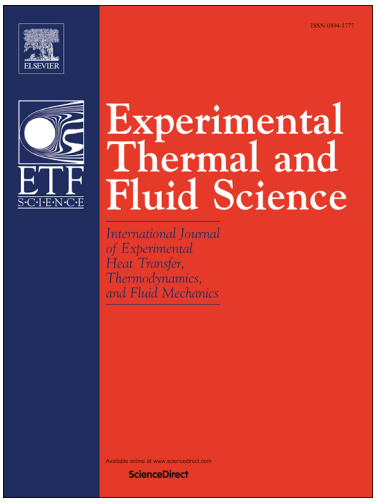

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Critical Heat Flux on Downward-facing Carbon Steel Flat Plates under Atmospheric Condition

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<Abstract>

Carbon steel is used as a heating material in severe accident mitigation components, such as in in-vessel retention through the external reactor vessel cooling (IVR-ERVC) and core catchers strategies, since the reactor pressure vessel and some core catchers in nuclear power plants are made of this material. During a severe accident, molten corium is located on the down plenum or core catcher facility, depending on the strategy; through coolant flow at the downward face that is induced by natural circulation, decay heat is removed. The effect of carbon steel in downward-facing conditions has been considered in previous studies, and the critical heat flux (CHF) enhancement was mainly explained by surface morphology changes induced by corrosion. In this study, SA508 Gr.3 Cl.1 has been used in various orientation and width conditions. The effect of width was evaluated; the burnout point tended to decrease with increasing width. For the assessment of the effect of heater material, the phenomena could be divided into two conditions: narrow and wide. As width size decreased, the CHF enhancement ratio increased for carbon steel compared with stainless steel heaters, especially at high inclination angles. At low angles, the effects of both width and material tended to decrease. The effect of oxidation was assessed with various boiling schemes, static contact angles and dissolved oxygen concentrations in the coolant used for the experiments. Based on the test results, other contributing factors, such as the thermal properties of carbon steel, should also be considered to explain the enhancement.

Keywords: Carbon steel; CHF; downward-facing flat plate