

Calibration of MHD Flow Meter Using COMSOL Multiphysics

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Abstract

There is limited option for non-intrusive flow measurement of liquid metals at high temperature. Liquid metal flowing in a conduit along with the transverse magnetic field induces emf in the liquid metal. The emf developed; which has linear dependency on flow velocity; can be used for flow velocity estimation. In case of conducting conduit the emf can be measured at the conduit wall. The main hindrance with this technique is the calibration. The induced emf depends upon the thermo-physical parameters like electrical conductivity, viscosity of the liquid metal as well as the electrical conductivity of the conduit wall. The flow meter calibrated with a fluid at some temperature will not behave in the same way with other liquid metal or at another temperature. Usage of flow meter with different fluid necessitates calibration with that fluid at required temperature; which increase the cost of usage. In this paper, an effort has been made, using numerical methods, to eliminate the repeated calibration work for different fluid at different temperature. Physics interfaces from CFD and AC/DC Module in COMSOL Multiphysics have been coupled to imitate the actual scenario. At first, the numerical code has been benchmarked to simulate the calibration data for known fluid at a given temperature. After successful benchmarking, the same code has been used to calibrate the MHD flowmeter for other liquid metal at different working temperature.

Reference

- [1] T Schlenberg, R. Stieglitz; Flow measurement techniques in heavy liquid metals; Nuclear Engineering and Design; 240 ; 2077-2087(2010)
- [2] H.J. Willwnberg, T.J.Kabele, et. al.; Materials flow, recycle, and disposal for deuterium-tritium fusion;PNL-2830 (1978)
- [3] V.Sharma, S.Narmadha, et. al.; Probe type permanent magnet flowmeter; Comsol conference 2010, India
- [4] AC/DC module and CFD module user manual; Comsolmultiphysics 4.3
- [5]. Bhuyan, K. Goswami; Effect of magnetic field on MHD pressure drop inside a rectangular conducting duct; P IEEE Transactions on plasma science, vol 36. No 4.:(1955-1959) August 2008,
- [6]P. L. Kirillov; Thermo physical properties of materials for nuclear engineering, Institute for heat and mass transfer in nuclear power plants, Obninsk 2006
- [7] B.Schulz; Thermophysical properties of the Li(17)Pb(83) alloy; Fusion Engineering and Design 14 ;199-205 (1991)
- [8] S.I.Sidorenkov and A.Ya. Shisko; A variational method of calculating magnetohydrodynamic flows in slotted channels with conducting walls; MagnitnaGidrodinamika, Vol. 27, No4, pp. 87-99 oct-dec, 1991