Long-term thermal stability of reduced activation ferritic/martensitic steels as structure materials of fusion blanket

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Blanket is one of the important components of fusion reactors, which provide the primary heat transfer and tritium breeding systems. Currently, reduced activation ferritic / martensitic (RAFM) steels are considered as the primary candidates for blanket structural components because of their most matured industrial infrastructure and relatively good radiation resistance [1]. In these applications, they will withstand high temperature for long periods of time. Although the thermal stability behavior is one of the critical issues, the research to understanding the performance is not sufficient.

In this work, thermal ageing with temperature ranging from 823 to 973 K on JLF-1 and CLAM steels was carried out and the mechanical properties were tested. The temperature of 823 K was chosen to test at the upper temperature limit in fusion reactors, and 973 K to accelerate the aging effects. The Larson-Millar parameter, the time-temperature relationship, was proposed to describe the long term behavior [2]:

$$P = T * (C + \log t) * 10^{-3} \quad (1)$$

Where the T is the temperature, K, C is the constant and t is the rupture time, hour.

The results showed that strengthening by ageing at 823 K for 2000 h and softening at 973 K for 100 h occurred, as shown in Fig. 1. According the Larson-Millar parameter, prediction of the long-term aging effects from the short-term experiments for assessing the design window of RAFM was carried out.

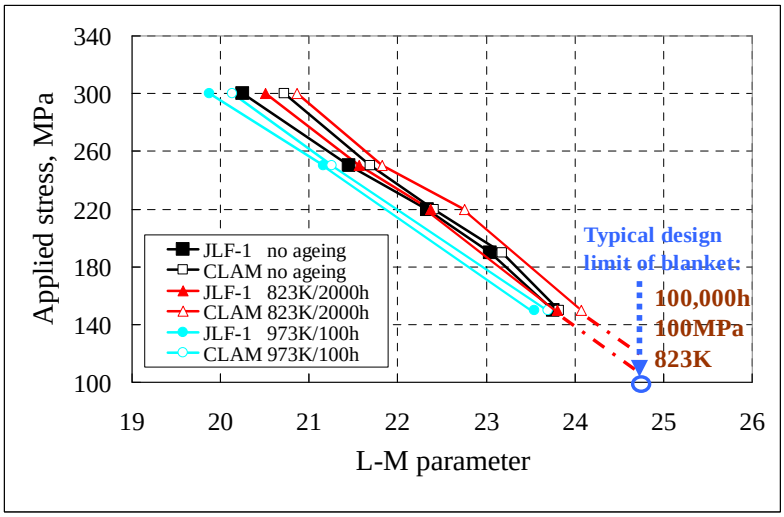

Fig. 1 Larson-Millar parameter to predict the long term behavior

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[2] F.R. Larson, J.Miller, Trans. ASTM **74** (1952) 765.