§8. Effect of Thermal Ageing on Mechanical Properties of JLF-1 and CLAM Steels

Li, Y.F. (Grad. Univ. Advanced Studies),
Nagasaka, T., Muroga, T.

Introduction

In fusion reactor, the structure material will be exposed during long-time load at higher temperatures [1]. One of critical issues for Reduced Activation Ferritic / Martensitic (RAFM) steels, the primary candidate material, is the stability of mechanical properties and microstructure by ageing [2]. In this work, the effect of thermal ageing of the Japanese candidate JLF-1 and Chinese candidate CLAM steels on mechanical properties were investigated.

Experimental procedures

The materials used were JLF-1 (JOYO-II-HEAT) and CLAM (HEAT 0603) steels.

Thermal ageing treatments were carried out at 823 K up to 2000 h to simulate the in-service condition and at 973 K for 100 h to provide an accelerate condition. Tensile test was conducted from RT to 873 K at an initial strain rate of 6.67×10^{-4} s^{-1}. The creep test was preformed at 823K with the stress of 250 MPa in a vacuum of $< 1 \times 10^{-4}$ Pa.

Results and discussion

Tensile results

The tensile results are shown in Fig. 1.

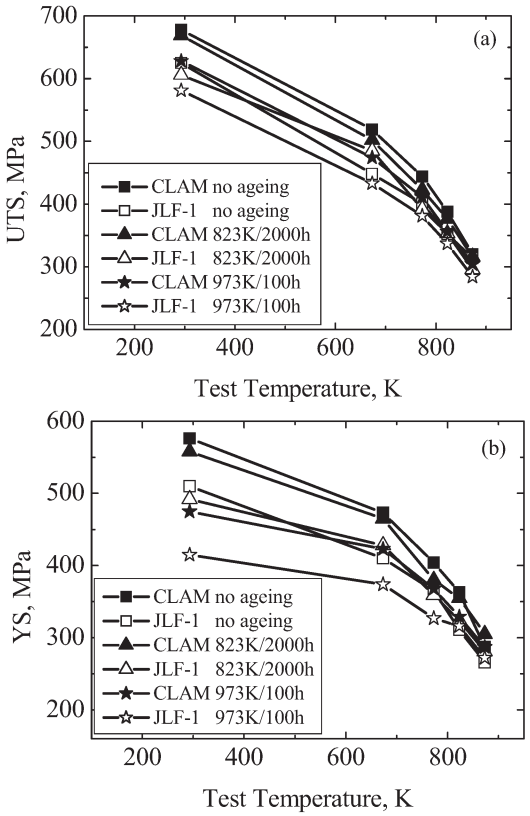

Fig. 1 Tensile properties: (a) UTS; (b) YS

The results shown that there are no significant degradation of ultimate tensile strength (UTS) and yield strength (YS) were detected after ageing at 823K for 2000h. However, the strength decreased after ageing at 973K for 100 h. The strength of CLAM was higher than that of JLF-1.

Creep results

Fig. 2 shows the results of creep properties tested at 823 K with the stress of 250 MPa.

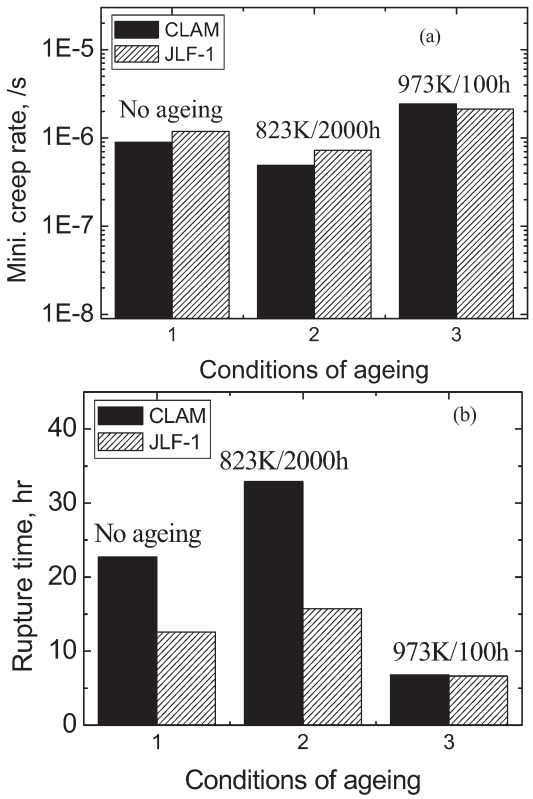

Fig. 2 Creep properties tested at 823 K / 250 MPa: (a) minimum creep rate; (b) rupture time

After ageing at 823 K for 2000 h, the minimum creep rate decreased and the rupture time increased for both steels, relative to the no-ageing case, suggesting strengthening occurred. However, the creep properties degraded after ageing at 973 K for 100h.

Summary

By ageing at 823 K for 2000 h, tensile properties did not change significantly, and creep properties improved for both steels relative to no-ageing case. These results imply that the strengthening could occur by the ageing.

By overageing at 973 K for 100 h, tensile strength decreased and creep properties degraded.

The examination for microstructures before and after ageing by SEM and TEM is in progress.

1) T. Muroga, M. Gasparotto, S.J. Zinkle: Fus. Eng. & Des.61-62 (2002) 13-25.
2) Y. de Carlan, A. Alamo, M.H. Mathon, etc.: J. Nucl. Mater. 283-287 (2000) 672-676.