

## **Homogeneous Charge Compression Ignition Combustion: Advantages Over Compression Ignition Combustion, Challenges and Solutions**

**M.M. Hasan<sup>a</sup>, M.M. Rahman<sup>ab</sup>,**

<sup>a</sup> Automotive Engineering Research Group, Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

<sup>b</sup> Automotive Engineering Centre, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

### **ABSTRACT**

The homogeneous charge compression ignition (HCCI) engine uses a relatively new mode of combustion technology. In principle, there is no spark plug or injector to assist the combustion, and the combustion auto-ignites in multiple spots once the mixture has reached its chemical activation energy. It is noticeably faster than either compression ignition (CI) or spark ignition combustion (SI). The HCCI combustion mode provides better thermal efficiency and maintains low emission by modifying CI as well as SI engines. A wide variety of fuels, combinations of fuels and alternative fuels can be used in this technology. However, some challenges including combustion phase control, limited operating range, cold start, a high level of noise and homogeneous charge preparation need to be overcome for successful operation of HCCI engines. The objective of this study is to illustrate the engine performance and emission characteristics of HCCI engines at different test conditions and various challenges associated with these engines. Also introduced is a potential guideline to overcome these challenges and improve engine performance and emission characteristics. From the review, it can be concluded that HCCI combustion can be applied in existing CI engines with modifications and the most significant result of applying this combustion is the lower NO<sub>x</sub> and soot emissions with almost the same performance as with CI combustion.

**KEYWORDS:** HCCI; Compression ignition; Engine performance; Emission; Combustion phase

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