Abstract

Supersonic steam injector is a passive jet pump which operates without rotating power source or machinery and it has high heat-transfer performance due to the direct contact condensation between supersonic steam flow and subcooled water jet. Since the injector has a quite simple and compact structure, it has been considered to apply to the safety system for the Next-generation nuclear power plant. The objective of the present study is to investigate the relation between thermal characteristics and interfacial behavior between the flows to develop a model which is able to assess the heat and momentum transfer characteristic and the flow structure of the injector in detail. In the present study, a visible test section of water jet-centered supersonic steam injector was adopted to conduct visualization of the water jet with high speed video camera. In addition, special measurement instrumentations of temperature and velocity were applied to investigate flow structure in mixing nozzle of the injector.

Flow structure in mixing nozzle

Quantification of interfacial behavior

Effect of interfacial behavior on heat and momentum transfer

Conclusion

In this study, the effect of interfacial behavior of water jet on heat and momentum transfer was experimentally examined. As a result, following conclusions were acquired.

- The relation between interfacial wave velocity and Jacob number as well as slip ratio between the flows were confirmed.
- Correlation between heat and momentum transfer and interfacial behavior were well described by Jacob number and slip ratio.
- Heat transfer between steam flow and water jet increased as wave velocity increased.

Shunsuke SHIBAYAMA, University of Tsukuba

1University of Tsukuba, 2Toshiba Corporation, 3Hokkaido University, 4Tokyo Electric Power Company