Current Distribution of Lead Ions Deposition Within Porous Flow-Through Electrodes Operating Under Simultaneous Hydrogen Gas Evolution

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This study addresses the impact of operating hydrodynamic and structural parameters affecting the distribution of metal deposition current within flow-through porous reactors, i.e., the electrolyte resistivity (ρ_{eff}) and flow rate (v) as well as the electrode thickness (L) of the porous bed. Measurements are performed on the distribution of the lead deposition reaction within packed bed electrodes composed of stacked screens, with simultaneous hydrogen evolution (as a parasitic side reaction). The uniformity of the current distribution is found to increase with the decrease of the electrolyte resistivity and/or increase of electrolyte flow rate, while increase of the electrode thickness results in a less uniform current distribution. The results are explained in the light of the existing electrochemical theory, in which a dimensionless ohmic index, ξ ($= i_{\text{cell}} \rho_{\text{eff}} L/b$ where i_{cell} is the cell current and $b = RT/F$) is developed. Larger values of ξ produce less uniform current distributions with less than 10% of the entire thickness of the porous bed is in effective use. Whereas, higher electrolyte flow rates sweeps away the generated gas bubbles, thus, causes a marked decrease of ρ_{eff} by decreasing the fraction of the trapped hydrogen gas bubbles within the electrode and hence lead to more uniform current distributions.

Keywords: Porous reactors, Gas evolving electrodes, Heavy metals, Wastewater treatment.

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