IFERC Newsletter

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International Fusion Energy Research Centre, Rokkasho, Aomori 039-3212, Japan

Status of DEMO R&D Activity

Highlights in development of materials corrosion database

Task 4 is composed of two main activities: (sub-task 4-1) Material corrosion/erosion handbook development, and (sub-task 4-2) Activated Corrosion Product (ACP) evaluation model development for fusion in-vessel components.

Regarding sub-task 4-1, the main achievements are (1) corrosion test apparatuses under fusion-specific environments were developed to obtain basic data on corrosion and environmental embrittlement of blanket and divertor systems, (2) corrosion characteristics of RAFM and CuCrZr alloys in high-temperature and high-pressure water were further evaluated specifically addressing on the effect of water radiolysis, and (3) the literature review on EUROFER corrosion in PbLi, effects of irradiation, magnetic field, and chemistry on corrosion has been completed.

Relating the 2nd item above, the hydrogen peroxide injection system was equipped to the hydrogenated disk corrosion test system and stress corrosion cracking test systems as shown in Fig-1. As an initial assessment of the effect of hydrogen peroxide, an evaluation of the effect of hydrogen peroxide injection rate on the hydrostatic corrosion rate was conducted. Hydrogen peroxide injection hydrostatic water corrosion tests were conducted in high-temperature, high-pressure water at a temperature of 300°C and a pressure of 15 MPa using 20 x 10 x 1 mm coupon-shaped specimens. Based on the results, the corrosion rate decreased with increasing hydrogen peroxide injection rate, resulting in suppressed weight change, and a guideline was obtained that the addition of hydrogen peroxide should be considered as a future corrosion data acquisition policy.

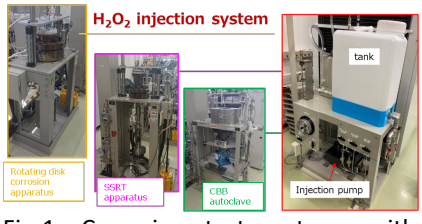

Fig-1: Corrosion test systems with hydrogen peroxide injection apparatus.

As for sub-task 4-2, the three planned actions have been mainly achieved; (1) for the tritium behavior, the R&D evaluated the permeation behavior from tritiated water and the effect of the oxide film formed on the F82H surface on hydrogen isotope permeation behavior, (2) in relation to the ACP evaluation code, EU-DEMO Divertor Primary Heat Transfer Systems have been modeled using the OSCAR-Fusion v1.3 code developed by the CEA of Cadarache (France), and (3) a corrosion database of EUROFER in LiOH-added water was constructed as input data for ACP evaluation and validation.

Relating to the 3rd item above, corrosion tests were performed using an autoclave equipped with a rotating sample holder system and an experimental corrosion loop, named HTHP (High Temperature High Pressure). A summary of the corrosion testing results performed in autoclave related to LiOH water chemistry is presented in Fig-2 below. Fig-2 shows (a) the correlation between the corrosion rate of EUROFER as a function of LiOH concentration, (b) a diagram of the iron concentration versus LiOH concentration, and (c) the correlation of the final water pH measured at room temperature as a function of LiOH concentration.

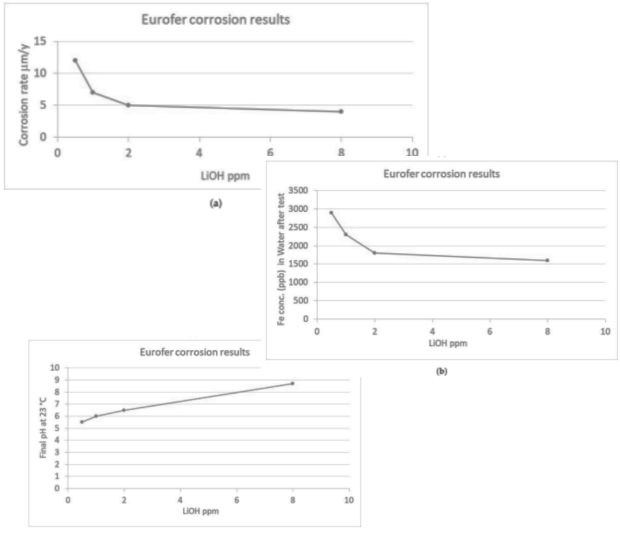

Fig-2: Summary of the EUROFER corrosion results performed in autoclave and corrosion loop HTHP facilities

(DEMO R&D Task-4 TROs)