ISSN 0971-0167

भाकृअनुप
ICAR

Fish technology NEWSLETTER

Vol. VII Nos. 1 & 2 Jan. – June 1994

Corrossion Control in Fishing Boats

For most of the developed countries, the loss due to corrosion is estimated to be about 3 to 4 per cent of their GNP. The CSIR has estimated the corrosion loss in India as 1,000 crores of rupees per year. These figures point out the seriousness of the problem and the practical significance of R & D activities on corrosion controls.

Fighting corrosion is an interdisciplinary effort. The designer, the materials expert and the maintenance staff should work as a team so that corrosion failures can be prevented or at least reduced substantially.

Seawater is an aggressively corrosive medium and causes considerable loss to materials employed in ocean engineering. Realising the economic importance of the problem, intensive R & D work is in progress at CIFT and suitable anticorrosive measures for fishing craft have been developed.

Metals corrode by chemical or electrochemical reaction with its environment.

Metal + Environment →		Corrosion product
Fe Cu Al	Water, Oxygen	Oxide, hydroxide

Salinity of seawater, dissolved oxygen, pH, flow of water, temperature, biological activity (fouling) and pollutants are factors contributing tocorrosion. The hull, hull fittings, deck machnery, navigational systems, fish finding equipment etc. experience heavy corrosion damages In the marine atmosphere, the extent and intensity of corrosion process like galvanic corrosion, pitting, crevice attack are generally aggravated.

Carbon steel is the basic material used for several structural applications. Its performance depends upon the marine zone to which it is exposed. The highest corrosion rate occurs at the splash zone where water is well aerated and rust films do not develop protective properties. In this zone the corrosion rate is as high as 18 mils per year (450 microns per year).

A lower rate of corrosion is experienced by areas which are continually submerged where the corrosion is mainly controlled by the rate of diffusion of dissolved oxygen in the seawater through the layers of rust film and marine organisms on metal surface. The typical corrosion rate in this region is about 3-6 mils (75—150 microns) per year.

The superstructure of a fishing boat is also vulnerable to attack owing to the presence of atmospheric salinity and moisture. The velocity and direction of wind, rainfall, temperature, solar radiation, pollutants etc. are also factors affecting the corrosion of steel in the atmosphere.

Owing to the presence of dissimilar metals such as steel hull, bronze propeller, stainless steel shaft, mild steel rudder etc at the stern area of boats, corrosion is observed to be more in this area. When dissimilar metals are coupled through an electrolyte (sea water), one metal (anode) experiences severe corrosion while the other (cathode) receives protection owing to difference in electric potential. Galvanic compatibiliry of different metals and alloys for seawater applications are listed in the following "galvanic series". In the galvanic series, metals are arranged in an order, starting with less nobler metals and ending up in higher nobler metals. Less nobler metals are called base metals (anode) which protect nobler metals (cathode) when they are electrically coupled together through an electrolyte such as seawater.

Galvanic Series of Metals and Alloys in Seawater

Anodic (base)
Magnesium and magnesium alloys
Zinc
Aluminium
Aluminium alloys
Galvanised wrought iron
Mild steel

Cast Iron
Manganese bronze
Naval brass, 60/40 bronze
Copper
Silicon bronze
Cupro nickel
Nickel and high nickel alloys
Stainless steel (Type 304)
Stainless steel (Type 316)

Cathodic (noble)

When a metal piece is immersed in seawater corrosion takes place at anodes At the cathode a reducing reaction takes place with the formation of hydroxyl ions. The existence of numerous anodes and cathodes on a metal surface causes the local corrosion currents. In cathodic protection an external current is supplied in such a way as to nullify the corrosion currents. In this way the whole metallic structure becomes a cathode and dissolution of metal stops. The source of external current may be from galvanic anodes made from high purity metals such as zinc, magnesium, aluminium etc. and their alloys with minor addition of other metals, the composition of which is a closely guarded secret. The cathodic protection supplements the protection given by the coating system on the hull.

The hull protection system consists of a two pronged approach: Protection against corrosion and protection against fouling. The former is achieved through anticorrosive coatings supplemented with cathodic protection while the latter is achieved through the use of toxic compositions. In either case, the system is to be so designed and applied as to achieve maximum efficiency without impairing the quality of the environment

Mercury free ternary aluminium anode

Cathodic protection is achieved in boats by fixing anodes which show little or no polarisation. Usually electrolytic grade zinc or ternary anodes are used. One of the disadvantages of the commercially available ternary anodes is that they contain mercury as one of the ingredients and this leads to mercury pollution of aquatic environment. In an endeavour to overcome this problem, the Central institute of Fisheries Technology has successfully developed a ternary aluminium anode free from mercury, and christined it as "CIFTAL". This is an innovative development.

"CIFTAL" was put to several electrochemical preformances with reference to electrode potential, and anode current efficiency in natural seawater was determined. The ability of the anode to function at high current efficiency and its stable performance is particularly noteworthy. Service trials on fishing boats showed high degree of protection. The life of these anodes is three times that of zinc anodes.

The electrochemical properties coupled with its low cost make it an ideal material for short and long-term marine cathodic protection.

Several maritime agencies have laid down regulations restricting the entry of vessels fitted with anodes containing mercury for cathodic protection into protected harbour areas. In the light of these regulations, the mercury free Al-Zn-Sn 'CIFTAL' anodes developed by CIFT assumes special significance.

In view of the acute shortage of several structural materials, and to ensure safety of the sea going vessels there is an overwhelming need for educating the public regarding the pestilence of corrosion.

K. RAVINDRAN