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Induction Heating and Electromagnetic Stirring of Bi-Phasic Metal/Glass Molten Bath for Mixed Nuclear Waste Treatment

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Abstract : For nuclear waste treatment and confinement, a specific IN-CAN melting module based on low-frequency induction heating have been designed. The frequency of 50Hz has been chosen to improve penetration length through metal. In this design, the liquid metal, strongly stirred by electromagnetic effects, presents shape of a dome caused by strong Laplace forces developing in the bulk of bath. Because of a lower density, the glass phase is located above the metal phase and is heated and stirred by metal through interface. Electric parameters (Intensity, frequency) give precious information about metal load and composition (resistivity of alloy) through impedance modification. Then, power supply can be adapted to energy transfer efficiency for suitable process supervision. Modeling of this system allows prediction of metal dome shape (in agreement with experimental measurement with a specific device), glass and metal velocity, heat and motion transfer through interface. MHD modeling is achieved with COMSOL and Fluent. First, a simplified model is used to obtain the shape of the metal dome. Then the shape is fixed to calculate the fluid flow and the thermal part.

Keywords : electromagnetic stirring, induction heating, interface modeling, metal load
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