

Two-Phase Measurement with Electromagnetic Flowmeters in the Liquid Metal Two-Phase Flow and Water-Air Two-Phase Flow

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Abstract

In order to investigate the characteristics of an electromagnetic flowmeter in the liquid metal two-phase flow, AC electromagnetic flowmeters were designed and manufactured. Two-phase flow experiments, encompassing bubbly to slug flow regimes were conducted with the water-air mixture and the liquid sodium-nitrogen mixture, respectively. The simple relation $\Delta U_{TP} = \Delta U_{SP} / (1 - \alpha)$, relating flowmeter signal between single-phase flow and two-phase flow, was verified with measurements of the potential difference and the void fraction for a bubbly flow regime. Whereas there is no difference in the shape of the raw signal between single-phase flow and bubbly flow, the signal amplitude of bubbly flow is greater than that of single-phase flow under the same water flow and liquid sodium flow rates, since the passage area of the liquid flow is reduced. In the case of slug flow, the phase and the amplitude of the flowmeter output show a dramatic change in the flow characteristics around each slug bubble and the position of a slug bubble itself. Therefore, the electromagnetic flowmeter shows a good potential as a useful device for identifying the flow regimes. The void fraction can be simply measured with two electromagnetic flowmeters for a low-void fraction flow such as bubbly flow with some error margins. Thus, the flowmeters can be used to measure the void fraction for a liquid sodium within some tolerable error margins.