学 位 論 文 概 要

題 目　Experimental and Computational Study of Diesel Spray under Non-Evaporating and Evaporating Conditions

（非蒸発および蒸発条件におけるディーゼル噴霧の実験およびシミュレーション）

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The combustion in the diesel engine is a characteristic of the mixing process, which is determined by the fuel injection, air motion and chamber design. The injection system is consisted of parameters including the injector hole size and rail pressure. This study is an attempt to determine effects of nozzle hole number, nozzle hole size and injection pressure. Three single hole injectors and two multi hole injectors with varying injection pressure are used to exhibit these effects under non-evaporating and evaporating conditions. In non-evaporating condition, Diffused backlight illumination technique is used to visualize fuel spray. However, Laser Absorption Scattering technique is applied, in the evaporating condition, to observe vapor phase of fuel and measure mixture concentration. On the other side, CFD commercial Code AVL Fire is used to simulate diesel sprays with k-ζ-f, KHRT and multicomponent as turbulence, breakup and evaporation models, respectively.

Previously, whenever the experimental and computational studies are compared, only macroscopic properties are taken into account. While in the current study, along with the macroscopic characteristics, mixture and evaporation characteristics are also considered. Furthermore, in most of the previous studies, the input parameters of the spray simulation especially initial spray trajectory angle, are always assumed as a constant value; although it is a full transient profile and need to be measured carefully for accurate spray prediction. Moreover, according to its definition, this is a near-nozzle field angle; thus, separate microscopic non-evaporating spray experiments are performed, in the current work, to measure this angle. The dissertation order is presented in following paragraphs.

Chapter 1 introduces the background of this study, defines broad objective and review the previous work on experimental, analytical and computational study of diesel sprays.

Chapter 2 demonstrates the details of experimental apparatus, techniques which are applied to perform experiments, experimental setups and conditions where experiments are conducted.

Chapter 3 provides detailed review work on computational approach. Selected models and input parameters for spray simulation are explained in details.

In chapter 4, different CFD models are activated and deactivated. Moreover, model constant related to break up time of secondary breakup model is altered to understand their effects of spray simulation.

In chapter 5, effects of nozzle hole diameter and injection pressure under non-evaporating condition are shown. Experimental results including spray shape, spray tip penetration and spray angle are compared with analytical and computational studies.

Chapter 6 uses same injection conditions to that of Chapter 4 and exhibits effects of nozzle hole diameter and injection pressure under vaporizing conditions. Experimental and computational spatial equivalence ratio distribution, liquid penetration, vapor penetration and fuel evaporation ratio are compared.

Chapter 7 determines effects of nozzle hole and injection pressure when similar injection rate profile is adopted for three single hole injectors.

Chapter 8 compares diesel sprays from single and multi hole injectors under non-evaporating and evaporating conditions.

In chapter 9, conclusions drawn from this study are described. Also, the future work, to get better spray simulation results, is suggested.