

Overall of the Experiment Implemented in DRAGON Loops for Fusion Blanket

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Helium-cooled Lead Lithium (PbLi) blanket was designed for ITER, CFETR, DEMO and FDS fusion reactors. Before commercial application of fusion energy, PbLi blanket technologies are urgent to be studied, especially the integrated performance of full scale blanket module, PbLi loops play an important role in the development of liquid PbLi blanket technologies out of pile. Series of DRAGON PbLi experimental loops, the largest group and high level loops in the world, have been designed and constructed in China. The thermal convection PbLi testing loops DRAGON-I/II/III, the multi-functional liquid PbLi experimental loop DRAGON-IV, and the large scale dual-coolant experimental loop DRAGON-V were built to validate the key issues, such as the service performance of structural materials, magnetohydrodynamic (MHD) effect, LOCA issues and the purification technology, etc..

Several experiments have been carried out to support greatly the design of FDS fusion reactors and blankets. The corrosion experiments of CLAM steel in flowing PbLi at 480°C for long term showed that the corrosion rate was intensified with increasing of the magnetic field and service time, and the corrosion rate at 550°C was similar with the results of EUROFER steel. The experiment of MHD flow in a rectangular pipe under 2T was conducted, the relative error between theory data by MTC code and experiment results was below 5%, which reached to the same level of test results presented by UCLA. In addition, some key components were validated in DRAGON loops, such as hydraulic performances of EMP, the calibration of flow meter and purification system, and so on.

In this manuscript, the design information of DRAGON loops were described, the material corrosion behavior with/without magnetic field, pressure drop test for MHD effect validation, impurities purification experiment was introduced, and the development plan of PbLi blanket is presented as well.