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Numerical Analysis of Two Phase Flow and Heat Transfer in Condensers

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Steam surface condensers are widely used in the power generation industry. And the improvement of the performance of condensers could result in a significant increase in the efficiency and energy saving. Therefore, it is of great importance to understand the fluid flow and heat transfer in condensers in order to improve the design of condensers. With the development of computer technology, it becomes possible to simulate a complicated fluid flow and heat transfer process by numerical methods. The fluid flow in steam surface condensers is turbulent and multi-phase with distributed flow resistance due to tube bundles. Therefore, a suitable turbulence model for multi-phase flows with distributed flow resistance is necessary in order to predict the performance of steam condensers more accurately. Therefore, the objective of this study is to develop a suitable turbulence model for the gas-liquid two-phase flow in steam surface condensers and valid the proposed turbulence model.

Industrial condensers usually contain large number of tubes, and it is therefore practically impossible to solve the detailed fluid flow and heat transfer around each and every tube in the condenser. Therefore, a method considering the pressure drop due to the presence of tube bundles using porous media analogy is used for the simulation of industrial condensers. In this method, the effect of these tubes is accounted for by using a distributed resistance against the motion of the fluid. Turbulence modelling is known to be the most challenging task mainly because there does not exist a universal turbulence model for multiphase flows that can accurately include the effects of gas-liquid interaction and tube bundles.

In this study, modified standard k-ε and RNG k-ε models are proposed to account for the effects of tube bundles and two-phase interactions on the gas-phase turbulence. The numerical results are compared with the experimental data to assess the performance of the proposed turbulence models.