SEACON®

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CATHODIC DELAMINATION

Brief History:

During the early 80's Navy submarines discovered stainless steel parts, designed for 15 years of service were failing in a fraction of the time. In severe cases, the failure occurred in just a matter of months. Upon investigation the failures were attributed to a phenomenon known as cathodic delamination.

What is Cathodic Delamination?

When an elastomer is bonded to metal a primer is required. The elastomer will not bond directly to the metal. The primer bonds to the metal and the elastomer then bonds to the primer. Cathodic delamination occurs when an electrochemical cell (like a battery) is formed between the connector body and a cathodic protection system such as a zinc anode or an induced current. The chemistry of the cell creates a highly basic (pH as high as 14) solution at the bond line that eats away the primer and adhesive - causing bond failure. An example of cathodic delamination is shown in Figure 1.

Figure 1 - Elastomer Pulled back to show area where bond has failed due to Cathodic Delamination

Figure 2 – Anti-Cathodic Delamination Ring

Why Does This Occur?

When two metals are joined by an electrolytic solution such as salt water the anode begins to lose mass as electrons or current run through the system. This lost mass can be found deposited on the cathode. On ships and submarines, the metal Hull of the ship becomes the anode, so the hull slowly loses mass or corrodes. To counteract this, the vessels are equipped with large sheets of zinc known as "sacrificial anodes". Chemical properties in the zinc cause it to corrode rather than the hull of the ship. Other methods of counteracting hull corrosion exist as well; one example is an induced current. The difference in electrochemical potential between the connector shell/body and the cathodic protection system provides electrons to the shell surface. These in turn form hydroxyl ions (OH-) that create the high alkaline (basic) conditions that eventually swell and destroy the adhesive materials. See figure 3.

How Does SEA CON® Deal With Cathodic Delamination?

Solutions to cathodic delamination involve eliminating the conducting nature of the shell to stop an electrochemical cell from forming. SEA CON® has four general methods of dealing with cathodic delamination. They are:

1. Use of GRE (Glass Reinforced Epoxy) connectors. This eliminates the presence of metal for reduction to take place, and thus no bond is deteriorated.
2. Use of NCC (Non-conductive Coating). A non-conductive coating is placed on the metal prior to bonding so the current is not able to cause reduction to occur.
3. Use of an ACDR (Anti Cathodic Delamination Ring). As seen in the diagram after cathodic delamination occurs the GRE ring and o-ring seal still provide a seal so the connector does not fail. See figure 2.
4. Layer of GRE over a metal shell. This eliminates all metal to seawater contact and thus the ability of the saltwater to facilitate reduction.

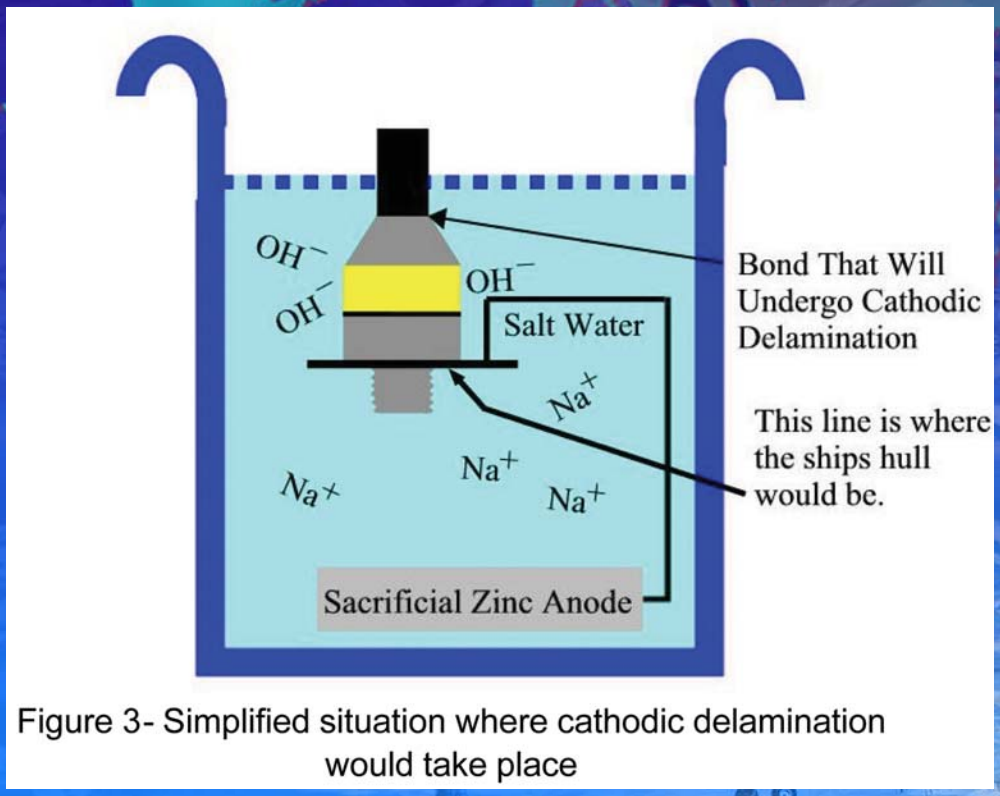

Figure 3- Simplified situation where cathodic delamination would take place