Trial Production of a Non-poralizational 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. There 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*10^-6mol^3/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 it's solubility product is 1.8*10^-10mol^2/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 it's water soluble compounds are the chemical materials which were specified at the government ordinance of PRTR, and there 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 solusion 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.