EXTRACTION RESIDUE ANALYSIS ON F82H-BA07 HEAT AND OTHER REDUCED ACTIVATION FERRITIC/MARTENSITIC STEELS

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In order to develop fabrication technologies for DEMO fusion reactor, reduced activation ferritic/martensitic steel (RAFM) F82H-BA07 heat (Fe-8.00Cr-1.88W-0.09C-0.017N-0.19V-0.03Ta) was produced in the research framework of Broader Approach. The purpose of the present study is to reveal precipitation behavior of the F82H-BA07 heat from extraction residue analysis. The results were compared to those of the other RAFMs, such as F82H-IEA heat (Fe-7.71Cr-1.95W-0.09C-0.006N-0.16V-0.02Ta), JLF-1 (Fe-9.00Cr-1.98W-0.09C-0.015N-0.2V-0.083Ta) and CLAM (Fe-8.94Cr-1.45W-0.13C-0.19V-0.15Ta) steels to understand the effect of minor element addition and annealing conditions.

Table 1 lists the annealing and aging conditions for the RAFMs used in the present study. Coupon specimens with the size of 10 x 20 x 1 mm were prepared from these steels. The specimens were examined by extraction residue tests with the standard methods of JIS G0577 and JIS G0579. The extraction residue was separated by using the different filters, such as 0.05, 0.1 and 1 μm. The filters containing the residues were chemically analyzed by inductive-coupled plasma atomic emission spectroscopy. X-ray diffraction analysis, microstructural observations with scanning electron microscopy, transmission electron microscopy and energy dispersive X-ray spectroscopy were conducted on the residues. Vickers hardness tests were performed on the coupon specimens with a load of 500 g for 30 s.

Total amount of extraction residues were similar to each other among the RAFMs. According to the size separation and chemical analysis for the residues, size of precipitates containing Cr, Fe and W in F82H-BA07 heat was larger than that in the other steels. The precipitate growth was likely due to the larger heat load by the two step normarizing for F82H-BA07 shown in Table 1. No significant difference in the precipitation behavior of the minor elements, such as V and Ta, was observed in the present study.

Aging at around 500 ^{o}C induced slight hardening for F82H-IEA heat, while softening was observed above 600 ^{o}C. This behavior is similar to JLF-1 and CLAM steels. From the extraction residue analysis, it is indicated that the softening is mainly caused by reduction of W in solid solution state due to the precipitation of Laves phase, and growth of $M_{23}C_6$ type precipitates.

Table 1 Annealing and aging conditions for the reduced activation ferritic/martensitic steels.

Code	Normalizing	2nd normalizing	Tempering	Aging
F82H-BA07	1040 ^{o}C x 40 min	960 ^{o}C x 30 min	750 ^{o}C x 60 min	
F82H-IEA	1040 ^{o}C x 40 min		750 ^{o}C x 60 min	400~650 ^{o}C x 100 khr
JLF-1	1050 ^{o}C x 60 min		780 ^{o}C x 60 min	550~650 ^{o}C x 2 khr
CLAM	980 ^{o}C x 60 min		760 ^{o}C x 90 min	550~650 ^{o}C x 2 khr