

# MGDUFF

## ELECTRO-CHEMICAL DECAY IN WOODEN VESSELS

Electro Chemical Decay is the breakdown of the cellulose structure in timber which occurs as a result of the flow of electrical current through water or a water saturated material between two connected electrodes immersed in the water. These electrodes may occur in the form of a natural anode and cathode in a galvanic or electrolytic coupling of dissimilar metals, or the elements of a cathodic protection system. In this process, known as "Hydrolysis", water is 'broken down' into its component parts of hydrogen and oxygen. The liberation of hydrogen at the cathode results in an increased level of alkalinity which can cause the breakdown of the cellulose structure in timbers local to the cathode. Normally the alkalinity generated at the cathode is openly exposed to copious amounts of water and will constantly be diluted by that water. However the protective current from the anode will flow to all parts of the cathode surface where it is in contact with water including where the water is contained within saturated timber through which the cathodic item or its fastenings pass or are embedded. In these circumstances there is no dilution and levels of alkalinity can become concentrated enough to cause the timber to breakdown!

The effect of the breakdown is to allow a greater amount of water to enter the timber but not sufficient to materially reduce the alkalinity. Eventually leaks begin to occur along the path of the fastenings or fittings passing through the timber. The ingress of water is not initially great but contains a high level of alkaline salts in solution. On meeting the atmosphere within the vessel the water evaporates and the salts form crystals on the surfaces around the point of leakage, often building up to form a significant deposit. There will be very high alkaline conditions beneath the crystals (pH11 to pH13 are common) and the timber can break down into a fibrous woolly texture with little or no structural strength. Fastenings securing load bearing items such as shaft brackets begin to pull through the timber.

The first obvious indication of this condition is the formation of crystals around various metal items within the vessel. If these are found and the items are believed to be in contact with some form of anode the contact must be broken and the crystals washed off with fresh water. If the damage to the timber is slight it may be possible to avoid further deterioration by repeated washing of the internal surfaces with fresh water to dilute the alkalinity. If the condition is detected in the early stages and dealt with in this way no further action may be needed but if the timber is softened structural repair will be required.

Probably the biggest single factor that encourages the conditions necessary for this process to develop is the drying out of the vessel when brought ashore for winter storage as joints can open and sealants dry out. Whilst the joints close again on re-floating the vessel the sealants do not always recover especially if they are themselves susceptible to alkalinity. In some instances repair may be extensive, particularly in the case of vessels constructed on the old system of double or triple skin planking where usually an impregnated cotton material is placed between the skins. In such vessels the cotton around the cathode also decomposes and acts as a reservoir for the highly alkaline water which it disperses throughout the skins to a far greater extent than if single skin planking were used. The multiple skins are much thinner than a single skin and degradation of the timber soon renders an area of the skin structurally weakened. Because the condition is usually worse within the vessel due to the concentration of salts brought about by evaporation it is often the inner skin of multi-skin vessels that requires most extensive repair and this usually involves removal of large areas of the external skins to afford access. Associated framing and supporting structures also often need repair. A further factor with this construction is the deterioration of the fabric membrane between the skins which will result in a small gap forming and some difficulty in maintaining a fully watertight hull thereafter. Differing types of timber react to the presence of alkaline solutions to a varying extent but in general the heavy resinous types are more resistant than the hard wood types. A heavy single skinned vessel planked with a very resinous pine will be least effected whilst a light displacement multi-skinned vessel such as a double diagonal motor boat planked in African mahogany is likely to be severely effected.

This condition can be associated with galvanic corrosion or electrical installation defects as well as being an undesirable side effect of cathodic protection. However it can really only exist where some deficiency is already present in the vessel's structure. That is not to say the vessel is un-seaworthy but the defect is more a natural process whereby the timber around fastenings, particularly in load bearing areas, becomes increasingly waterlogged as time passes. When constructed to good practise all metal fittings are bedded down on a sealant and the fastenings are made watertight by sealant around the external heads. The timber usually has some residual resin content and does not absorb much water in the early life of the vessel due to the protective effect of surface paint coatings etc. The condition is usually quite slow to start but becomes progressively worse. When large build ups of crystals are discovered internally it can be assumed structural damage to the timber exists. The extent of such damage will depend on the construction of the vessel and the type of timber used.