A Two-Compartment Vertical Channel Cell for Electrowinning Studies

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As part of the research and development work for a new zinc electrowinning process in the presence of iron(II) [1], a relatively small cell with controlled hydrodynamics and a planar cathode surface was required. For these studies, a vertical channel cell configuration was chosen. A feature of this cell necessitated by the process chemistry was division into two compartments. A microporous membrane was used as separator.

A prototype cell was designed and constructed. The cathode chamber channel had a flow establishment channel of identical cross-section, 62 cm high immediately below it. Cathode chambers were made for cathodes of 4 different heights, to determine how small the cathode could be made, and still achieve reliable, scalable results. The position of the bottom of the cathode remained the same whichever size cathode and matching chamber were used. The cathode dimensions are shown in Table 1.

A sturdy stand (of stainless steel) was constructed for the cell and its associated instrumentation, pumps and reservoirs for the catholyte and anolyte solutions. The instrumentation included magnetic flowmeters, heaters, resistance thermal detectors, and a differential pressure cell, backed up by a manometer. Electrical instrumentation, such as shunts, process monitors, power supply, voltmeters, a datataker and a computer, were mounted either on an adjacent bench or the wall behind the stand.

Once commissioned, the cell was first calibrated against a well-known process with a minimum number of variables. We chose an additive-free conventional zinc electrolyte operating under conditions published by Asturiana de Zinc [2,3] for their flagship electrolytic plant in Spain. This is the only commercial zinc electrowinning operation of which we are aware, which does not use any organic cell additives.

The calibration tests showed that as the cathode size was decreased, the observed value of Wark's constant [4-7] in a test of 80 minutes duration fell away from the value for full scale plant cells operated on a 40 hour stripping cycle. In addition, the deposit morphology became non-uniform, and apparently greatly affected by edge effects. However, the 200 cm^2 cathode gave acceptable uniformity of the morphology over its whole length, and a Wark's constant value indistinguishable from that calculated from data reported by Asturiana [3].

Following calibration, the 200 cm^2 cathode only was used to conduct tests on the effects of hydrodynamics on zinc electrowinning from zinc electrolytes containing iron(II). The sequential addition of antimony and gelatin were tested on an electrolyte already containing lead. The paper presents the results and compares them with data obtained in small scale cells without controlled hydrodynamics. Advantages of the vertical channel cell over small laboratory cells alone are highlighted.

References

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Table 1. Dimensions of Cathodes

Area cm^2	**Height mm**	**Width mm**
200	312.5	64.0
100	156.2	64.0
50	78.1	64.0
16	25.0	64.0