MEASUREMENT OF ISOBARIC HEAT CAPACITY OF BORIC ACID SOLUTION AT TWO LEVELS OF CONCENTRATION

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Boric acid is an important substance in safety and control system used as neutron moderator, trapping agent and coolant in pressurized water reactors in nuclear industry [1]. The $^{10}$B concentration is one of the key parameters for water radiolysis in applications [2]. But it is hard to provide adequate enriched boric acid due to the limitation of chemical technology. Therefore boron recovery system and boric acid separation column in nuclear power plant are necessary to make the enriched boric acid recycling. Basic thermophysical properties, such as heat capacity and viscosity, are indispensable for the design of recovery system and separation column. What’s more, as primary coolant in pressurized water reactors, heat capacity data of boric acid solution are significant to control the cooling process. However, no experimental heat capacity data of boric acid solution is released. The aim of this study is to provide accurate experimental heat capacity data of boric acid solution in different levels of concentration to guide the design of boron recovery system and boric acid separation column in nuclear power plant.

In this work, a flow calorimeter was developed to measure the isobaric heat capacities of boric acid solution in a wide region of pressure and temperature. The combined measurement uncertainties of temperature and pressure are 0.025K and 9kPa, respectively. The relative experimental uncertainty of the isobaric specific heat capacity is estimated to be not greater than 1.4%. In order to verify the accuracy of the experimental system, isobaric heat capacities of pure water in the temperature range from 296 K to 393K at atmospheric pressure were investigated. The maximum deviation of the comparison result of experimental data and the calculated values from the IAPWS-95 Formulation is 0.43% [3].

And then, experimental isobaric heat capacities of baric acid solution with the $^{10}$B concentration of 0.7wt% and 4wt% in the temperature range from 303 K to 393K at the pressure up to 5 MPa are presented. From the experimental results, we can see that isobaric heat capacity of boric acid increases with the temperature increasing along isobars, and isobaric heat capacity of boric acid solution is smaller than that of pure water at the same temperature and pressure at both the two $^{10}$B concentrations.

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