

**Alloy 600 690****The Electrochemical and Stress Corrosion Cracking Behavior of Alloy 600 and 690  
in High-Temperature Caustic Solutions**

,  
 150  
 ,  
 300  
 가 280~315 NaOH Cr  
 Alloy 600 690 가 .  
 Ni 가 C-ring  
 , 가 .

**Abstract**

The electrochemical and the stress corrosion cracking behavior of Alloy 600 and 690 were evaluated in sodium hydroxide solution at the temperature range of 280~315 . The anodic polarization curves were measured to comprehend the dissolution and passivation kinetics of the two alloys and pure nickel and chromium. The resistivity of the oxide film formed on Alloy 600 was also estimated by in-situ electrochemical impedance measurements. In addition, the crack propagation rate was measured using C-ring specimens at various applied potentials and solution temperatures. The stress corrosion cracking behavior was discussed in a viewpoint of anodic polarization behavior, film properties and activation energy for crack propagation.

*Keywords* : caustic IGSCC, Alloy 600, Alloy 690, passivity, impedance, film property, activation energy

**1.**

가

Alloy 600 1 2

가

1999

51

, 20

[1].

가

2

가

. 2 pH

. pH가 10

가

mV

. pH 5

Alloy 600 [2].

가 pH 2 order

가 가 [3].

가 pH

pH

, silica

가

NaOH

Alloy 600

가

Alloy 600

Alloy 690

[4]. 가

가

가

280~315

NaOH

Alloy 600 690

가

## 2.

### 2.1

Alloy 600(Heat No. NX9824)

690(Heat No. 766881)

19.05 mm,

1.10 mm

4

flattening

5 mm

10 mm

가

Table 1

NaOH

a.c.

Alloy 600 lead wire

Teflon

. Ni

Ni-200

Ni

5% H<sub>2</sub>-95% N<sub>2</sub>

가

1.38

MPa (200 psi) 가

2

, 1

350 cc/min

cover gas

5% H<sub>2</sub>-95% N<sub>2</sub>

가

1.38

MPa 가

20 mV/min

Ni

315 10% NaOH Alloy 600  
 150, 200, 250, 300, 400 mV 2 가

2-3.

22.22mm, 가 1.23mm Alloy 600 (H602019)  
 Alloy 690(Heat No. 766881), Table 1 . C-ring  
 가 Alloy 600 1.50mm 가  
 3 C-ring  
 10% NaOH 280, 300, 315 가  
 Ni 120, 150, 200 mV C-ring 가  
 5

Table 1. Chemical composition of Alloy 600 and 690 (wt%)

Element Heat No.	Ni	Cr	Fe	C	Si	S	Mn	Cu	Ti	Al	Co	P	B	Nb	Mo	N
NX9824	75.28	15.57	8.31	0.026	0.10	<0.001	0.20	0.01	0.32	0.17	<0.001	0.004	0.004			0.009
H602019	74.8	15.5	8.4	0.02	0.2	0.001	0.20	0.1								
766881	58.9	29.57	10.54	0.02	0.22	0.001	0.32	0.019	0.26	0.019	0.01	0.015	0.0004	0.1	0.01	0.017

2-4.

C-ring scanning Auger  
 electron spectroscopy(AES) . Cr Cr  
 . Sputtering SiO<sub>2</sub> 82 Å/min .

2.

3-1.

Fig. 1 315 10% NaOH Alloy 600 Cr Ni  
 Alloy 600 . Alloy 600 가 -  
 (active-passive transition) . Ni 140, 490, 880 mV  
 . Cr Ni 1 1 order  
 가 400 mV (transpassive) . Alloy  
 600 110 mV - Ni 1  
 500 mV 가 Cr Ni 2

Alloy 600 870 mV Ni  
 3 , 1080 mV Ni

315 0.1%, 1%, 10% NaOH Alloy 600 690  
 Fig. 2 . NaOH 가 0.1% 10% 가 1 order 가  
 가 가 . 0.1% - 가 Alloy  
 NaOH - 가 Alloy  
 600 690 가

Cr Alloy 600 15% Alloy 690 30%  
 가  
 149 50% NaOH Alloy 690 Fe-base Alloy 800  
 [5] caustic

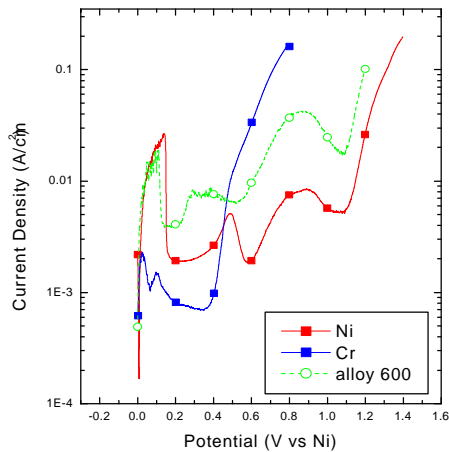


Fig.1 Polarization curves for Ni, Cr and Alloy 600 in 10% NaOH at 315°C .

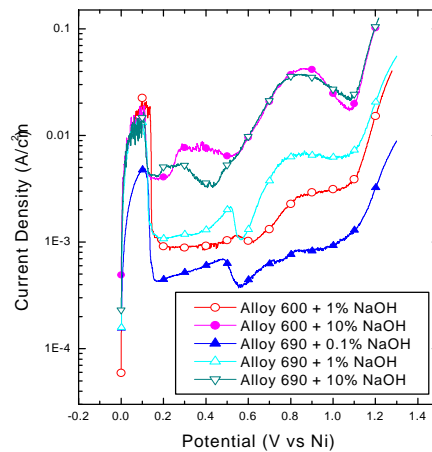


Fig.2 Effect of NaOH concentration on the anodic polarization behaviors of Alloy 600 at 315°C .

Fig. 3 315 10% NaOH  
 가 가 가  
 150, 200, 300, 400 mV 가  
 가 가  
 가  
 . Saario[6] 300 1 M  
 NaOH  
 300 mV  
 Alloy 600

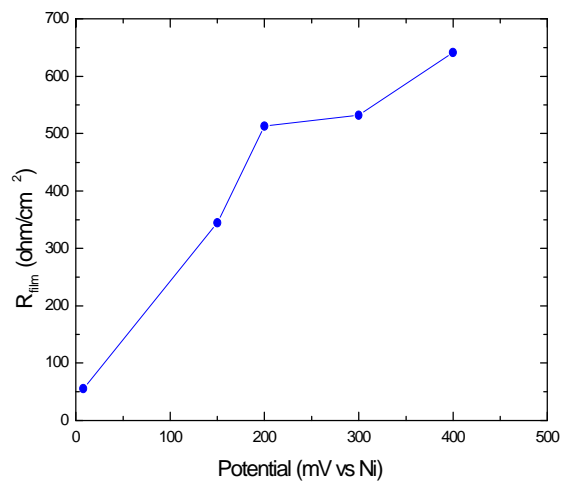


Fig. 3 Effect of polarization potential on the film resistance of Alloy 600 in 10% NaOH at 315°C .

300 mV

가

Saario

150~200 mV

400 mV

가

가

3-2.

Fig. 4 315 10% NaOH Alloy 600 가

가 110, 150, 200 mV

가 가 , 200 mV

가 150~200 mV [7,8]

200 mV

200 mV

10% NaOH

Fig. 5

280, 300, 315

150 mV

가

5

22.7 kcal/mole

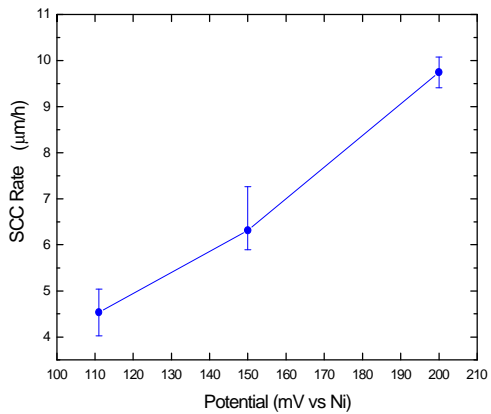


Fig. 4 Effect of polarization potential on the SCC rate in the 10% NaOH solution at 315

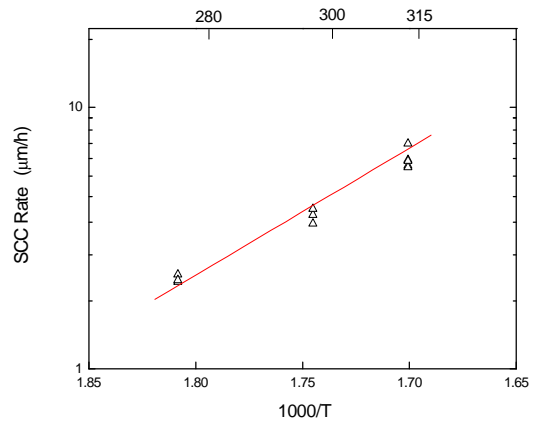


Fig. 5 Effect of Temperature on the SCC propagation in the 10% NaOH solution at 315

315 10% NaOH 150 mV

가

C-ring

Fig. 6

AES

Fig. 7

Cr

Ni-Fe

Ni-Cr-

duplex

Fe

IGSCC Alloy 600 [9,10]. Ni, Cr, Fe  
 300 Pourbaix diagram[11] 316 [12] 가 150  
 mV -1.15 ~ -1.25 V<sub>SHE</sub>, Ni NiO  
 , Cr CrO<sub>2</sub><sup>-</sup> Fe Fe<sub>3</sub>O<sub>4</sub> HFeO<sub>2</sub><sup>-</sup>  
 . Cr caustic Fe CrO<sub>2</sub><sup>-</sup>  
 Fe depth-profile Fe  
 Cr , Ni NiO 가  
 Ni  
 Alloy 690 7

Fig. 2

가 Alloy 600 690 caustic  
 . Fe-base Ni-base  
 Cr ,  
 Alloy 600 315 10% NaOH Cr  
 [13] Alloy 690 Alloy 600  
 Cr Alloy 690  
 Alloy 690 가 Cr 가

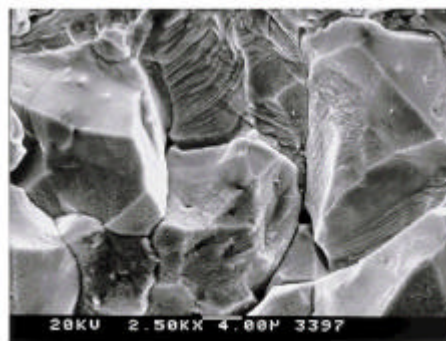


Fig. 6 SEM morphology of crack tip after exposure to 10% NaOH solution at 315 K

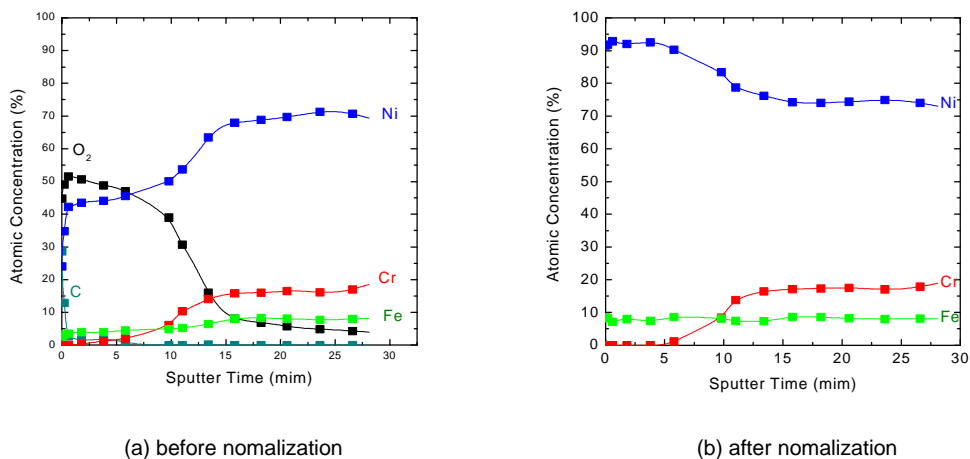


Fig. 7 AES in-depth composition profiles of alloy 600 in 10% NaOH at 315 K for 5 days at 150mV (vs Ni).

Alloy 600 690 150 mV  
AES

#### 4.

- 1) Alloy 600 Cr Ni-Fe 가 Ni-Fe-Cr
- 2) Alloy 600 690 가 Alloy 690 Alloy 690 Cr 가 Alloy 600
- 3) NaOH 가 가
- 4) Alloy 600 22.7 kcal/mole

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