A CASE HISTORY ON THE PHENOMENAL CORROSION OF MARINE PROPELLERS IN FISHING BOATS

R. BALASUBRAMANYAN

Central Institute of Fishery Technology, Craft & Gear Division, Cochin-11

Although high tensile brassess of copper-zinc alloys (Manganese bronze) find extensive use in all marine applications, under aggressive sea-water, marine propellers cast out of such an alloy frequently suffer heavy corrosion damages due to dezincification. An interesting case history where a number of propellers have undergone dezincification in the Cochin back-waters is narrated in this paper.

Some time back during the end of 1970, a number of fishing trawlers in and around Cochin became inoperative due to the sudden break-down of their propellers on account of heavy corrosion damages on them. This unusual incident of propeller break-down in a mass scale was brought to the notice of the Central Institute of Fisheries Technology in Cochin, seeking for remedial measurers.

Immediately the boats under reference were inspected and six such affected trawlers were hauled up on land for closer examination. The condition of the propeller in each boat was minutely checked. Besides inspecting the entire hull below water-line of each boat including the protective copper sheathing on the wooden hull, fastenings, complete stern gear assembly including anode installations and the hull painting schedule, necessary samples of the damaged propellers were also collected for further examination and analytical evaluation at the Institute's laboratory. These new fishing boats, it was reported, were completed and launched during early 1969 but were not put to commission till the end of 1970. They were lying at anchor in the Cochin back waters at different locations not far from each other. Necessary water samples and bottom mud samples from the place of anchorage were also collected and later analysed for any unusual hydrographical characteristics.

The following observations were recorded and a detailed case history made: (1) Under visual examination all the propellers were found broken at their blade tips with long streaks of cracks running to the base of blades.

The original diameter of the propellers were considerably reduced from 31" to 26" with a reduction of 20 to 25% in the total blade area.

(2) Broken pieces of the damaged propeller blades were brick red in colour, brittle to touch and porous in nature. Small pieces could be easily broken off from the tips. By light hammering more cracks were formed and more pieces could be collected. Broken pieces had very poor mechanical properties and were tend to crumble to powder under the pressure of the thumb. Spots of incrustations (like measles) were seen all over the propeller blades. Corroded areas have also been disintegrated due to erosion on their surfaces caused by water movements. Corroded pieces were put to laboratory analysis.

(3) Blocks of zink anodes installed for cathodic protection at the stern quarter have all been used up.

(4) Though no visible signs of corrosion were seen on the copper plates used for the hull sheathing, they were thin (28 SWG)

(5) There were no signs of corrosion on any other under-water installations.

(6) The water samples collected had all shown considerable oxygen deficiency.

(7) The bottom mud samples showed highly putrified organic detritus with high content of hydrogen sulphide.

From the diagnostic characters as have been observed on the damaged propeller blades, the present case history only suggests the corrosion phenomena as "dezincification", of the manganese bronze. In the present instance, it appears that from the entire lot of damaged propellers all the alloying metals have been corroded preferentially in sea—water and zinc has been more or less completely replaced with a porous, brittle and weak matrix of less tensile copper. The deposit of copper and absence of zinc has been confirmed by laboratory analysis. The highly contaminated water under prolonged stagnation with abundant hydrogen sulphide and deficient in oxygen also seem to have given a helping hand in accelerating dezincification of the manganese bronze propeller.

Many of the marine propellers undergo selective corrosion such as *dezincification*, *graphitisation*, *aluminification* etc., Uhlig (1948). It is well known that copper-zinc alloys are prone to dezincification in sea-water and problems brought about by brasses *(Manganese bronze)* failing due to dezincification has been reported before for many years, Uhlig (loc. cit); Taylor (1961); Breckon et al (1964); Bradley et al (1964) and Backer (1971), but the exact mechanism involved in this process of corrosion is not yet perhaps fully understood. Copper-zinc alloys containing 85% or more copper and less than 15% zinc do not dezincify. One of the preferred methods of overcoming dezincification is by the addition of 0.02 - 0.06 per cent arsenic, antimony or phosphorus to the base alloy. Polluted estuarine waters may also cause corrosion of copper alloys, Bradley et al (loc. cit). A restricted supply of oxygen, chlorides and acidity of water, low flow velocity etc. can enhance dezincification rate, Lahiri (1971).

Since all the six propellers examined in the present case have revealed an exatly similar pattern of corrosion damages under exactly identical conditions, the entire materials of metals used in the casting at the foundry have to be examined carefully. Further, it is also possible that the other propellers cast from the same batch of parent alloy are likely to experience the same type of damages due to dezincification (in fact this has been ascertained to be true and the propeller manufacturer had to replace all the propellers that were cast in one lot from the same batch of parent alloy). Test bar examination might be useful under such of these contingencies.

It may be possible to combat corrosion damages due to dezincification that is common in high tensile brasses by adopting to the following courses ;

(1) Use only less zinc and more of copper

(2) Use suitable inhibitors like antimony, arsenic, phosphorus or tin

(3) High content of lead, manganese, iron in brasses increases the susceptibility to dezincification

(4) Addition of aluminium will increase strength and corrosion resistance.

The performances of manganese bronze under very aggressive conditions have been far from satisfactory, more especially in the case of marine propellers, involving frequent replacements. From the number of case histories that have now been known, there is now real economic justification for the use of suitable and better alloys more durable than manganese bronze for marine propellers. Ravindran et. al (1969) have suggested an alternative newer material in the use of spheroidal graphite austenitic cast iron-D2C-ASG3 of IS 2749 - 1964, for marine propellers.

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