§38. Study on Design and Experiment of Tritium Recovery System from Blanket of Falling Liquid Layer of Laser Fusion Reactor

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Koyo is a concept for commercial laser fusion reactor designed by Osaka Univ. D-T solid pellets are injected into a chamber, and D-T burning due to inertial fusion reaction is induced with intensed laser irradiation. In order to avoid heavy neutron irradiation damage and to produce T, liquid wall concept of falling liquid $Li_{17}Pb_{83}$ eutectic alloy is adopted. LiPb is selected because of low vapor pressure, low T solubility and comparatively easy T recovery. LiPb works as a protection film of the chamber wall and a T breeder through the n-Li reaction. The net power is expected 1GWt and the T production rate is 1.5MCi/day. Tritium and heat are simultaneously recovered from the outside LiPb loop. The high T recovery ratio from the loop and the low T permeation rate through heat-exchanger walls are inevitable. The allowed T leak rate is around 10Ci/day.

In order to design the recovery apparatus of T and heat from the LiPb loop, correct data of T solubility, diffusivity and permeability are necessary. In the present study, their data are determined by means of a permeation method [1-5]. The results determined in the present study, which are determined in the operating temperature of the laser fusion reactor, are correlated in **Figs. 1** and **2**. The isotope effects in solubility and diffusivity are correlated in terms of the harmonic oscillation model and the zero-point energy in the solution site surrounded by Li and Pb atoms. The corresponding values for T can be estimated using the zero-point energy at the solution site and the saddle-point site.

The demanded simultaneous recovery rates of tritium and heat can be achieved by the system illustrated in **Fig. 3**. The conditions of temperature, the T concentration in LiPb and steam flows, the flow rate and the area of heat exchanger are estimated. The balance of T and heat is estimated using the mass-transfer parameters.

1) S. Fukada, Y. Edao, A. Sagara, Fusion Engineering and Design, in printing as a proceeding of ISFNT-9.
2) Y. Edao, H. Noguchi, S. Fukada, Fusion Engineering and Design, in printing as a proceeding of ISFNT-9.
3) Y. Edao, S. Fukada, H. Noguchi, et al., Fusion Science and Technology, 56 (2009) 831-835.
4) Y. Maeda, S. Fukada, Y. Edao, Fusion Science and Technology, 54 (2008) 131-134.
5) S. Fukada, Y. Edao, Y. Maeda, T. Norimatsu, Fusion Engineering and Design, 83 (2008) 747-751.

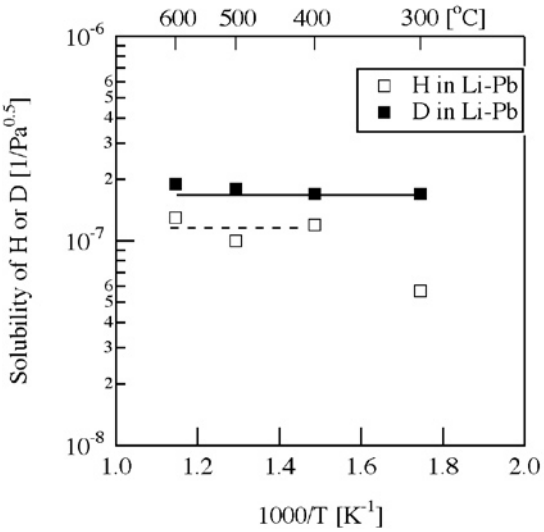

Fig. 1 H or D solubility in $Li_{17}Pb_{83}$

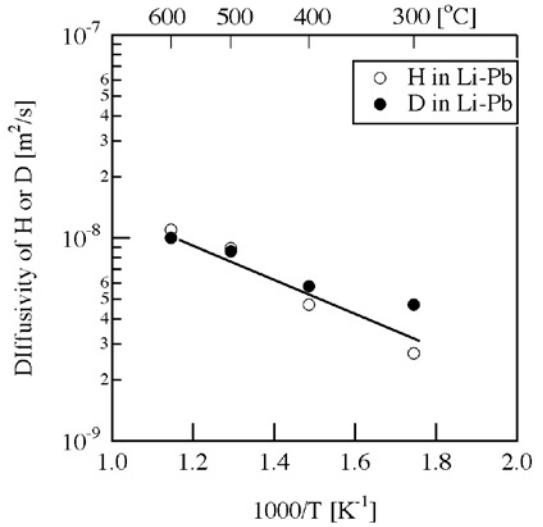

Fig. 2 H or D diffusivity in $Li_{17}Pb_{83}$

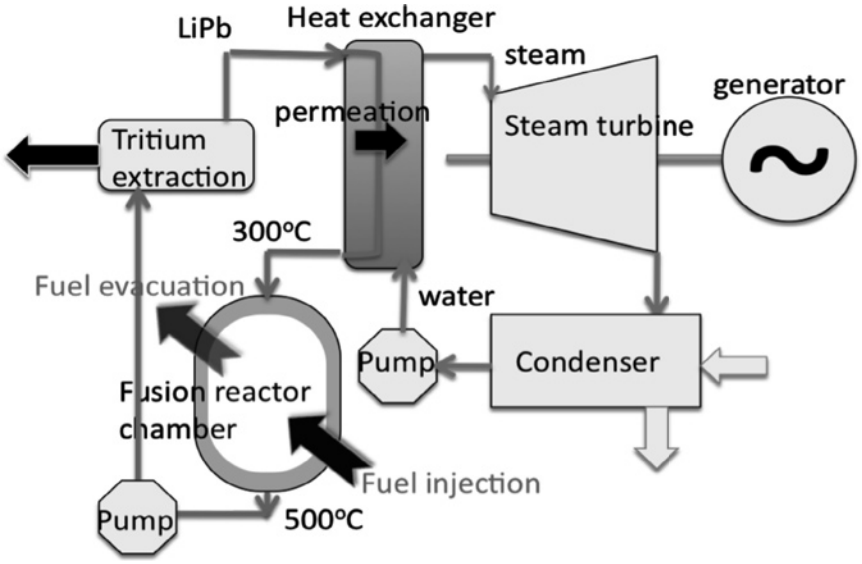

Fig. 3 LiPb and steam loops for Koyo laser fusion reactor