Oxygen-Depolarized Chlor-Alkali Cells. Some Consequences of Using Oxygen Diffusion Cathodes.

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Replacement of hydrogen-evolving cathodes in membrane chlor-alkali cells by oxygen-depolarized cathodes leads to substantial savings of electrical energy, approaching 30 % at standard industrial throughputs. However, different mechanism and conditions of operation of gas diffusion cathodes require significant changes in cell design, materials of construction, and operating conditions.

This work focused on various performance characteristics of oxygen-depolarized chlor-alkali cells with an emphasis on the cells of a zero-gap type, where the gas diffusion cathode and the membrane remained in an intimate contact. Selected factors affecting the cell resistance/voltage, caustic current efficiency, and purity of the product are discussed.

The cells were operated in the constant current mode at current densities from 0.2 to 1.0 A/cm^2. The parameters monitored were: (i) the cell voltage, (ii) the cell high frequency resistance, (iii) caustic current efficiency, and (iv) peroxide and chloride contents in the caustic product. Among others we demonstrated:

(i) Effects of cathode structure and composition on the cell performance
(ii) Excellent corrosion resistance of silver plated nickel hardware in strongly corrosive environment of the cathode chamber,
(iii) Catalytic surface effect of the cathode hardware (flow-field and current collector) on decomposition of unwanted byproduct, peroxide (Fig.1),
(iv) Effect of oxygen humidification on caustic current efficiency for different cathode hardware designs (Fig.2).

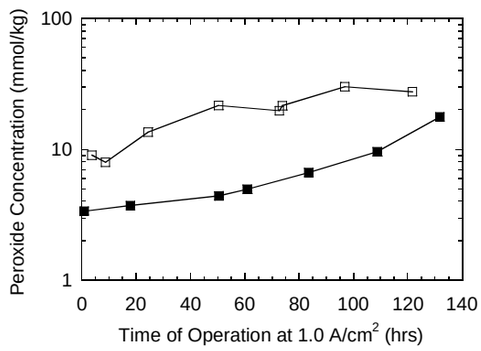

Figure 1. Catalytic surface effect of the cathode hardware on decomposition of peroxide. Silver plated hardware – open squares, gold plated hardware – full squares. Temperature 90 °C. Cathode: 50 cm^2 ELAT® with 5.0 mg/cm^2 carbon supported Pt (80% Pt) plus a hydrophilic spacer (Panex® 30) between the electrode and the membrane.

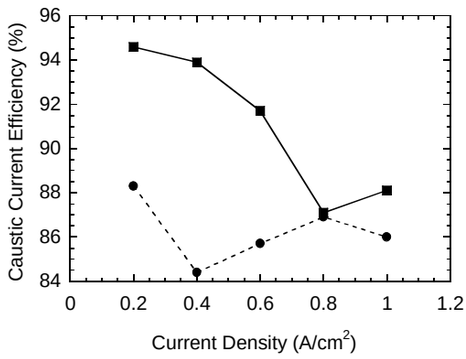

Figure 2. Effect of oxygen humidification (0.5 cm^3/min) on caustic current efficiency for two different designs of the cathode chamber. Cell 1, where water can easily reach the membrane – circles. Cell 2, where water cannot reach the membrane – squares. Temperature 90 °C. Cathode: 50 cm^2 ELAT® with 5.0 mg/cm^2 carbon supported Pt (80% Pt) plus a hydrophilic spacer (Panex® 30) between the electrode and the membrane.

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