

Fellow's Corner

This series of articles is intended to highlight industry-wide engineering experience, guidance, and focussed advice to practising technologists. It is written by ICorr Fellows who have made significant contributions to the field of corrosion management. This issue features the problem of galvanic corrosion in tanks, by Chris Googan, antiCORR (Anticorrosion Engineering Ltd).

Galvanic Corrosion – Getting the Message Across

Readers of Corrosion Management will be familiar with the perils, and mitigation, of galvanic corrosion. However, the engineering world at large is often unaware of the pitfalls. This article illustrates this with three case histories drawn from the effluent treatment industry. What is interesting is, not so much that the problems arose, but the conflicting remedial measures recommended by (so-called) corrosion experts called in to help.

Case 1 – Poultry Processing

The first case was a waste-water treatment tank at a UK poultry processing facility. As can be seen in Figure 1, this included stainless steel processing equipment which was electrically earthed to the tank. The effluent treated was warm, intentionally aerated and, being relatively chloride-rich, was highly conducting. The tank supplier recognised this as a galvanic corrosion situation, and that it was made all the more damaging by the very high ratio of the stainless steel area to that of carbon steel at lining defects. Accordingly, the supplier warned the owners of the problem, whilst at the same time prudently withdrawing its warranty.



Figure 1.

In response, the owners declined to invest in corrosion expertise. Guided by their accountant, they elected to remedy the situation by cathodic protection (CP), a plausible but, in this case, optimistic approach. Dispensing with the cost of any CP evaluation or design, some small anodes were procured. It is, however, by no means clear how, or indeed if, these anodes were actually installed. In any event, the outcome was all too predictable. Within a matter of weeks, the tank was leaking like a sieve (Figure 2), its role having changed from effluent treatment to effluent dispersal!



Figure 2.

Fortunately, this amusing case was not particularly costly. Since the tank was relatively small, the pragmatic remedy was to rebuild it in GRP.

Case 2 – Municipal Refuse Treatment

The second case involved several very large effluent aeration tanks constructed for municipal refuse treatment facilities in northwest Europe. Even before formal handover, the tanks were found to be springing leaks, to the consternation of the owners and the exasperation of the environmental authority. Investigation revealed dramatic holes in the shells (Figure 3).



Figure 3.

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The facility EPC contractor interpreted the problem as defective lining, and called in lining experts. Time and money were then invested in carrying out lining repairs in the hope that this would remedy the problem. Unfortunately, it seems the lining experts had forgotten their galvanic corrosion lessons. They missed the fact that the very well-lined carbon steel tanks contained multiple bare stainless steel nozzles. As in Case 1, the cathode to anode area ratios were enormous, so the galvanic corrosion penetration was very rapid (the steel effectively undergoing electrochemical machining). Improving the quality of the lining on the carbon steel breached a cardinal rule of managing galvanic corrosion, which is to coat the cathode. All the re-lining work achieved was that the tanks developed leaks even more quickly when returned to service.

Eventually corrosion expertise was called up. The solution was straightforward: paint the stainless steel, and install a modest sacrificial anode provision. Unfortunately, however, the EPC contractor was unwilling to engage in what it regarded as the “untried” technology of CP. Facing litigation, it took the financially punishing step of demolishing the tanks and rebuilding them in polymer-lined reinforced concrete.

Case 3 – Beverage Manufacturing Effluent

In many ways, Case 3 was similar to Case 2. It involved a number of large aeration tanks for treating effluent produced by a major European beverage manufacturer. Again, the carbon steel tanks were very well lined, but they contained stainless steel inlet piping and aeration equipment. Some credit is due to the designers who recognised the potential for galvanic corrosion. They addressed it, in accordance with good engineering practice, by ensuring that the stainless steel piping and diffusers were electrically isolated from the tank (or so they thought).

Experience tells us that a corrosion engineer can always call for electrical isolation between tanks and piping. But, in practice, the electrical engineers will always be working to achieve the opposite for the purpose of electrical safety. Thus, although the piping was electrically isolated at the point of entry to the tanks, both piping and tank walls were bonded into the common site electrical earthing system. So, notwithstanding the design intent, a galvanic cell with an adverse cathode to anode area ratio was created. Inevitably, galvanic corrosion occurred and the tanks leaked (Figure 4).



Figure 4.

Unlike the EPC contractor in Case 2, the Owner of this facility called in corrosion, rather than *lining*, expertise. The corrosion specialist advised installing CP. This was accepted by the owner, and a competent contractor was engaged to supply a simple, but effective, system of sacrificial anodes suspended from cantilevered brackets fixed to the tank rim (Figure 5).



Figure 5.

The tanks were patch-repaired and returned to service. When they were inspected five years later, the tanks were found to be in good condition. Corrosion of the tank walls, galvanic or otherwise, had been effectively suppressed.

Corrosion Community Responsibility

Doubtless, those involved in these three cases are now more aware of galvanic corrosion, and how not to manage it, than previously. Unfortunately, there remain too many engineers who, although competent in their own discipline, find themselves taking galvanic corrosion engineering decisions without even a rudimentary comprehension of the basic principles. Therefore, the question for corrosion professionals is, are we doing enough to get the right messages to the right people?

Chris Googan



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