学位論文概要

題 目　STUDY ON HEAT TRANSFER OF STEADY AND PULSATING TURBULENT FLOWS IN STRAIGHT AND 90° CURVED PIPES
（直管と 90°曲り管内の定常および脈動乱流場における熱伝達に関する研究）

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The measurements of temperature fields inside pipes have rarely been reported owing to the difficulty of measuring the internal temperature of pipes in pulsating flow. In curved pipes, owing to the secondary flow, the internal temperature field inevitably changes after the curvature part, which leads to changes in the local heat transfer characteristics. The catalyst is installed downstream of the exhaust manifold, therefore the study of the temperature field inside the straight and curved pipes can be used to improve the efficiency of the catalyst.

Few researchers have studied the heat transfer of turbulent flow or pulsating flow in curved pipes based on the third type of wall thermal boundary condition (the heat transfer coefficient of the wall and ambient temperature are defined). Automotive intake and exhaust manifolds are directly exposed to the environment. This situation is more appropriate for this type of wall thermal boundary condition. Therefore, the third type of wall thermal boundary condition was employed to the numerical simulation in this study. For the experimental and numerical conditions, the inlet temperature was set to 402 K. The time-averaged Reynolds number was approximately 60,000 in both the straight and the curved pipes. The Dean number was 31,000 in the curved pipe. The Womersley number was 43.1, in the pulsating flows.

To present this work, the dissertation is organized as follows:

Chapter 1 introduces the research background, previous works, and the objectives of this study. The environmental issues, emission standards, and the flow and heat transfer in straight and curved pipes have been presented.

Chapter 2 is the study of turbulent flow and heat transfer in the straight and 90° curved SUS pipes. The combination of the experiment and the simulation demonstrated the difference in heat transfer between the straight pipe and the 90° curved pipe.

Chapter 3 reports heat transfer of the turbulent flow in the straight and 90° curved aluminum pipes. This chapter also compared the heat transfer performance of the SUS pipe and the aluminum pipe.

Chapter 4 reports the heat transfer of the pulsating flow in the straight and 90° curved aluminum pipes from both the experiment and the simulation and compared it with the steady turbulent flow.

Chapter 5 further reveals the heat transfer mechanism of pulsating flow from the conjugate heat transfer simulation results.

Chapter 6 is the summary of this research and the prospect of future work.