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"Electrolysis" – Gradual and Inevitable, or Insurable?

When it comes to disputes over vessel corrosion damage, "electrolysis" as a word is often misused. While electrolysis is traditionally thought of as a naturally occurring, gradual process (and therefore not insurable), some causes of severe electrolysis damage, such as stray current or impressed current corrosion, can occur suddenly, accidentally, and despite the owner's reasonable best efforts to maintain the vessel.

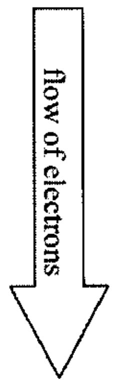
In 2005 I published an article on the issue of whether certain causes of electrolysis triggered an insurable claim. That article made me popular with some vessel owners and, not surprisingly, unpopular with insurance companies. I suggested that some underwriters were using the term "electrolysis" to refer to electrochemical damage whose cause did not fit within the meaning of electrolysis used in industry or referred to in the insurance policy. The benefit to the insurer of their interpretation was that the insurance did not have to respond to significant claims for damage even though the claim had all the hallmarks of true insurable marine loss, being a sudden and fortuitous loss. This was because the insurance policies either expressly excluded claims for "electrolysis", or because the insurer relied on the common misconception that all electrolysis was not a sudden or accidental process and therefore not a true peril of the sea. Both court cases referred to in that 2005 article were resolved short of trial. On one hand, that was good for the vessel owners. On the other hand, it has left us without a court decision confirming that sudden and fortuitous electrolysis, such as that caused by severe stray or impressed current corrosion, is an insurable loss.

While I am certainly not a chemist or an engineer, I have had the benefit of such experts in litigation, and I can provide the following brief distinction between two common types of marine corrosion as it relates to whether the corrosion may be insurable. These are galvanic corrosion and electrolytic corrosion.

Galvanic corrosion will occur when two different metals, each with their own electrical potential (ability to hold their electrons), are placed in proximity - the flow of electrons from one metal to the other results in corrosion to the metal. Figure 1 is a common table of the galvanic potential of various metals – the further apart two metals are on the galvanic scale the more vigorously they will react. Galvanic corrosion is most effective when an electrolytic solution (such as salt water) is present between the metals, but can occur when it is dry if the metals are touching. This type of corrosion tends to be a gradual process, and does not require an external source of current to occur. It can be found on a boat when, for example, a steel and a brass pipe fitting, each having a different potential, are joined (the steel will lose electrons to the brass, causing the steel to rust). Because galvanic corrosion is both gradual and preventable (you can chose whether to attach the two non-compatible metals together), galvanic corrosion would almost never be insurable.

Figure 1

ANODIC / CORRODED END	LESS NOBLE
Zinc	
Aluminum	
Galvanized Steel	
Cadmium	
Mild steel – wrought iron	
Cast iron	
Stainless steel, types 304 & 316, active*	
Lead-tin solder	
Lead	
Brass, Bronze	
Copper	
Stainless steel, types 304 & 316, passive*	
CATHODIC / PROTECTED END	MORE NOBLE



*active stainless is stainless that hasn't been chemically treated

Electrolytic corrosion, on the other hand, may commonly be understood to be the loss of metal as electrons flow from one metal to a distant metal through an electrolyte such as salt water. Zincs on your hull dissolve as electrons pass from the zinc out into the water and onto other metals. Unlike galvanic corrosion, electrolytic corrosion can be found even when metals are not tied together or in close proximity, and will only occur when there is an electrolyte solution. In normal circumstances, electrolytic corrosion typically happens relatively slowly – some mariners may replace their zincs only once every two years or so. It is also inevitable, or non-accidental, that some electrolysis will occur to submerged metals. The typical characteristics of this corrosion, being gradual and inevitable in nature, is what has lead to electrolysis damage commonly being thought of as an uninsurable loss. However, not all causes of electrolysis damage are "typical".

Stray Current (Electrolytic) Corrosion, can occur much more quickly when there is "stray current" present. Stray current is current that exists between two substances for a reason other than the difference in each metal's natural potential. Stray current can occur, for example, when there is a fault in the DC system of a vessel and the DC current strays, or leaks, through the vessel and out the hull into the water looking for ground – as it leaves the hull it takes electrons of metal with it causing the metal to corrode. Another example is when a vessel is plugged into shore power and has a ground fault in the DC system which allows DC current to flow into the dock's ground system – this DC current will flow back onto each vessel (unless the vessel is protected with a galvanic isolator or isolation transformer) in the marina that is plugged into the ground, and out through each of the hulls back to ground. Again, as this current passes out of the hull it takes electrons of metal with it, corroding the metal. This corrosion can be more than zincs can handle. Indeed, corrosion may occur to portions of the hull even though there is life left in the zincs because the zincs may be insulated by a thin layer of zinc oxide, or the zinc has lost a proper connection to the hull.

Impressed Current Corrosion, lastly, are more severe forms of stray current corrosions that exist when there is a great deal of stray current or when the voltage associated with the current is high.

Because it is impressed, the current can cause catastrophic damage to the hull extremely quickly, destroying the hull in a matter of days. More severe examples of DC current ground faults can cause this. As well, although AC current is commonly thought not to be able to cause stray current corrosion, there are some authorities that opine that metallic oxides can act as diodes that convert the AC current into DC current at the surface of the metals, and that because the voltage of AC is much higher than DC, damage caused by AC current can occur as dramatically and as quickly as that caused by DC current. There are, however, conflicting opinions on this point.

Many policies of vessel insurance expressly exclude damage caused by electrolysis. For example, policies often state something to the effect that "we exclude damage caused by wear and tear, delamination, denting, electrolysis, vermin, …". To be clear, however, many policies that do have an express exclusion for electrolysis also have a clause stating that while the electrolysis damage itself is not covered, loss that occurs as a consequence of the electrolysis is covered. This is significant because sometimes consequential damage is much more expensive to repair than the electrolysis damage itself, but sometimes not. For example, a $15 yellow brass fitting attached to a stainless seacock corrodes causing the $600,000 yacht to sink. The $15 corroded fitting would not be covered by the insurance, but the $600,000 hull and the machinery and electronics damaged by seawater would be. This is an interpretation that many vessel owners can live with. On the other hand, in a case where an aluminum passenger vessel with a small AC ground fault ties into shore power, next to a steel vessel that is being welded on, and suffers severe electrolysis damage over a three day period, the fact that insurance will not cover the $200,000 hull replating bill is a little more difficult to swallow.

In the end, the causes of electrolysis damage are not all the same. While most electrolysis damage is the result of a gradual and inevitable process, some severe and very expensive cases of electrolysis damage are sudden and fortuitous. Depending on whether you are a vessel owner, a repairer, a marina, or an insurer, how you determine the cause of electrochemical damage that occurs to metallic hull and machinery components can make a difference measured in tens, and often hundreds, of thousands of dollars.

Darren Williams is a marine lawyer practicing with Williams & Company in Victoria B.C. and can be reached for question or comment locally 250-385-7777, toll free 1-866-765-7777, by emergency cell phone at 250-888-0002 or at dw@MarineLaw.ca.