VAPOR CONDENSATION STUDY FOR HIF LIQUID CHAMBERS*

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The condensation rate of flibe vapors under conditions relevant to a HIF system is experimentally assessed and reported. An HIF system involves using liquid flibe to absorb the energy released by the fusion reaction (x-ray, debris, and neutrons). As a consequence, part of the liquid material vaporizes. Because of the high repetition rates necessary to keep the IFE power plant economically competitive, the issue of chamber vapor clearing plays an important role in demonstrating the feasibility of the concept. In the laboratory experiment, the prototypical dynamic characteristics of the excited vapor are obtained by rapidly passing a large current generated from a pulsed electric arc to a pool of molten flibe. The excited vapor expands inside a chamber that has been scaled to reproduce IFE conditions, and condenses as it comes in contact with the chamber walls, in which are maintained at a controlled temperature. The pressure history in the chamber and the residual gas composition are recorded to characterize condensation rates. The experiment results show that chamber clearing can be characterized by an exponential decay with a time constant of 6.58 milliseconds. The resulting period for chamber clearing for IFE systems requirements is 60 milliseconds. The conclusion is that condensation rates are sufficiently fast to allow the required repetition rates, but that the problem of the feasibility of the use of flibe in IFE systems lies in the control of the impurities dissolved in the salt.

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