STUDY OF THE INFLUENCE OF THE NEEDLE ECCENTRICITY ON THE INTERNAL FLOW IN DIESEL INJECTOR NOZZLES BY CFD CALCULATIONS

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Abstract

It is well known that during the opening and closing process of a diesel injector, the fuel characteristics at the nozzle exit change significantly as a consequence of the needle movement. This change of fluid properties at the exit of the discharge orifices due to the variable position of the needle strongly affects the spray pattern and the air-fuel mixing process, and therefore its subsequent combustion.

Nevertheless, despite most investigations focus only on the vertical motion of the needle, the internal flow and spray characteristics can be also affected by an eccentric location of the needle due to random oscillations of the needle in the transverse direction during the opening or closing of the injector.

In the present paper, a computational study has been performed in order to clarify the effects of the needle eccentricity in a real multihole microsac nozzle with cylindrical holes at typical operating conditions of a diesel engine, paying special attention to the internal flow development and cavitation appearance in the nozzle sac and the discharge orifices. For that purpose, a multiphase flow solver based on a homogeneous equilibrium model with a barotropic equation of state has been used, introducing the turbulence effects by RANS methods with a RNG k-ε model.

The results obtained from this investigation have demonstrated the huge influence of the needle position on the flow characteristics in the sac and the orifices, showing important hole to hole differences, especially in terms of mass flow and cavitation pattern.

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