Thermal Hydraulic Study for Heavy Liquid Metal Flows Using COMSOL Multiphysics

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Abstract

Liquid metals are the extensively used as coolants in nuclear reactors. Heat removal by liquid metal is the prime factor determining efficiency of the reactor. However, the heat transfer mechanism differs significantly in low Prandtl number heavy liquid metals (HLM's) than those observed in common fluids. It is crucial to have the accurate heat transfer correlation for the liquid metal to estimate the heat removal efficiency. The present paper describes the use of COMSOL Multiphysics tool for analysing the heat removal phenomena for a circular pipe with molten Lead Bismuth as the process fluid. The Nusselt number have been obtained under a fully developed turbulent flow approximation and is compared with various empirical and experimentally validated liquid metal heat transfer correlations (HTCs). After successful comparison, the same procedure can be applied to estimate the heat transfer correlation for similar heavy liquid metals for fusion reactor applications. This analysis shows the feasibility of using numerical tools in comparing the performance of various liquid metal as a coolant in reactor grade application. The details of the physical problem associated numerical model, analysis procedure and the preliminary analysis results will be discussed in this paper.
Keywords: LBE, nusselt number, numerical analysis, liquid metals, prandtl number

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