KEY MESSAGE
CREVICE CORROSION
JOINT TECHNICAL BULLETIN TO INDUSTRY

Although aluminium is an extremely reactive metal it has excellent corrosion resistance in most environments primarily due to its capacity to quickly form a surface barrier layer of aluminium oxide. This layer is only a fraction of a micron thick and in an environment containing oxygen re-forms immediately if damaged.

Crevice corrosion can occur when a metal surface is exposed to a stagnant solution under conditions where the solution may become depleted in oxygen. Crevices, cracks and non-hydrophobic surfaces in close contact, all tend to stay wet much longer than exposed surfaces. Since oxygen cannot reach into such crevices except through diffusion from the atmosphere, any reduction reaction can quickly deplete the solution of oxygen.

The oxide barrier layer that protects aluminium from attack is stable in the pH range between about 4 and 8.5. Bricks, concrete and mortar (even after curing) can generate highly alkaline waters having pH between 10 and 13. If such corrosive solutions enter a crevice with an unprotected aluminium surface, for example at a mortar/door sill interface, the natural aluminium oxide layer is corroded.

Under these conditions the chemically inert oxide barrier layer corrodes, and aluminium ions begin to enter the stagnant solution creating a local net positive charge. If chlorine is available from the environment, fast moving chloride ions are attracted into the crevice where they can react to hydrolyse the aluminium. The result is an aluminium hydroxide and free hydrochloric acid. Both chlorine and hydrogen accelerate the dissolution rate of aluminium, hence the rate of corrosion increases. The buildup of corrosion product acts as a further barrier to oxygen diffusion and aluminium chlorides tend to dissolve and become liquid by absorbing moisture from the air, thus retaining moisture to drive the corrosion reaction.

The crevice corrosion reaction sequence is autocatalytic – it creates a favourable micro-

environment, and the corrosion continues over time.

Several conditions are necessary to initiate crevice corrosion:

(a) There must be a crevice wide enough to permit liquid entry, but narrow enough to inhibit oxygen diffusion and allow the creation of a stagnant zone.

(b) Moisture must be present for an extended period of time. If the crevice dries out frequently, oxygen will reach the aluminium surface and the oxide barrier layer will reform before the reaction has reached an autocatalytic state. If the crevice is sealed so that no moisture reaches it, the corrosion reaction cannot occur.

(c) Chlorine must be available from the surrounding environment in sufficient quantity to reach the moist but stagnant crevice and initiate a corrosion reaction cascade before the crevice dries.

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AUSTRALIAN ALUMINIUM COUNCIL

Preventative measures include:

(a) Eliminate crevices and contact points which can become starved of oxygen.

(b) Reduce exposure to moisture using effective dampcourses and sealants.

(c) Reduce chlorine in the environment (by using washed sand for example).

(d) Prevent exposure to highly alkaline solutions such as wet Mortar.

Note:

(a) If a crevice is wide enough it will not allow stagnation and de-oxygenation to occur. (This is dependent on building orientation, exposure to sunshine and water and design configuration).

(b) Powder coating is permeable to the atmosphere, highly porous at sharp corners, and usually only applied to visible faces so its protective effect in severe environments can be dramatically reduced.

Recommendations for reducing the possibility of crevice corrosion:

(a) The use of an isolation membrane between the aluminium and the sill and/or jamb.

(b) If using applied coatings all surfaces including cuts and fixing holes must be coated.

(c) The use of effective damp course and sealants.

(d) Eliminate crevices and contact points where possible. If crevices are unavoidable ensure that there is sufficient ventilation to prevent moisture build.

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