the HCCI compression process in a Premixed Charge Compression Ignition (PCCI) mode assisted with Pilot Injection (PI) as the combustion initiator. Several experiments were conducted in a modified single cylinder water-cooled diesel engine, employing a conceptual system known as Transient State Fuel Induction (TSFI) with different fuels such as diesel, petrol, and bio-diesel. In the present research setup, it is observed that there is a reduction in the emission level of CO and HC, with the same power as obtained from a conventional diesel engine.