

Trial Production of a Non-polarizational Electrode with Few Leakage of the Heavy Metallic Ions

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1. Introduction

Metal-metallic salt non-polarizational electrodes are used to measure the spontaneous-potential. The heavy metals are often used for these electrodes. Their concentration of the leaked solution often become problems. Then, they were measured, and consider how to cope with the situation.

2. Feature of Various Non-polarizational Electrodes

(a) Cu-CuSO₄

The sheet copper or the copper wire is put in the container which is leaked the solution. The container is full of the saturated CuSO₄ solution. The CuSO₄ solution always leaks from the container.

(b) Pb-PbCl₂

The surface of the Pb plate are make to a chloride, and it is put in the container. The electrode is made filling with the powder of PbCl₂. To keep the electrical contact of the ground surface, the electrolyte is added to it. For the Cl⁻ is made excess and PbCl₂ is not soluble in, saturated KCl solution is used for the electrolyte. K⁺ and Cl⁻ bear the movement of the charge. Because mobility of both is almost equal, saturated KCl solution turns to the electrolyte of such a electrode.

(c) Ag-AgCl

Ag-AgCl electrode is a structure same as Pb-PbCl₂ electrode. It is difficult to say for this to be used widely because silver material is expensive. Saturated KCl solution is used for the electrolyte, too. Because AgCl decomposes into the metallic Ag and Cl₂ when there is photolysis, it is necessary to put Ag-AgCl in the container with shading.

3. Heavy Metal Concentration in Electrolyte

(a) Cu-CuSO₄

The leakage solution is a saturated CuSO₄ solution, and the Cu-concentration is about 70g/L. If CuSO₄ remains in the soil, the growth of the plant is obstructed. It is provided that this value becomes 3mg/L or less in the effluent standard.

(b) Pb-PbCl₂

It is said that PbCl₂ will not dissolve in cold water so much. The solubility product is $1.6 \times 10^{-6} \text{mol}^3/\text{L}^3$. It has been said that PbCl₂ will not dissolve because the Pb²⁺ concentration becomes small if the electrolyte is made a Cl⁻ solution. But, 1800mg/L and a very big value were indicated. To verify this, the following experiment was done. 1g PbCl₂ was added to 100mL saturated KCl solution and it was agitated for 300s. This was filtered and measured with AAS. As a result, 76mg/L (pH=6.2) was obtained. An effluent standard of Pb is 1mg/L, and an environmental quality standard is 0.01mg/L. The result exceeded the effluent standard.

(c) Ag-AgCl

AgCl is not dissolved scarcely in water, and its solubility product is $1.8 \times 10^{-10} \text{mol}^2/\text{L}^2$. It has been measured that 0.87mg/L (pH=9.6) Ag dissolves in the saturated KCl solution when the experiment was done as well as PbCl₂. The effluent standard etc. are not provided about Ag. However, Ag and its water soluble compounds are the chemical materials which were specified at the government ordinance of PRTR, and their carcinogenic property is doubted.

4. Countermeasures and Discussion

(a) Cu-CuSO₄

Countermeasures are difficult.

(b) Pb-PbCl₂

When several drops of 1% KOH solution was added to 100mL electrolyte and pH was increased, Pb concentration of the leakage solution became 5.9mg/L. Because K₂[PbCl₄] is formed as PbCl₂ reacts with K⁺ in KCl solution when the electrolyte is not made basicity, Pb becomes a complex and dissolves. However, it is thought that the formation of chloroplumbate complex is obstructed by adding OH⁻. Therefore, the electrolyte is kept basic adding a few amount of KOH to the saturation KCl solution.

(c) Ag-AgCl

Ag concentration was 1.2mg/L when a small amount of 1% KOH solution was added to 100mL electrolyte and pH was prepared to 13.8. Therefore, it has been understood that this leakage solution hardly receives the influence of pH.

5. Conclusion

In this study, the electrodes with few environmental loads will be able to use when measuring the spontaneous-potential. It will be necessary to evaluate the noise or drift characteristic of these electrodes in the future.