Compatibility of Indian RAFMS with molten Pb-17Li at 773K.

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The Lead–Lithium cooled Ceramic Breeder (LLCB) has been proposed by India as the blanket concept for its Test Blanket Module (TBM) to be tested at the International Thermonuclear Experimental Reactor (ITER). Lead-17 atom% Lithium eutectic (Pb-17Li) will be used as a coolant for the LLCB-TBM where as Indian Reduced Activation Ferritic Martensitic Steel (IN-RAFMS) has been proposed as the structural material. In this regard, a number of compatibility experiments have been carried out for investigating the compatibility of IN-RAFMS with molten Pb-17Li under static and dynamic conditions. Most of these tests have been conducted at 773K which is expected to be the maximum temperature experienced by molten Pb-17Li when in contact with the structural material inside the Indian TBM. Corrosion of IN-RAFMS and modified 9Cr-1Mo steel (P91) have been studied in static Pb-17Li for 355 h at 773 K. Exposure to Pb-17Li led to a loss of weight in P91 whereas IN-RAFMS gained weight possibly due to its longer incubation period and post-exposure surface oxidation. The compatibility of IN-RAFMS material with Pb-17Li has also been investigated in a rotating disc type corrosion test facility at 773 K for 3000 h. A corrosion rate of 11.45 µm/y was observed for the IN-RAFMS disc rotating with a peripheral velocity of 1.14 m/s. Another experiment in the same facility has revealed the nature of variation in weight loss of IN RAFMS with time of exposure in Pb-17Li for durations up to 4000 h at 773 K. The results also showed that cleaning of the adherent Pb-17Li layer after 2000 h of exposure led to increased weight loss in the subsequent 2000 h as compared to the un-cleaned samples. On the other hand, an electromagnetic pump driven Pb-17Li Loop (EMPPIL) has been installed and operated with corrosion coupons of IN-RAFMS exposed to flowing Pb-17Li at 773 K for 5000 h continuously. EMPPIL consists of important components like the permanent magnet based electromagnetic pump, heat exchanger, test section, level sensors and electromagnetic flow meter. The loop has been operated with a pump rotation speed of 360 RPM. After completion of the experiment, detailed analyses of the exposed IN-RAFMS samples and lead-lithium eutectic have been performed. All the above experimental results will be discussed in detail in the present paper.

Keywords: LLCB-TBM, Corrosion, IN-RAFMS, Pb-17Li, 773 K.