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Abstract

Spray cooling heat transfer in the film boiling regime is of great importance to attain stable and uniform cooling. At this, spray cooling using intermittent sprays has been suggested as a technological concept in terms of effectiveness and controlling of the cooling potential (Panão et al., ICMF 2007). A suitable combination of pulse duration and injection frequency promises a reduction of thermal stresses and distortion in components as well as a reduction of coolant.

The transient surface temperatures during intermittent spray cooling features two ranges for each injection cycle: a period of direct liquid-solid contact during the initial phase of spray impact and a period, where a vapour layer is formed. The heat transferred from the wall in this first phase is in order of magnitude higher than the amount of heat transferred through the subsequent formed vapour layer. Characteristics, such as length, temperature drop or mean heat transfer coefficient, depend on the surface temperature as well as on the matching of injection frequency and pulse duration. Furthermore, previous work (Fest et al., ISHT 2008) has been shown that nether the injection frequency nor pulse duration leads to significant changes of droplet diameters and axial velocity distribution. Thereby, changing in heat transfer can not be ascribed to changing of spray properties. A research program is being conducted aimed at characterising the effect of injection frequency on the transient surface temperature as well as on the heat transfer coefficient in the film boiling regime, whereby, the coolant mass flux is kept constant. It is observed that low injection frequencies lead to reheating during the injection cycles with decreasing surface temperature due to the reduced thermal driving force. Nevertheless, the measured decrease in surface temperatures along a serious of consecutive injection cycles shows that the cooling efficiency is enhanced with decreasing injection frequencies. At high injection frequencies, the liquid does not completely vaporise, and the formation of a liquid film becomes the limiting factor of the cooling efficiency.

Key words: spray cooling, intermittent sprays, film boiling, heat transfer coefficient

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