Heat transfer coefficient of pulsed superheated aqueous solution of boric acid for efficient and safe operation of pressurized water reactors

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An important independent control and protection system (CPS) of pressurized water reactors (PWR) is the boron control system (BCS). The BCS is designed to compensate for a portion of the excess reactivity at the beginning of a fresh fuel loading campaign and to compensate for slow changes in reactivity during a campaign. Boric acid (BA) is used in the PWR CPS. BA in the primary coolant is used as an absorber of thermal neutrons, and its concentration depends on the state of the core and is set depending on the reactivity margin of the core. Maintaining the PWR in a critical state during slow transient processes is achieved by regulating the concentration of BA introduced into the coolant. The BA concentration is changed either by diluting the reactor coolant with clean water, or, conversely, by feeding the primary coolant loop with a high-concentration BA solution. The range of BA concentration variation is 0 – 16 g/kg. Heat transfer to aqueous solutions of boric acid in the region of stable and relatively stable states is investigated in the case of short-term superheating relative to the solution liquid-vapor equilibrium temperature at different pressures. The heat transfer coefficient of aqueous solution of boric acid was measured by the method of controlled pulse superheating of the wire probe in the temperature range up to 600 K and pressures up to 20 MPa.
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