外部電源에 依한 水中鋼管의 陰極防蝕에 關한 硏究*
(Ⅱ) 陽極間의 鋼管防蝕

田 大 熙·金 垣 寧
韓國海洋大學 機關學科
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A Study on the Cathodic Protection of a Steel PiPe in Water by Impressed Current Method (Ⅱ)

Jeon Dae Hi · Kim Won Yeong
Department of Marine Engineering, Korea Merchant Marine College, Busan, Korea
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Abstract

The arrangement of anodes in the cathodic method should be made to prevent corrosion on the surface of the whole metal to be protected with the least electric power. It is desirable for the distance between anodes to be made short by increasing the number of anodes. The number of anodes, however, is to be limited considering the cost of electrode and installation. Especially the impressed current method is more restricted in comparison with the galvanic anode method. In this case the polarization potential distribution varies according to the distance between anode and the metal to be protected as well as to the distance of anodes.

In the previous paper, the authors published a survey and an analysis concerning how the polarization potential distribution and electric power etc. for corrosion prevention on the surface of steel pipe of the two outer sides of anodes varied when two insoluble anodes were arranged above the submerged steel pipe.

In this paper, the authors dealt the corrosion prevention of the surface of steel pipe between anodes which occupies the most part of the surface of a long steel pipe. And analysis produced the following results:

1) The cathodic polarization potential on the steel pipe surfaces between anodes can be calculated by

$$E_x = E_0 \cosh \alpha(l-x)/\cosh \alpha l$$
$$= E_0 \cosh[2\sqrt{\rho_s/\{D_2-(D-2t)^3\}}/\sqrt{R}\,](l-x)/\cosh[2\sqrt{\rho_s D/\{D^2-(D-2t)^2\}}/\sqrt{R}\,]l \quad (\mathrm{mV})$$

$$E_0 = \{1.7667/\log(lh)\}^{0.9582} i_0 - 146.4624/(lh)^{0.5688} \quad (\mathrm{mV})$$

$$\sqrt{R}\times 10^3 = (0.02774lh + 0.1306)x + 12.5955lh + 156.1420 \quad (\Omega^{1/2}\mathrm{cm})$$

2) Required voltage of power source for the cathodic protection can be determined by

$$V_0 = I_0[0.0723 + 0.0144\log(lh)]\rho\times 10^{-3} + 1.85 \quad (\mathrm{V})$$

$$I_0 = 4\pi D l i_0 \times 10^{-4} \quad (\mathrm{mA})$$

and the required electric power for the corrosion prevention on the steel pipe surfaces between anodes becomes $P = \frac{1}{2} V_0 I_0 (\mathrm{mW})$

3) The h range which requires minimum power is 0.58~0.70 in accordance with the specific resistanec of water.