AEC-NASA TECH BRIEF

Study of Crevice-Galvanic Corrosion of Aluminum

A study was initiated to determine the corrosion effects of aluminum–copper and aluminum–nickel couples in oxygenated distilled water, and aluminum alloys in oxygenated copper sulfate solution.

The aluminum–copper and aluminum–nickel couples were made from bars of 3/8-inch diameter 1100 aluminum (99.3% pure), electrolytic tough pitch copper (99.9%), and Grade-A nickel (99.4%) by matching screw threads on the mating members and screwing them together. One aluminum–copper couple and one aluminum–nickel couple had watertight seals at their joints by the application of a high-melting-point inert wax (Unichrome 330). One of each of the couples was left unsealed.

The four couples were then wet-ground with 400-grit Durite paper, degreased, and immersed in refreshed, oxygenated, distilled water at 50°C by suspending them on Pyrex glass hangers.

Four aluminum alloy samples, 3/4-inch by 3-inch, were cut from 1/16-inch sheets. These samples were as follows: Swiss High Purity (99.999% Al); 1100 (99.3% Al, 0.5% Fe, 0.1% Cu, and 0.1% Si); X8001 (98.3% Al, 1.0% Ni, 0.5% Fe, 0.1% Cu, and 0.1% Si); and A288C (98.4% Al, 1.0% Ni, 0.5% Fe, 0.1% Ti, and 0.003% Si). The samples were wet-ground with 400-grit, and suspended on Pyrex glass hangers while separated by spacers of the same material. The samples were exposed to corrosion in an oxygenated solution of reagent-grade cupric sulfate containing 5 mg of copper per liter. The solution continuously passed through the test chamber at 6 ml/min and 50°C.

As a result of the study, the following conclusions were reached:

1. After 100 days of corrosion, the sealed couples showed no substantial corrosion either on surfaces directly exposed to the water, or in the crevice between the copper and aluminum and the nickel and aluminum. The unsealed aluminum–nickel couple developed a thin oxide and a little tarnishing on the aluminum screw. The unsealed aluminum–copper couple developed considerable corrosion and white corrosion product on the aluminum screw.
2. Of the four aluminum alloy samples, only the high purity aluminum escaped corrosion pitting by the copper sulfate. The two nickel bearing alloys, X8001 and A288C, were most susceptible to galvanic attack, although in a few tests the attack on 1100 was equally severe. The pitting was most prevalent in the support hole and (crevice) areas where the spacers were in contact with the metal.
3. The tests indicated that accelerated corrosion occurs in exposed crevices when 1100 aluminum is coupled to copper, but little or none occurs when coupled to nickel. In no case does it occur outside the crevice. More severe corrosion occurs where copper from a copper sulfate solution is deposited on aluminum, forming effective crevices. Pure aluminum, however, is not susceptible to this type of attack.

Notes:

1. Additional details are contained in *Crevice-Galvanic Corrosion of Aluminum*, by S. Mori, J. E. Draby, and R. E. Loess, ANL-6236, June 1966, Argonne National Laboratory, Argonne, Illinois. This report is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151. Price: $3.00 each (microfiche, $0.65).

(continued overleaf)

2. Inquiries concerning this innovation may be directed to:

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Reference: B67-10583

Source: S. Mori, J. E. Draley, and R. E. Loess
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Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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