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Determination of the pressures within an injector: Experimentation and model validation.

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Abstract

Amid concerns of global warming, it has become necessary to reduce the emissions produced by engines. One method of achieving this is by controlling the air/fuel mixture formed by the spray of the injector within the combustion chamber. In comparing previous experimental results and the equations which describe the spray structure disagreement was found, which is expected to be caused by having insufficient information of the injection pressure; a required input of the equation. The aim of this research is to predict this injection pressure by modelling a mechanical injector, and testing and modelling a common rail injector. The mechanical injector simulations show that the injection pressure is lower than the line and opening pressure and is dependent on the number of discharge orifices, throttling condition and opening pressure of the injector. Consequently, the line and opening pressures are not sufficient approximations of the injection pressure and must not be used to predict spray properties. The simulations showed the injected flow rate is higher for a three hole injector at high engine loads and higher opening pressures, resulting in a more atomised and penetrating spray. The common rail injector model agrees with the experimental results and both show the injection pressure being about 90% of the rail pressure. The rail pressure is therefore suitable for use in the penetration equations. A sensitivity analysis of the common rail model showed that it could be used to diagnose injector problems because each varied parameter changed the injected flow rate differently, allowing the source of the problem to be easily identified.