Research for prevention of corrosion, erosion and fouling on the ship

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Abstract- Ship builders mainly uses ferrous metal Mild steel plate for the ship construction. Over the years metal decay starts due to corrosion, erosion etc. Fouling of underwater hull is another problem for hull deterioration. Sun's thermal activity also affects the metal day by day to a small extent.
This research is great helpful to ship builders and ship-owners in understanding the corrosion reactions, activity on metal as well as in deployment of control measures.

Key Words- Corrosion prevention, metal erosion prevention, Brittle fracture control, control on hull fouling.

INTRODUCTION AND TEXT

In my practical experiment done with metal piece when checked in different condition following result was found:
Metal piece kept in the dry air without present of water for 20 days, result was no rust formation in new metal piece.
In second condition new Iron piece of same size was kept in the presence of pure water plus air for a period of 20 days, result was mild rust formation.
In third condition, new Iron piece of same size was kept in the presence of salt water plus air for a period of 20days there was more rust formation that sighted in the second condition.
In fourth condition, Iron piece of same size was kept inside water but without air and result was no rust formation.

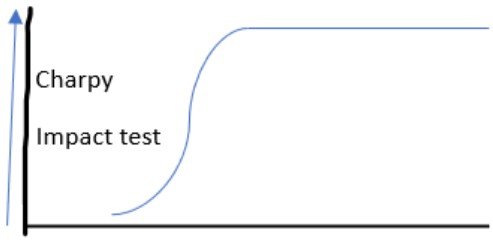
Chemical reactions involved in the rust formation are given below:
$4Fe + 3O2 = 2Fe2O3$
$Fe2O3 + \text{Water Molecules} = Fe2O3,3H2O$
$4Fe^{++} + O2 + 2H2O = 4Fe^{+++} + 4OH^-$
$Fe^{+++} + 3OH^- = Fe(OH)3$
$Fe(OH)3$ converts into $Fe2O3.3H2O$

These chemical reactions clearly indicate that corrosion is a process of oxidation plus hydration of ferrous metal.
Experiment number two done with three metals piece of different atomic number.

Chosen metals were Iron, Copper, Silver and result is given below:
Iron new piece was kept open in moist air for 60days and sighted the rust formation;
Copper new piece was kept open in the moist air for a period of 60days and sighted no rust formation;
Silver new piece was kept open in the moist air for a period of 60days and sighted no rust formation.
Above studies clearly gave me a result that metal with higher atomic numbers are less reactive to oxygen cum hydrogen oxide and therefore no or very less corrosion in them.
In my third experiment Iron piece was put in open air plus wet with Sulphuric acid result was again deterioration of metal due to corrosive nature of acid plus effect of moist air.

Bimetal reactions
When two different metal joins together and remains in the close proximity then also corrosion reaction accelerates.

Effect of Solar temperature variation on metal
In this experiment I found that Fe metal kept at temperature of constant 30degree Celsius for a period of one year and in other condition Fe metal kept exposed in variation of thermal temperature from Minus 75 degree Celsius to plus 75 degree Celsius and result was metal deteriorated in environment condition with large variation of temperature. Brittle fracture also takes place at large negative temperature.



Kinetic Energy air mechanism impact on the metal surface

When a ship remains active then kinetic energy of moving air keeps the ship still better condition than in the laid-up ship with moist environment and still air present in the atmosphere.

Erosion on the Ship

Mechanical erosion also reduces the metal life as it leads to decay in the metal plate. On ship never use chipping hammer hammering if rust is only like a brown colour layer, in this case remove fine rust from soft wire brushing. Crevices formed due to hammering will even more harm the ship. In case of deep loose rust only hammering etc. should be used.

Erosion also takes place due to cargo loading, unloading condition on the ship.

Metallurgical degradation at higher temperature

It is also found by the experiment that at higher temperature metal grains orientation gets disturbed and metal weakness takes place.

Fouling of Ship's hull below waterline

And also, near sea chest etc.

Fouling of hull takes place in the submerged portion of vessel. White cake formation, attachment of Barnacle, sea growth makes the hull deteriorated. In some cases, sea growth can blow the flow of water through the sea-chest valve.

Methods of protect to ship's metal

Paint Application

Paint application is the primary method of protecting the ferrous metal of ship. Paint, primer surface covers the bare metal and prevents contact of bare metals from the moist air.

Chromium coating

Chromium coating in the entire plate can protect the ship from derusting.

Galvanization of ships' part

Zinc metal fine coating is called as Galvanization protection on the ship, it is an effective method against corrosion control.

Electroplating with less reactive metals

Electroplate of Ships part with less reactive metal like Copper etc. also can protect the ship effectively.

Use of Sacrificial Anodes

Sacrificial anodes like Aluminium made, Magnesium made anode used inside ballast water and also on the hull can protect the ship's part. Here more reactive metal than Iron which is Magnesium, Aluminium anode reacts with moist oxygen and gets corroded itself.

Covering metal or other part effectively

Grease or any material used to cover the metal etc. can protect the metal against corrosion. Greasing of moving ball bearings, sheave bearings, wires, etc. is very important maintenance.

Impressed Current control protection

Impressed current control system used in the commercial ships gives correct current to hull part and breaks the corrosion cell.

Protection method against the Fouling of hull

- Application of correct Antifouling paint
  Bio friendly antifouling paints can protect the hull against fouling. Copper is one of the good antifouling agent. Antifouling system works in two ways, in one method antifouling compound destroy the fouling growth while in the second method it does not allow any following agent to get stuck-up with the hull part.
- Hull Cleaning
  Divers are used to clean the underwater hull of ship. It is also an effective system.

CONCLUSION

With help of above research ship owner, ship manager can take lot of benefits in protecting the ship.

Citation

IMO Convention on AFS.
The Theory and Practice of Seamanship book by Graham Danton