Abstract

A homogeneous charge compression ignition (HCCI) engine test stand was developed for research and instructional purposes. A commercially available 6 hp diesel engine was modified to run as an HCCI engine using 91 RON gasoline and intake heaters for ignition control. The design philosophy behind the necessary engine modifications and the methodology implemented to design the necessary laboratory infrastructure are detailed in this work.

A custom ac motor dynamometer was designed to accommodate the system constraints according to proper mechanical design axioms. It was fabricated using the available facilities and was fully integrated into the laboratory control and data acquisition systems. The system was first proven with the baseline diesel engine, where data compared favorably with the manufacturer's published data sheets.

The diesel engine was then modified with a new intake, complete with a fuel injection system which included a custom fuel injector driver. A modified piston was also prepared with a compression ratio of 17.7:1 (lowered from 19.3:1), and is ready to use for future projects if the lower compression ratio is desired. The engine was instrumented with a variety of sensors to measure in-cylinder pressure, engine rotational position, fuel flow rate, and exhaust gas composition.

Stable HCCI combustion was verified via both in-cylinder pressure curves and positive engine power output. An average 1.4 hp was recorded with a bmep of 2.3 bar and an average BSFC of 410 g/(kW·h). The engine in HCCI mode produced less power less efficiently than the engine in diesel mode. While a lower power output was expected, a lower efficiency was likely due to poor ignition control and the use of the stock diesel bowl-in-piston type piston. A list of future recommendations is offered to the reader who may be interested in continuing the project.