Mechanical energy transfer in liquid metal MHD flows in DCLL breeding blanket singularities

D. Suarez, E. Mas de les Valls, L. Batet

Universitat Politècnica de Catalunya, Barcelona, Spain

Dual-Coolant Lithium-Lead (DCLL) is one of the breeding blanket proposals for DEMO reactor investigated under EUROfusion consortium. The purpose of this large system is to absorb heat and breed tritium, and transfer them to other systems. Transport phenomena and their dynamics in large engineering process systems like DCLL are commonly analysed with the so-called system codes. System codes consist of a limited number of nodes that are commonly modelled in a way that flow characteristics (as Reynolds number) affect the transport parameters (as heat transfer coefficient or friction factor) and a 0D balance is performed at each node. CFD calculations can be used as numerical experiments able to provide detailed insights on the fluid flow characteristics and at the same time can result in a powerful tool to obtain the transport coefficients to be used in system codes. When an incompressible fluid such as liquid metal encounters a geometrical singularity like expansions and contractions pressure changes do not correspond exactly to head losses because velocity is affected as well. In an expansion, momentum decreases and, consequently, pressure increases. If downflow the fluid contracts again, the mechanical energy transferred from one form of energy to the other is transferred back. Therefore, when a geometrical singularity is analysed the whole mechanical energy transfer needs to be considered. This work analyses numerically liquid metal MHD expansions and contractions from this point of view to contribute to the fluid mechanics knowledge when designing the DCLL breeding blanket.

Key words: momentum transfer, breeding blanket, DCLL, magnetohydrodynamics, computational fluid dynamics