

EFFECT OF Mn-Fe-Co IN THE ELECTROLYTE AND PbCaSn ANODE MECHANICAL PROPERTIES ON THE LEAD OXIDE LAYER MORPHOLOGY

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ABSTRACT

Rolled PbCaSn alloys are the preferred anode materials in copper solvent extraction - electrowinning (SX-EW) facilities. The oxygen corrodes the anode directly by the formation of PbO, PbSO₄, complex sulphates, βPbO₂, and αPbO₂ on the surface. The PbSO₄ compound is especially undesirable because it acts as an insulator that passivates the anode surface. The βPbO₂ layer morphology is important in inhibiting the spalling effect of the anode surface, which particles contribute to cathode contamination. Alloy additions and anode production techniques can promote a more continuous and adherent layer of this oxide. The evolution of oxygen gas takes place on this formed α or β PbO₂ instead of corroding the lead surface. However, the lead alloy elongates and deforms, then the adherent PbO₂ layer cracks and fresh lead surface is available for continuing the corrosion. The anode lead alloy must be completely cold-rolling at temperatures below 40 °C, to achieve the required strain hardening and to get a σ₀ higher than 5.8 kg mm⁻². These anodes should have one month aging period before use to improve precipitation hardening. This article summarizes the results obtained in the last five years research work. Experiments were made by a potentiostatic at 2.0 V/SHE and an intentiostatic at 300 A m⁻² at 50 ° C in a matrix of 180 g L⁻¹ H₂SO₄ during 9 h. The effect of molar ratio Fe²⁺/Mn²⁺ in the electrolyte (5.6 and 50; extreme values found in industrial electrowinning), the mechanical properties of the PbCaSn anode (3.6 and 6.2. kg mm⁻²) and the addition of Co²⁺ ions (170 mg L⁻¹) on the morphology of the lead oxide layer formed was studied. XRD, image SEM and XRF were used to analyze the oxide layer. The main conclusions are that the need of cobalt decreased significantly for PbCaSn anodes with σ₀ 6.2 kg mm⁻² in electrolytes having a molar ratio Fe²⁺/Mn²⁺ ≤ 5.6. Amorphous manganese compounds (MnOOH) is deposited on the lead oxide, avoiding direct contact of the electrolyte with the anode lead, which was observed together with a poor detection of βPbO₂ in this layer oxides. The formation of the active electrochemical MnOOH mainly depends on the electrolyte molar ratio Fe²⁺/Mn²⁺ and cell potential. Outside of the indicated conditions, anode layer of corrosion is formed principally for PbO, PbSO₄ and no MnOOH was found. Finally, the presence of the most oxidized states of cobalt or manganese in an electrolyte without iron favours the formation of βPbO₂.