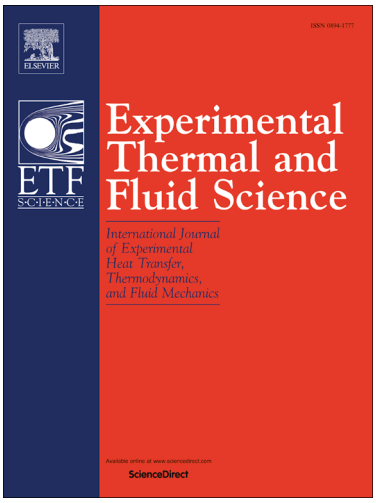

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A correlation for dropwise cooling on metallic microfin surfaces

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Abstract

Dropwise cooling can be of interest in many fields where it is necessary to remove heat from surfaces at a high rate and heat transfer by gaseous convection is not enough. Regrettably, the prediction of the heat transfer rates is still a major issue, particularly on innovative and engineered surfaces. Existing models offer fairly reliable predictions for smooth or isotropically textured surfaces, but information is lacking for surfaces with directional grooves and edges. A correlation is presented here to predict the heat removal rate during evaporation of sessile and impinging drops on microfin metallic surfaces, whose coefficients were fitted on experimental data acquired on aluminium and brass surfaces with triangular microfins. Eight samples, differing in material and microfin dimensions, and drops from sessile to impinging with Weber number up to 40, were studied. The correlation is based on the drop Fourier and Eötvös numbers, on the surface effusivity and on another quantity - the dimensionless free drop height - that summarizes the drop shape. It was developed using surfaces at 70 °C and then validated also against experimental tests at 60 °C and 80 °C. The mean absolute percentage error in the prediction of the heat removal rate in all the investigated conditions is within 6 %.

Keywords: dropwise cooling, microfin surfaces, heat removal rate, evaporating drops, dimensionless correlation

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