Olympic

POOL AND DECK COATINGS

TECHNICAL BULLETIN

Kelley Technical Coatings

MEMBER NATIONAL SPA & POOL INSTITUTE

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ALL OLYMPIC PRODUCTS ARE VOC COMPLIANT

Bulletin No. 162, pgs 1 & 2 of 3

Galvanic Corrosion - Electrolysis Prevention - Remedial Measures

Galvanic corrosion is self-generated activity resulting from differences in potential which develop when metal is placed in an electrolyte. These differences in potential can result from the coupling of dissimilar metals or they can result from variation in conditions which exist upon the surface of a single metal. These variations would include variations resulting from the non-homogeneity of the metal as well as connected electrically and are immersed in an electrolyte, current will be generated and one of the metals will corrode. Current from the corroding metal will flow into the electrolyte, over to a non-corroding metal, and then back through the connection between the two metals. The corroding metal is the one where current leaves to enter the electrolyte and is known as the anode: The metal which received current is known as the cathode.

As previously indicated, the same metal can develop differences in potential and as a result portions of the surface of that metal are anodic which respect to the remainder of the surface. At those anodic locations, corrosion will occur.

Electrolytic and galvanic corrosion are similar in that corrosion always occurs at the anodes. The essential differences between the two is that in electrolytic corrosion, it is the external current which generates the corrosion, whereas in galvanic corrosion, it is the corrosion activity which generates the current. There is also a difference in polarity. In an electrolytic cell, the anode is the positive terminal, and in a galvanic cell the anode is the negative terminal.

Although the above is a rather abbreviated and no doubt an oversimplified explanation of corrosion, from this explanation it can be appreciated that electric current can generate corrosion and in turn that corrosion can generate electric current. As a result of these phenomena, it follows that it should be possible to prevent corrosion by using electrical current. This is a basis for cathodic protection. When direct current is applied with a polarity which opposes the natural corrosion mechanisms and with sufficient magnitude to polarize all the cathodic areas up to the open circuit potential of the anodic areas, corrosion is arrested. Thus, the theoretical considerations indicate that the basis for cathodic protection is relatively simple and is not difficult to appreciate. However, practical designs for the various applications can differ considerably because they depend upon the type of structure which is to be protected and the conditions which are encountered.

ELECTROLYSIS OR STRAY CURRENT CORROSION

In the trade, the terms galvanic corrosion and electrolysis are often intermixed. In galvanic corrosion there is a flow of current generated between dissimilar metals when the least noble one is corroding. In electrolysis a stray current is involved, a DC current, from an external source flowing on the metal, and leaving the metal to enter the pool water, carrying metal ions with it.

One of the origins of such stray currents may be a nearby DC welding machine, electroplating equipment, from lines, or a series of batteries. Normally such sources are not expected in the vicinity of a pool. It has sometimes been thought that grounding telephone or electric power wires might cause electrolytic corrosion, but several investigations have disproved the theory that AC current leakage contributes to corrosion. Electrolysis corrosion can almost be disregarded in pools except for the possible case of a vault if low voltage DC current is used for underwater lighting.

BIMETALLIC OR GALVANIC CORROSION

Next to concentration cells, the cells caused by contact of dissimilar metals and alloys are probably the most widespread and persistent type of corrosion encountered in swimming pool systems. Corrosion of this type results usually in an accelerated rate of attack on one member of the couple and protection of the other. The protected member, the one that remains virtually unattached is called the nobler metal or cathode. The galvanic effect speeds up the corrosion beyond the ordinary rate on the least noble material or anode.

GALVANIC SERIES

We have learned from experience to arrange the metals in a series, called galvanic series or electromotive series, which help us predict which metals are relatively safe to use in contact with one another, and which metals are apt to produce strong galvanic corrosion on each other. The following table shows a simplified arrangement of the galvanic series:

CORRODED END (ANODIC OR LEAST NOBLE)

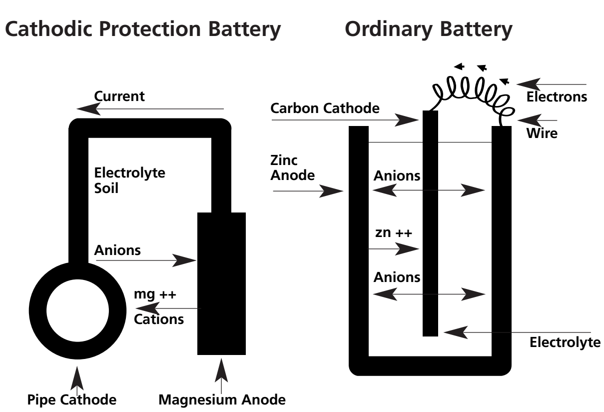
Magnesium
Zinc, Galvanized Steel
Aluminum
Mild Steel Case Iron
Stainless Steels (Active: no protective oxide film on the surface)
Lead, Tin
Stainless Steels (Passive: with protective oxide film)

PROTECTED END (CATHODIC, OR MOST NOBLE)

It will be noted that some of the metals are grouped together. These groups have no strong tendency to produce galvanic corrosion on each other, and from a practical standpoint they are safe to use in contact with one another. But the coupling of two metals from different groups, and distance apart from each other in the series will result in accelerated corrosion of the higher in the series. The further metals are apart, the greater will be the galvanic tendency.
FACTORS INFLUENCING GALVANIC EFFECTS - The three factors are pre-dominant: **(A)** the quality of current generated between the dissimilar metal--the distance apart in the Series is an indication, **(B)** the ease of flow of current--a function of water conductivity and therefore of total dissolved residue, and **(C)** the relative areas of the two materials forming the couple--corrosion will be the directly proportional to the ratio of the meter lower in the Series to the area of the metal higher in the Series. Therefore, one should avoid making combinations where the area of the less noble material is relatively small. In contrast it is good practice to use the more noble metals for fastenings and other small critical parts in the equipment that is built largely of less resistant materials.

CATHODIC PROTECTION

Such protection may be achieved through the use of a impressed current (a battery or a rectifier) or by the use of a sacrificial anode (magnesium, zinc, or aluminum). In the pool industry, magnesium anodes have been used to protect coated filter tanks and other equipment. It is necessary to have the magnesium in electrical contact with the part to be protected by bonding, bolting or wiring, and to have it located near the part to be protected.



PAINTING AND COATING

Paint is a mixture of a pigment and a vehicle which is applied in thin coats in order for the vehicle to oxidize. Coatings are solutions of heavy materials in a solvent or thinner which are thickly applied, the thinner evaporating after application. The surface should be checked after the required coating drying time for pinholes, which are caused by solvents escaping. It is important that these pinholes be recoated. You can secure a pinhole detector for this purpose. Some coatings are heated to get a thin consistency for application and they reharden when cooled.

Painting or coating is the oldest and most widespread means of combating corrosion, but no single coating is a cure-all. Protective coatings must be selected to suite the particular corrosion conditions affecting the structure to be protected.

The first and most important step in painting is surface preparation. Sandblasting to white metal is recommended. The surface must be clean and dry, because the coating cannot give good service if it is applied over a dirty, greasy, or wet surface.

The second step in painting is proper mixing of the coating. The manufacturer's instructions should be carefully followed, because inadequately mixed or improperly thinned coating will give greatly reduced protection. Coatings of good quality give satisfactory results because the manufacturer has properly proportioned the pigment and vehicle.

Kelley Technical Coatings offers two epoxy systems for the protection of metal swimming pools. These are the ZERON system and the POXOLON 2 system. The ZERON system consists of one coat of ZERON over the appropriate primer. The primers available are No. 215 BONDERITE PRIMER for aluminum No. 219 PRIMER for steel, and No. 220 PRIMER for galvanized steel. Unless a pinhole detector is used, either a rectifier or sacrificial anodes should be secured to insure against corrosion. All steel pools should be back primed--two coats with No. 965 BITUREZ - a black bitumen epoxy coating.

Magnesium anodes provide economical and 100% positive surface protection. Even where the protective coating is damaged and bare steel is exposed, cathodic protection from anodes will prevent corrosion.

You can apply the same principles of cathodic protection to stop corrosion of the pool exterior and underground piping. Anodes are equally effective for filter tank interiors.

A protective coating on steel in immersion or in contact with the soil will prevent corrosion only where the coating is perfect. Engineers, employing pinhole detectors, have demonstrated time and again that even the finest applications contain some pinholes. Corrosion starts at these pinholes as well as areas later abraded. Under film corrosion, it may spread and lead to premature failure of the entire coating system.

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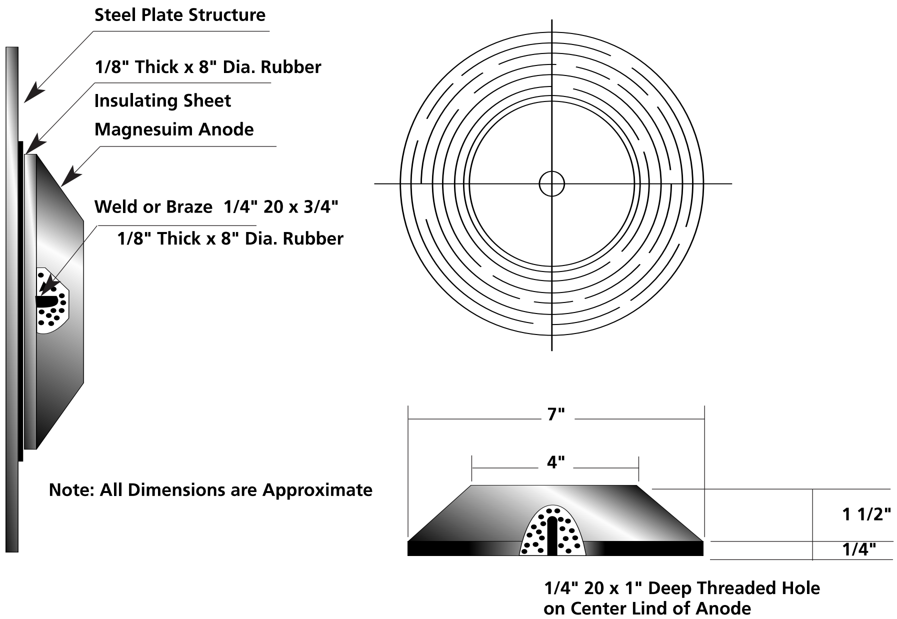
Sacrificial Anodes



Sacrificial anodes may be installed at approximately equal intervals around the perimeter of the pool. They are located on steel studs welded to the sidewalls and located approximately six inches above the floor. Studs are 1/4" standard machine thread and approximately 3/4" long. Anodes are threaded on these studs with an epoxy adhesive on the backside to provide additional holding power. The life expectancy of the anodes varies according to resistivity of water, quality of the applied coating and other factors. In most instances it appears that one anode will last at least three to five seasons. When the anodes are consumed, they can be removed and new ones threaded on the studs. Our suggestion is to install one anode for every 200 square feet. This type of cathodic protection will more than pay for itself by:

- Preventing deterioration of the steel structure
- Eliminating ugly rust stains
- Extending the life of the protective coating

The selection and the application of the protective coating have a direct bearing upon the performance of a cathodic protection system.

WARNING!
If you scrape or remove old paint, you may release lead dust. **LEAD IS TOXIC. EXPOSURE TO LEAD DUST CAN CAUSE SERIOUS ILLNESS, SUCH AS BRAIN DAMAGE, ESPECIALLY IN CHILDREN. PREGNANT WOMEN SHOULD ALSO AVOID EXPOSURE.** Wear a NIOSH approved respirator to control lead exposure. Clean up carefully with a HEPA vacuum and a wet mop. Before you start, find out how to protect yourself and your family by contacting the National Lead Information Hotline at **1-800-424-LEAD** or log on to **www.epa.gov/lead**

Information herein given has been accumulated through many years of experience and verified by our technical personnel and is based upon tests believed to be reliable, but RESULTS ARE NOT GUARANTEED.

NOTE: KELLEY TECHNICAL COATINGS, INC. makes no implied warranty of merchantability, no implied warranty of fitness for a particular purpose and no other warranty, either express or implied, concerning its products.

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