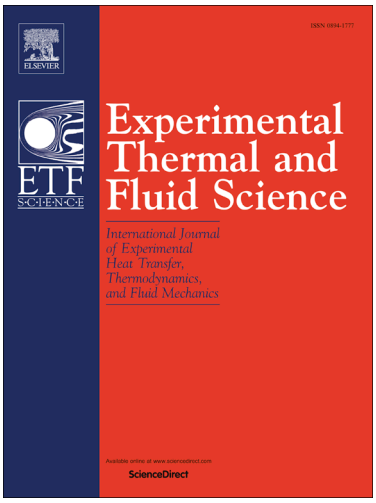


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# Effect of fuel temperature on cavitation flow inside vertical multi-hole nozzles and spray characteristics with different nozzle geometries

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ABSTRACT

The effects of the fuel temperature on diesel nozzle internal flow and the subsequent atomization were analyzed experimentally. Flow visualization was studied by using a 10-times scaled-up transparent acrylic model nozzle with different geometries. A high-speed digital camera was used to capture the flow pattern in the region of the sac chamber and the nozzle. The energy loss in the occurrence of the hydraulic flip was also analyzed. In addition, cavitation images obtained in the multi-hole tapered nozzle with different fuel temperatures had revealed that although the conical shape of the converging tapered holes suppresses formation of geometry-induced cavitation, string cavitation has been clearly observed anyway. Afterward, the experimental method was used to analyze the effects of the nozzle sac volume structure on the cavitation flow inside the nozzle and subsequent spray. It was found that the in-nozzle flow stage and spray formation were sensitive to the fuel temperature. The visual experiment is helpful to understand the nozzle flow and optimize the diesel injectors eventually.

## 1. Introduction

In the last decades, lots of studies have proved that the fuel injection characteristics play a vital role in the pollutant formation and performance of diesel engines [1-3]. The researches on modern diesel engines now a days mainly focus on the reduction of the main pollutant produced by diesel engines (particle and $NO_x$), because of the increasingly stringent emission regulations and the enormous increase in oil prices [4,5]. As we all know, air–fuel mixing process and internal flow have an important influence on the subsequent combustion and emission. How quickly a fuel burn depends on the mixing process which is closely related to the nozzle structure and spray characteristics [6-13]. Various studies have shown that the cavitation flow inside multi-hole nozzles strongly affects the near-field spray characteristics [14-16]. Meanwhile, the results show that cavitation occurred in the nozzle can accelerate the cavitation erosion and reduce the endurance of the nozzle [17-19]. Hence, it is inevitable to carry out the research of the cavitation.

Although more and more researches try to research the cavitation flow and the spray characteristics, the experimental research is still on a narrow range to yet reveal some of the special nozzle flow phenomenon's like string cavitation, cloud cavitation shedding largely influencing the subsequent spray and then combustion because of the high speed and high turbulent flow under high injection pressure, strong transient property, short injection period, micro-hole nozzle, and the two-phase

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