外部電源에 의한 水中鋼管의 陰極防蝕에 관한 研究
(Ⅲ) 分極電位와 所要電壓에 미치는 물의 比抵抗과 被防蝕面積의 影響

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A Study on the Cathodic Protection of a Steel Pipe in Water by Impressed Current Method (Ⅲ)

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Abstract

This pepar treated the problems involved in the corrosion prevention of the steel pipe submerged in water by arranging two insoluble anodes. In the previous (Ⅰ)(Ⅱ), the authors published the effects which anode location exerts on polarization potential distribution and electric power for corrosion prevention when two insoluble anodes were arranged above the submerged steel pipe. In that case the specific resistance of water was set as 1950Ω-cm and the test piece was a small size.

In this paper, the authours interpreted the influence of specific resistance of water on polarization potential distribution, and also presented the experimental analysis for the effects which the voltage of electric power source for corrosion prevention exerts on the protected area when the area increses up to that of semi-practical size of steel pipe. And the authors surveyed the applicable limit and accuracy of the empirical formulas presented by them.

The results of reseach are as follows:

(1) When the specific resistance of water is between 960~4, 800Ω-cm, the polarization potential at the drainage point is presented as follow:

$$E_0'=E_0+0.0083433\ (\rho-1950) \qquad \text{(mV)} \ ①$$

where E_0: polarization potential at the drainage point when $\rho=1950\Omega$-cm.

(2) In the range of ρ of 960~4, 800Ω-cm, the empirical formulas are corrected as follows:

1) At the outer parts of steel pipe above which two anodes are arranged,

$$E_x=E_0'\exp\left[-2\sqrt{\rho_s D/\{D^2-(D-2t)^2\}}\cdot\frac{50x}{l}\sqrt{R}\right] \qquad \text{(mV)} \ ②$$

$$\sqrt{R}\times10^3=(19.385h+1.0664)\cdot\frac{50x}{l}+1284.505h-64.4196 \qquad (\Omega^{1/2}\text{-cm}) \ ③$$

2) At the parts of the steel pipe between the two anodes arranged,

$$E_x=E_0'\cosh\left\{[2\sqrt{\rho_s D/\{D^2-(D-2t)^2\}}/\sqrt{R}]\left(50-\frac{50x}{l}\right)\right\}\div$$

$$\cosh[100\sqrt{\rho_s D/\{D^2-(D-2t)^2\}}/\sqrt{R} \qquad \text{(mV)} \ ④$$

$$\sqrt{R}\times10^3=(1.3877h+0.1303)\cdot\frac{50x}{l}+629.775h+156.1420 \qquad ⑤$$

(3) On the experimental measurement for comfirmation of semipractical pipe, the ratios of calculated polarization potential on the surface of steel pipe by the formulas ②~⑤ to measured values are revealed as follows;

$\rho=1050\Omega$-cm: within 4.0%

$\rho=1400\Omega$-cm: within 3.4%

$\rho=1950\Omega$-cm: within 3.3%

and when assuming Eo equal to Eo in eq ①

$\rho=1050\Omega$-cm: within 10.5%

$\rho=1400\Omega$-cm: within 7.7%

$\rho=1950\Omega$-cm: within 3.3%

(4) In the case of extending a small experimental pipe size to semi-practical one, the voltage of electric power source required for corrosion prevention is corrected as follow.

$$V_0=I_0(-0.5317973\ \log I_0+1.7299687)\{0.0723+0.0144\log(50h)\}\times\rho\times10^{-3}+1.85\ \text{(V)} \quad ⑥$$

$$I_0=i_0\pi DL\times10^{-4}\ \text{(mA)} \quad ⑦$$

水酸化나트륨과 鹽酸 水溶液에서의 니켈과 Inconel 600의 280°C에서의 腐蝕行動

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The Corrosion Behavior of Nickel and Inconel 600 in Sodium Hydroxide and Hydrochloric Acid Solution at 280°C

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要 約

니켈과 Inconel 600의 腐蝕行動이 용액의 pH 3～13 범위에서 무게變化測定法에 의하여 研究되었다. 試片은 210 시간동안 280°C의 autoclave에서 靜的인 腐蝕水溶液에 露出되었다. 이 溶液의 pH는 염산과 수산화나트륨으로 調節되었으며 溶存酸素의 濃度는 순수한 질소가스를 이용하여 10ppb가 되도록 하였다. 實驗된 pH 범위에서 Inconel 600의 무게 減少는 니켈의 무게 減少보다 적었다. pH 9.5에서 니켈과 Inconel 600의 最少 무게減少現象을 보여 주었으며 무게 減少量은 각각 $1.5 mg/dm^2$, $0.9 mg/dm^2$이었다. 金屬顯微鏡으로 觀察한 바에 의하면 니켈의 表面은 균일하게 腐蝕된 반면 Inconel 600의 表面은 원래의 微細構造와 큰 差異가 없었다.

Abstract

The corrosion behavior of nickel and Inconel 600 has been investigated by the weight change measurement method at pH ranges 3～13 of the solution. The specimens were exposed to aqueous solutions in a static autoclave at 280°C for 210 hours. The pH of the solutions was adjusted by hydrochloric acid and sodium hydroxide and the dissolved oxygen concentration was fixed as 10 ppb by using pure nitrogen gas. Weight loss of Inconel 600 was much less than that of nickel over the tested pH ranges. At pH 9.5 nickel and Inconel 600 showed the minimum weight loss phenomenon and the values of weight loss were $1.5 mg/dm^2$ and $0.9 mg/dm^2$, respectively. Microscopic examination showed that nickel surface was attacked uniformly, whereas Inconel 600 surface was not greatly different from the original microstructure.