TECHNICAL NOTE

Corrosion of Hastelloy-N in Molten Flinak Loop†

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Technologies of storing energy and search of appropriate materials for the generation of electricity by alternation from atomic energy or nuclear fusion reactor become more and more important after recent energy crisis. As the substances for storing heat energy, molten salts are promising ones because these are chemically stable and inexpensive. Besides, molten salts occupy an important position in molten salt breeder reactor as coolant[1] and are promising as a blanket material in nuclear fusion reactor. However, problems for the compatibility of molten salt with vessel materials have not fully been investigated.[2)3)] In this study, in the light of present situation, compatibility of flinak (LiF - NaF - KF eutectic salt) with Hastelloy-N was investigated.

Flinak was prepared from regent LiF, NaF and KF. Main impurities were Li_2CO_3 and H_2O, and these contents were 0.07 mol% and 0.15 mol%, respectively. **Table 1** shows the chemical composition of Hastelloy-N

Table 1 Chemical composition of Hastelloy-N

Ni	Mo	Cr	Fe	Mn	Al	W	Si	Co	C
Bal.	16.28	7.52	3.97	0.52	0.26	0.06	0.50	0.07	0.05

used in this study. Flinak was melted at 750°C in the higher temperature side (hot leg) and at 685°C in the lower temperature side (cold leg). Temperature-gradient mass transfers of chromium, molybdenum, nickel and iron in molten flinak loop and corrosion of Hastelloy-N were investigated by weight loss[4)], SEM observation and X-ray microanalysis (XMA). Hastelloy-N specimens were shaped to be rectangle (about 5 x 16 x 0.4mm) and these ten fragments were chained using platinum wires. Each chain was hanged down into hot and cold legs, respectively. The shape of loop is shown in **Figure 1**. Weight loss of

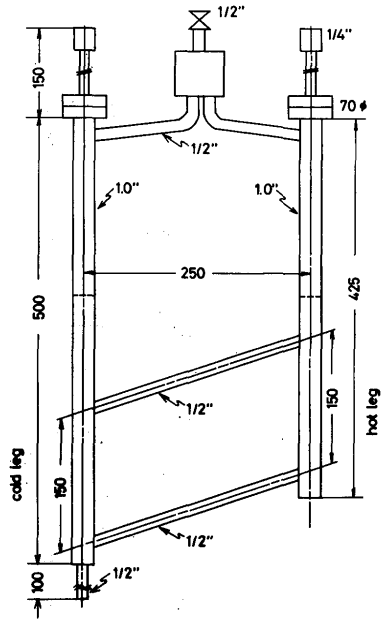

Fig. 1 Molten flinak loop apparatus

each specimen fragment was measured after immersed into molten flinak for 500 hr. Then, these specimens were lightly etched by aqua regia saturated with copper (II) chloride and these surface appearances were observed by SEM. Further, the distributions of chromium, molybdenum, nickel and iron near surface were measured using

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XMA by energy disperison method.

Weight losses of Hastelloy-N fragments are shown in **Figure 2**. The weights of these specimens in both legs

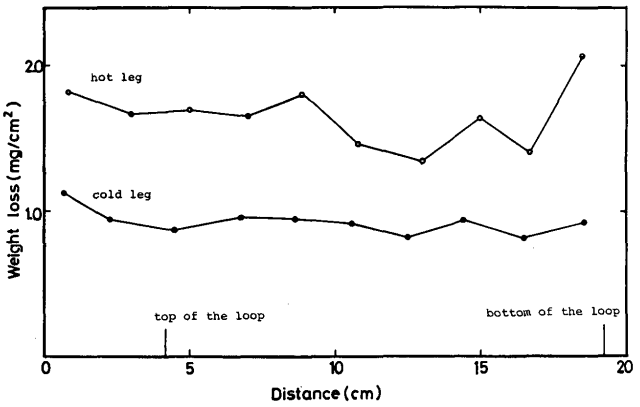


Fig. 2 Weight loss of each Hastelloy-N fragment

decreased and maximum weight loss was 2.06 mg/cm^2. As shown in **Figure 3**, chromium enrichness was observed in the region of about 10 μ in depth from surface in all specimens. Distributions of chromium, molybdenum, nickel and iron showed similar patterns in all specimens, respectively. Typical result is shown in **Figure 4**. Concentrations of chromium and molybdenum began to decrease from about 15 μ in depth from surface whereas those of nickel and iron increased from the similar depthes with approaching to surface. Further, the deposition of molybdenum on surface was locally observed in a specimen in cold leg as shown in **Figure 5**. However, the deposition of chromium on surfaces of specimens in cold leg was not observed.

The appearance of chromium enriched region has not been reported and this new observation may be due to the short circulating time of thermal convection loop. No deposition of chromium and molybdemum on surfaces of all specimens in cold leg, except locally deposition of molybdenum, suggests that the reaction between molten flinak and Hastelloy-N is in a initial stage. Observation of weight loss in both legs may also support the possibility of the deposition on the lowest temperature position of loop, so that detailed observation of inner wall of loop and chemical analysis of flinak after experiment are desired. From the result of X-ray microanalysis, it was suggested that dissolution of molybdenum and chromium are independent on the existence of grain boundary, though XMA may not perfectly identify micro-segregation of these elements in grain boundary. In the future, more detailed investigations including the relation between dissolved water in flinak and corrosion rate of Hastelloy-N are necessitated.

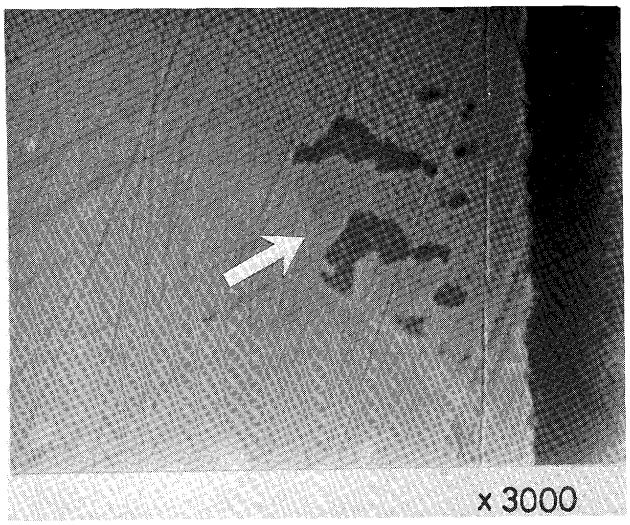
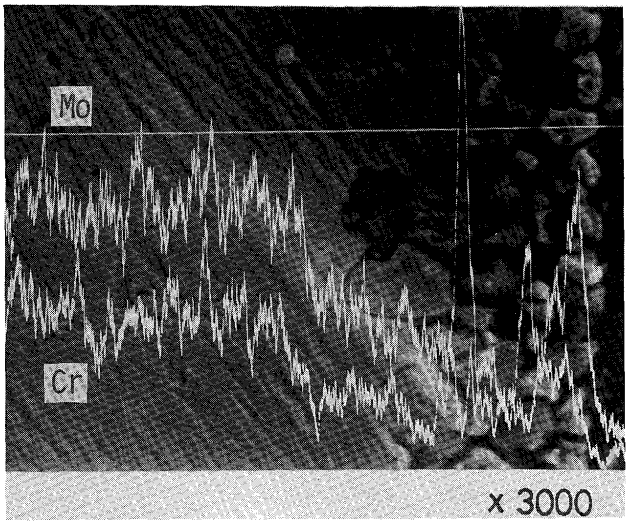


Fig. 3 Scanning electron micrograph of chromium enriched region in a non-etched Hastelloy-N specimen



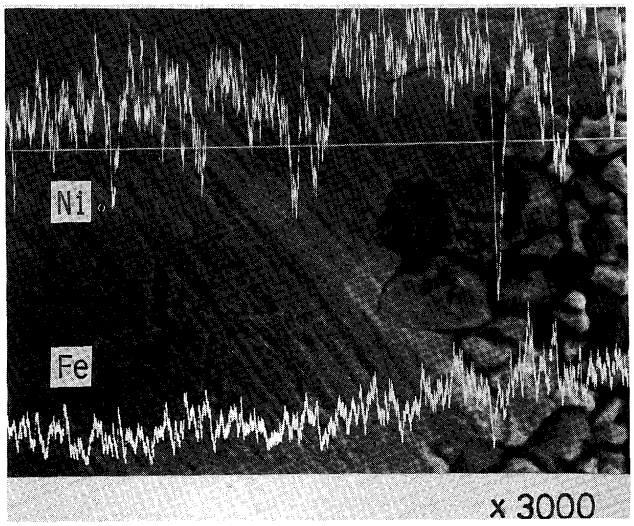


Fig. 4 Distributions of Mo, Cr, Ni and Fe near surface

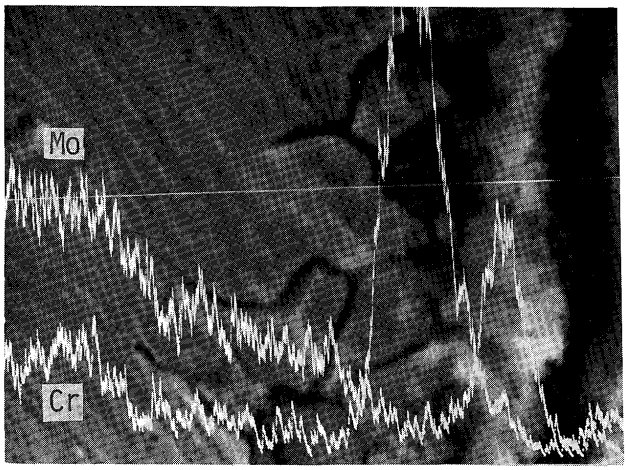


Fig. 5 Local deposition of Molybdenum on the surface of a Hastelloy-N specimen in cold leg.

Acknowedgement

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