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EFFECTS OF NEEDLE LIFT AND FUEL TYPE ON CAVITATION FORMATION AND HEAT TRANSFER INSIDE DIESEL FUEL INJECTOR NOZZLE

S. M. Javad Zeidi, George S. Dulikravich* and Sohail R. Reddy
Department of Mechanical and Materials Eng., MAIDROC Laboratory, Florida International University,
10555 West Flagler Street, Miami, FL 33174, USA
*Corresponding author: FAX: +1 305 348 1932 Email: dulikrav@fiu.edu

ABSTRACT In the present study, the flow inside a real size Diesel fuel injector nozzle was modeled and analyzed under different boundary conditions using ANSYS-Fluent software. A validation was performed by comparing our numerical results with previous experimental data for a rectangular shape nozzle. Schnerr-Sauer cavitation model, which was selected for this study, was also validated. Two-equation $k-\varepsilon$ turbulence model was selected since it had good agreement with experimental data. To reduce the computing time, due to symmetry of this nozzle, only one-sixth of this nozzle was modeled. Our present six-hole Diesel injector nozzle was modeled with different needle lifts including $30\ \mu m$, $100\ \mu m$ and $250\ \mu m$. Effects of different needle lifts on mass flow rate, discharge coefficient and length of cavitation were evaluated comprehensively. Three different fuels including one Diesel fuel and two bio-Diesel fuels were also included in these numerical simulations. Behavior of these fuels was investigated for different needle lifts and pressure differences. For comparing the results, discharge coefficient, mass flow rate and length of cavitation region were compared under different boundary conditions and for several fuel types. The extreme temperature spike at the center of an imploding cavitation bubble was also analyzed as a function of time and initial bubble size.