

https://dspace.org/

Analysis of Dimethyl Ether (DME) injection spray characteristics in comparison to diesel and theoretically predicted spray characteristics

Valentim, D. J.

2015-04-28
http://hdl.handle.net/10539/17542

Downloaded from a DSpace repository. https://dspace.org/

Abstract

The objectives of this research are to compare the spray characteristics of diesel and Dimethyl ether (DME), in order to investigate parameters which influence the spray characteristics such as penetration, cone angle, and spray velocity. A standard common rail system was used to inject high pressure fuel into a constant volume pressure chamber. Tests were conducted at 300 bar to 500 bar injection pressure, and atmospheric pressure to 17.7 bar chamber pressure using carbon dioxide as an ambient gas at room temperature. A Z-shaped schlieren system with a high power LED was used to form images for the high speed camera operating at 20 000fps. An experiment controller was constructed to simultaneously control the triggering of: the injector, the high speed camera, and the recording of pressure data. The diesel and DME spray penetration and tip velocity was found to increase with an increase in injection pressure, and the opposite result was seen with an increase in chamber pressure. DME consistently penetrated less than diesel throughout the tests conducted, the difference in penetration was larger at the lowest chamber pressures. The difference between DME and Diesel decreased at higher chamber pressures to 6 - 9%. The cone angle for DME was consistently larger than that of diesel for all the tests conducted. Both fuels showed a relatively linear increase in cone angle with an increase in chamber pressure, with the exception of the tests at atmospheric conditions. The DME had a tendency of flash boiling at these conditions resulting in a large cone angle. Experimental results were compared to theoretical predictions of penetration and cone angle. The experimental penetration for diesel and DME were reasonably predicted by some of the theoretical models at the higher chamber pressures. No correlation was found in terms of injection pressure for the diesel cone angle, whereas the DME showed a slight increase with an increase in injection pressure. While analysing the results a hesitation in the intial 0.2ms was observed, this was found to be due to the placement of the single-hole in the nozzle and the resultant pressure distribution around the injector needle. This hesitation was factored out when comparing penetration results to theoretical predictions.