Failure of Impressed Current Anode Supports on Jetty Piles

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Impressed current cathodic protection was installed on the coated piles of a jetty. The anodes were placed within galvanized steel support tubes that were welded to the piles. The anodes were isolated from the ends of the tubes, but a small portion of the anodes extended from each tube. After about a year, most of the support tubes had corroded and broken because of severe splash zone corrosion and the formation of hypochlorous acid (HOCl) from anodic reactions. Proper installation of anodes would have prevented this failure.

There are several methods for using and distributing anodes for an impressed current cathodic protection (ICCP) system on a jetty, including mounting them on a seabed sledge or piles, suspending them between piles, and floating them near the piles.[1-2] For one Iranian jetty, mixed metal oxide (MMO) impressed current anodes were installed as stand-offs from the jetty piles (Figure 1). The anodes were supported by a galvanized steel tube diagonally welded to the piles. After a short time, CP of the jetty failed because of broken anode support tubes in the splash zone (Figure 2).

Chlorine can be produced on the anode surface by following reaction:[3-4]

$$2Cl^- \rightarrow Cl_2 + 2e \quad (1)$$

Hypochlorous acid (HOCl), a powerful oxidizing agent, is formed when the produced chlorine reacts with seawater, as follows:[3-4]

$$Cl_2 + H_2O \rightarrow HOCl + HCl \quad (2)$$

This reaction caused HOCl to form inside the anode support tubes. Alternate wetting and drying occurred within the tubes from tidal and splash action. This led to a high concentration of HOCl inside the tubes where they were exposed to seawater in the splash zone. Since HOCl is a powerful oxidizing agent, it increased internal corrosion of the tubes in the splash zone area.

Because the corrosion rate in the splash zone is much higher than other areas on marine structures,[5] the external and internal corrosion rates for the portion of the anode support tubes in the splash zone were much higher. After a short time, the anode support tubes broke apart, and the anode cables became disconnected by severe wave strikes. This caused the CP of the jetty to fail.

Solutions

Materials and mounting design of anode supports for stand-off and suspended anodes are very important in the CP design of jetties. Corrosion-resistant materials (such as nonmetallic materials) should be used for the anode supports. Also, the supports should be designed in such a way as to prevent the concentration of HOCl in the splash zone.

The design of this anode mounting method was very poor. A new design utilized MMO anodes mounted on concrete sledges placed on the sea floor.

Conclusions

Materials, the mounting method, the corrosion rate in the splash zone, and the corrosive effects of anode reaction products on anode support structures are very important and should be considered when designing an ICCP system for a jetty.

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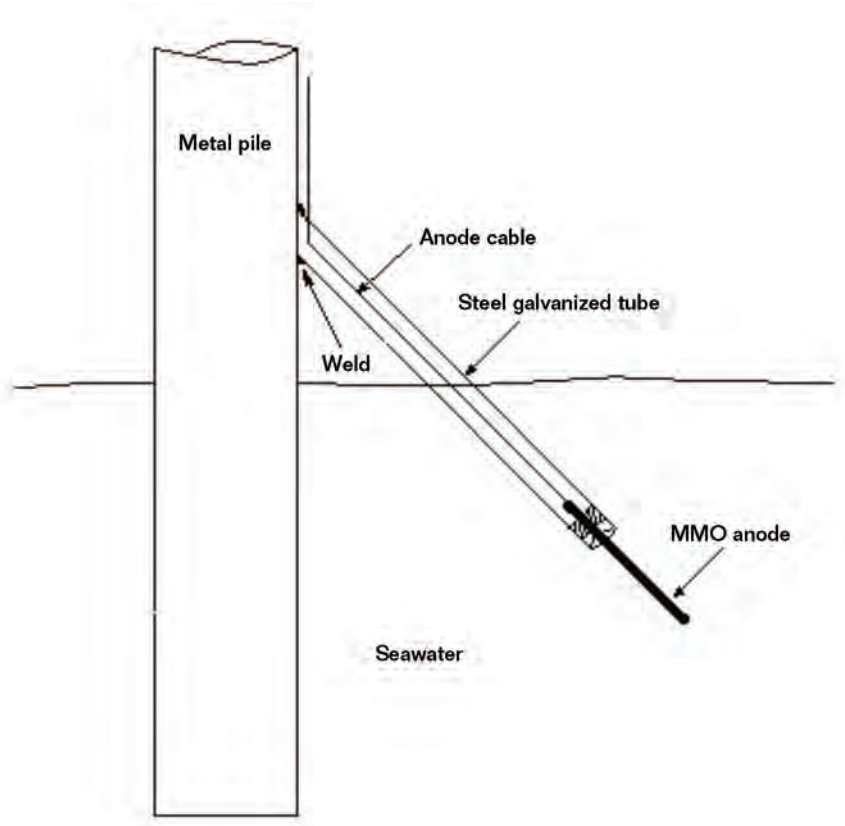

FIGURE 1 Method of mounting MMO anodes on a jetty pile.

FIGURE 2 Broken anode supports in the splash zone.