



## **Use of Hydrolab Series 5 in Marine (Saline) Environments: Corrosion**

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### **Introduction**

Applications for water quality instruments in marine (saline) environments are numerous, driven by water resource professionals' interest in characterizing oceans, harbors, bays, and estuaries. These aqueous environments are notoriously aggressive and lead to corrosion of many materials commonly used in scientific instruments.

To understand the causes of marine corrosion and the way protective systems and more resistant materials can be used to reduce sea water corrosion problems, the following application note provides helpful information for working with Hydrolab Series 5 multi-parameter water quality instruments.

Many different types of destructive attack can occur to multi-parameter probes used in sea water applications. The term 'aqueous corrosion' describes the primary cause of the challenges encountered with water quality instruments that are in contact with sea water. A systematic approach is required to manage it.

### **Corrosion by Sea Water**

Corrosion by sea water, aqueous corrosion, is an electrochemical process that affects all metals and alloys when in contact with sea water. Every metal and alloy has a specific electrical potential (or corrosion potential) at a specific level of sea water acidity or alkalinity (pH). Some metals are more corrosion resistant than others. Metals like titanium can resist virtually all corrosion, but titanium is a relatively expensive material for use in water quality instrumentation.

Most corrosion resistant metals rely on an oxide film to provide protection against corrosion. If the oxide is tightly adherent, stable and self-healing, as on many stainless steels and titanium, then the metal will be highly resistant or immune to corrosion. If the film is loose, powdery, easily damaged and not self-repairing - such as rust on steel - then corrosion will continue unchecked. Even so, the most stable oxides may be attacked when aggressive concentrations of hydrochloric acid are formed in chloride-rich environments.

Sea water, by virtue of its chloride content, is a very efficient electrolyte. The omnipresence of oxygen in marine environments - sea sprays, splash zones at the water-line, and dissolved in the water - increases the aggressiveness of salt attack.

### **Factors that Aggravate Marine Corrosion**

Sea water, if salt water is not destructive enough on its own, has several characteristics that assist the breakdown of metals and non-metals alike. Biological activity in sea water enhances its destructive power. Microbiological organisms, clusters of seaweed, barnacles, as well as deposits of sand, silt or slime not only exclude oxygen, but often create locally corrosive conditions which aggravate attack.

Coatings and composite structures can experience rapid degradation. Sulfate reducing bacteria left undisturbed in marine silt or mud deposits will produce concentrations of hydrogen sulfide that are particularly aggressive to steel alloys.

## Controlling Marine Corrosion

All exposed parts used in Hydrolab multi-parameter water quality sondes are either plastic or stainless steel. These materials were selected to balance the need to maximize durability and optimize overall material costs.

The recommended method for limiting the tendency of metals to corrode in sea water is to decrease the deployment time, which will allow more frequent sensor inspection and sonde maintenance. Maintenance schedules should be set based on the intensity of corrosion observed at the deployment site, known site conditions that could lead to excessive corrosion, and experience of the user. A maintenance timeframe should be selected that will minimize the compromising impacts of corrosion on the integrity of the sensors and instrument housing. Depending on the specific conditions of the application environment, the ideal maintenance timeframe can vary from a few weeks to several months.

Maintenance of the sensors and sonde housing should be performed by gently scrubbing the sensors and housing with a clean, soft-bristled brush, mild soap (like dish-washing soap), and de-ionized water. If de-ionized water is not available, clean tap water may be used. Be sure to thoroughly rinse the probes and housing with clean water to remove all traces of sea salts and minerals.



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