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Investigation of the Kinetics and the Morphology of Cementation Products Formed During Purification of a Synthetic Zinc Sulfate Electrolyte

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In zinc production, the purity of incoming zinc solution is of great importance. The presence of cobalt in the electrolyte used for zinc production lowers the current efficiency of zinc deposition and affects the purity of the zinc product. For this reason, cobalt must be removed from the electrolyte prior to zinc electrowinning. Cobalt removal is commonly achieved by the addition of metallic zinc dust through a process called cementation. The mechanism by which cementation occurs is not well understood. Parameters, such as cementation time, temperature, solution pH, concentration of activators, concentration of zinc ions in the electrolyte were investigated in this study. It was concluded that cobalt cementation could be described by a first order rate equation with an activation energy of 45 kJ/mol. Temperature played a significant role on the kinetics while the presence of hydrogen, intermediate compound formation, and zinc ions inhibited the cobalt cementation. Cu/Sb activators were cemented within the first 90 seconds and gave synergistic effect on cobalt cementation. Surface compounds on the cementation product were identified as mainly $Zn(OH)_2$ and $ZnSO_4$. Redissolution of cobalt did not occur from cemented cobalt but from dissolution of intermediate $Co(OH)_2$ and $CoSO_4$ salts.

Keywords: cementation, activators, zinc, metallurgy, mechanism