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Wall Boiling Theory and Practice for Immersion Quenching

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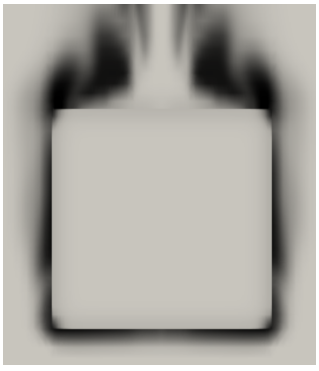
Abstract

The wall boiling boundary condition is the crucial part for successful numerical simulation of immersion quenching. It determines not only the heat transfer but also the mass transfer due to wall bubble nucleation. The more or less conventional approach to nucleate boiling is further widen to take into account other heat transfer regimes. The challenging aspect is the estimation of heat transfer coefficient which vary significantly depending on boiling regime. Other challenging aspect is the wall mass source which needs to be transformed into the volumetric source.

The wall boiling boundary condition is implemented within Eulerian-Eulerian framework and must suit well to a conjugate temperature boundary condition which estimates the temperature between solid and liquid regions.

This paper is going to elaborate on the appropriateness of the wall boiling models, their difficulties caused by the extension for heat transfer regimes such as film boiling and transitional boiling and assessment of the chosen approaches. Last but not least simulation results compared with an experiment will be present and the work procedure will be shown.

The discussion will be based on boundary condition developed by AVL-Fire[1] but implemented in OpenFOAM.



References

[1] Srinivasan, V., Moon, K.-M., Greif, D., Wang, D. M., and hwan Kim, M., "Numerical simulation of immersion quenching process of an engine cylinder head," *Applied Mathematical Modelling*, Vol. 34, No. 8, 2010, pp. 2111 – 2128.