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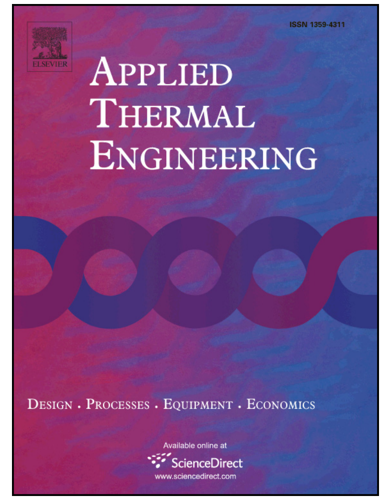

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Numerical Simulation of Sub-cooled Boiling Flow with Fouling Deposited Inside Channels

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Abstract: In this article, a numerical simulation has been performed to investigate the sub-cooled boiling flow in axisymmetric channels using the two-phase particle model. The equivalent diameter of the channel is 4.38 mm with 365.7 cm in length. The fouling deposited layer is filled with subsequent two-thirds of the flow channel. The internal surface of the channel is covered by a fouling deposit layer with a thickness ranging from 0.225 mm to 1.55 mm. Uniform heat flux of 29267.6 W/m^2 is applied on the heated wall. Validation of the CFD model is carried out through comparison with open published experimental data and a close agreement is achieved. A new parameter, Security factor, is introduced and defined in the current study. Numerical results show that the developed two-phase particle model could well predict the water-steam two-phase change flow. The Nusselt number in the fouling region without fouling deposited could be 50 times higher than that with fouling layer. The heat transfer performance of the channel with thickness of 0.225 mm fouling deposit layer is 5 times larger than that with thickness of 1.55 mm fouling deposit layer. It is also found that the inlet velocity has significant impact on the boiling and total pressure drops along the channel.

Keywords: sub-cooled, numerical simulation, boiling, fouling, heat transfer

NOMENCLATURE

A_w	whole surface is covered with bubbles of the wall (m^2)	M_a	momentum from phase β to phase a (kg·m/s)
C_P	specific heat capacity (J/kg·K)	$m_{a\beta}$	transfer of mass from phase β to phase a (kg/s)
d_w	bubble detachment diameter (mm)	Z	distance along the channel (m)
E_a	energy from phase β to phase a (W)	***Greek letters***	
L	length of the channel (m)	h	heat transfer coefficient (W/m^2·K)