Operation of continuous precipitator

A full-scale precipitator was designed, constructed, and operated in a continuous mode to assess production rate, population changes with time, and hardware aspects. A digester was used to perform the function of an aluminum/air battery, that is to drive $Al(OH)_4^-$ into solution. It was found that the required production of $Al(OH)_3$ could be attained at the high relative saturations indicated by computer simulations. The cyclone system for solid-liquid separation and classification did not function satisfactorily to provide a relatively solid-free electrolyte for recycle to the battery and a coarse fraction of the $Al(OH)_3$ as product leaving the mixed-suspension, classified product removal (MSCPR) precipitator. There is a need to test alternative designs for the precipitator hardware. These could include more effective methods for solid-liquid separation for mixed suspension type operation or alternatively, a fluidized bed operation.

Recent publications

1 T. G. Swansiger, Determination of the physical properties of the circulating electrolyte in the aluminum–air battery as a function of chemical composition and temperature, *Progress Report — Task 1*, Alcoa Laboratories, Alcoa Center, PA, April 20, 1981.

2 T. G. Swansiger, C. Misra, and F. S. Williams, Development and demonstration of process and components for the control of aluminum–air battery electrolyte composition through the precipitation of aluminum trihydroxide, *LLNL, UCRL-15503*, Alcoa Laboratories, Alcoa Center, PA, *Final Report of Subcontract No. 5724709*, May 1982.

ALUMINUM ANODE RESEARCH AND DEVELOPMENT

Reynolds Metals Company

This effort studied the feasibility of producing battery anodes directly from a Hall cell product, investigated the recycling of battery reaction products, and determined electrochemical properties of certain aluminum alloys.

The experimental program consisted of casting a series of alloys to simulated Hall cell metal and the use of these alloys in experiments to determine the effects of typical impurities on electrode efficiency. The addition of manganese to aluminum to minimize the deleterious effects of iron on coulombic efficiency was also examined.

The study of anode production from Hall cells indicated that aluminum anode plates containing 0.04 percent Ga and the minor impurities normally

occurring in 5A- and 6A-grade primary aluminum would cost 15 cents/lb over 3A-grade molten aluminum costs (3.5 cents/lb for premium purity, 2.4 cents/lb for alloying agents (principally, manganese and gallium), and 9.0 cents/lb for continuous casting and shearing). Anodes could be produced with 0.03 percent Fe using Hall cell metal and continuous casting by the use of specially prepared aluminas, such as some chemical-grade products. This would add another 10 to 15 cents/lb to the cost, over the 15 cents/lb described above. It is not feasible to produce lower iron anodes directly from Hall cell metal.

The contract has been completed.

Recent publications

1 C. J. McMinn and J. A. Branscomb, Production of anodes for aluminum–air power cells directly from Hall cell metal, *LLNL UCRL-15354*, Reynolds Aluminum, Reduction Research Division, Sheffield, AL, February 12, 1981.

2 P. McNamara and D. H. Scott, Aluminum auto battery summary report 1980, *MRD 80-25*, Reynolds Metals Co., Metallurgical Research Division, December 1980.

3 D. H. Scott, The effect of manganese additions on the performance of aluminum/air battery anode alloys, *MRD 82-14, UCRL-15478*, Reynolds Metals Co., Metallurgical Research Division, May 1982.

ALUMINUM DISSOLUTION RESEARCH AND DEVELOPMENT

Institute of Electrochemistry, Belgrade

The objective was to investigate the electrochemical properties of certain aluminum alloys containing gallium and phosphorus in neutral and alkaline electrolytes.

The research project consisted of the following:

- A number of alloy samples were made from high-purity aluminum (99.999) in the form of blocks 50 mm × 50 mm × 5 mm by splat-cooling from the melt. The alloys covered a range of gallium and phosphorus contents.
- The samples were submitted to electrochemical investigations consisting of the following measurements at 30 °C and 60 °C in both neutral (2 M NaCl) and alkaline [(4 M NaOH + 1 M $Al(OH)_3$ + 0.06 M $Na_2Sn(OH)_6$)] solutions:
  - Open-circuit potential (OCP),
  - Corrosion rate at OCP and at 150 mA/cm^2,
  - Polarization curve (to 200 mA/cm^2), and
  - Relaxation time constant of polarization.