The Effects of Chloride and Sulphate Ions on Anodic Dissolution Mechanisms of Copper

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Copper is generally used for the material in the water supplying system. However, the pitting corrosion happens on the copper tube, and leads the problem in the constructions. The pitting corrosion of copper is divided into the following these types; Type I, Type II, and the moundless type[1)]. The appearances of these pitting corrosions are greatly dependent on water quality[1)-4)]. As a corrosion factor, sulfate ions and chloride ions are significant.

In the present paper, the influences of chloride and sulfate ions in natural aqueous solution on the anodic dissolution of copper have been investigated by using the electrochemical techniques. The anodic dissolution mechanisms of copper were proposed by determining the reaction parameters by the anodic polarization curves. Furthermore, the valencies of copper ions were decided by the measurements of channel flow double electrode.

The anodic dissolution mechanism changed depending on the concentrations of chloride and sulfate ions in the fresh water in the neutral from weak acidity media: namely, (1) the concentration range of trace amount of chloride and sulfate ions, and (2) the concentration range more than about 100 ppm of chloride and sulfate ions. The anodic polarization curve didn't show the pH dependence in the concentration range (2), but in the concentration range (1). The anodic dissolution mechanisms in the concentration range (2) are proposed as follows.

In the chloride media:

$$Cu + Cl^- = CuCl + e^-$$

$$CuCl + Cl^- = CuCl_2^-$$

In the sulfate media:

$$Cu + SO_4^{2-} = CuSO_{4\,ads}^- + e^-$$

$$Cu + CuSO_{4\,ads}^- + 2SO_4^{2-} = CuSO_{4\,ads}^- + Cu(SO_4)_2^{2-} + 2e^-$$

$$Cu(SO_4)_2^{2-} = Cu^{2+} + 2SO_4^{2-}$$

Furthermore, the influence of silica in the fresh water on the anodic polarization curve was discussed.

References

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