§15. Experimental Study on Enhancement of Recovery Rates of Hydrogen Isotope and Decrease of its Permeation in Flibe Blanket of Fusion Reactor

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Collaboration study between NIFS and Kyushu Univ. has been performed for the design and experiment of a Flibe loop in the FFHR. Solubility and diffusivity of hydrogen isotopes in Flibe and Flinak were determined so far, and redox control of Flibe was successfully proved using a Be rod immersed in Flibe. The chemical form of tritium generated in Flibe was changed to a molecular form of T_2 by the reaction of $2TF+Be \rightarrow BeF_2+T_2$. Tritium recovery from neutron-irradiated Flibe was also numerically simulated as seen in Fig. 1.[1)] Close agreement between experiment and calculation is obtained.

A He-Flibe counter-current extraction tower of Fig. 2 is designed for the continuous recovery from the primary Flibe loop of the FFHR-2 conceptual design. The tower is packed with Rashig ring to keep good contact between He and Flibe and is operated at 500°C. Tritium is efficiently recovered from the Flibe flow by He purge gas in this tower design.[2)]

Special attention is paid to tritium permeation in the overall Flibe/He loop. In order to achieve stable and safety operation of FFHR-2, 1.5 MCi/day of tritium generated in the Flibe blanket is recovered under conditions of very low tritium inventory. At the same time, tritium is recovered by the He-Flibe extraction tower, and reactor heat is recovered by the heat exchanger with the total tritium permeation rate less than 10 Ci/day.[3)] Tritium migration and local inventory is estimated based on the primary Flibe loop and the secondary He loop shown in Fig. 3.[4)] The Flow rates of Flibe and He and temperature conditions are shown in the figure. So that, oxide coating with low tritium permeability is inevitable for the safety operation of FFHR-2.[5)]

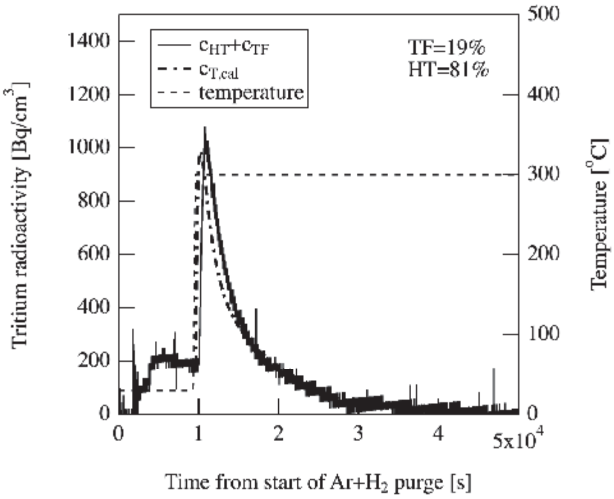

Fig. 1 T release curve from neutron-irradiated Flibe[1)]

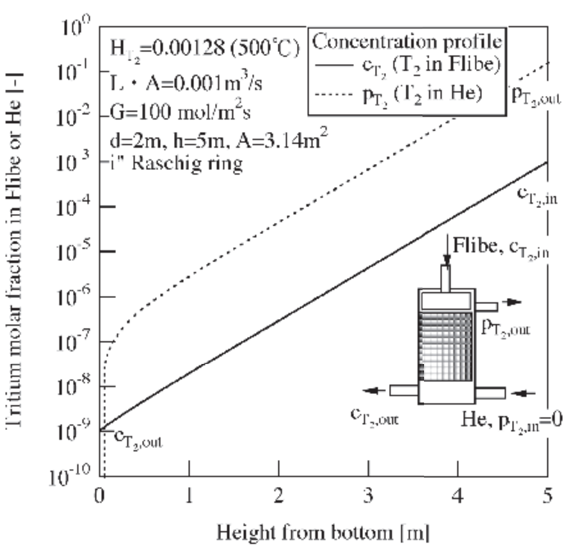

Fig. 2 T concentration in He-Flibe extraction tower

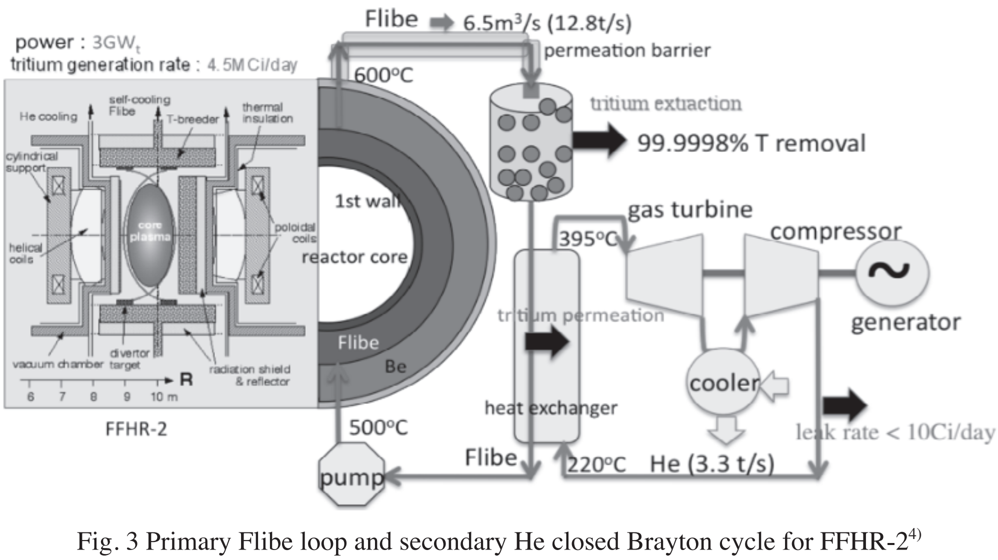

Fig. 3 Primary Flibe loop and secondary He closed Brayton cycle for FFHR-2[4)]

1) Edao, Y. *et al.*, Fus. Sci. Technol., 55 (2009) 140.
2) Fukada, S. *et al.*: Annual Report of NIFS, (2010) 286.
3) Ko, S. *et al.*: J. Kyushu Kyoritsu Univ. Research Center, **4** (2010) 13-18.
4) Fukada, S. *et al.*: Fus. Eng. Des., 85 (2010) 1314-1319.
5) Fukada, S. *et al.*: Proc. 15th ICENES-2011, San Francisco, (2011), Trans. Fus. Sci. Technol., in printing.