Methods of Protection from Foulers & Borers.

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Introduction

What is Fouling ?

- Fouling is the accumulation of unwanted material on solid surfaces to the detriment of function.
- The fouling material can consist of either living organisms (biofouling)or a non-living substance (inorganic or organic).
- Fouling phenomena are common and diverse, ranging from fouling of ship hulls.

Introduction

What Causes Fouling?

- Fouling is caused by the settlement of large number of sedentary marine organisms called "FOULERS".

Types of Fouling

1. Plant Fouling.
2. Animal Fouling.
3. Inorganic Fouling (Precipitation Of Inorganic Crystals)
4. Organic Fouling (Deposition Of Fat, Oil, Protein Etc.)
5. Particle Fouling (Deposition Of Silt, Clay.)

Plant Fouling

- The most important members of plant fouling includes the algal community, especially the green algae *Enteromorpha sp.* and the brown algae *Ectocarpus sp.*
- The smaller members of the same community includes diatoms such as Biddulphia, Chaetoceros, Rhizosolenia etc.
- The spores of the algae, can settle in seconds and colonize submerged surfaces within hours.
- Plant fouling usually occurs where there is availability of sunlight i.e. around the water line, Algal fouling.

2. Animal Fouling

- Animal fouling is more gregarious and causes severe extensive damages to the submerged surfaces.
- The chiefly responsible causative organisms are: Protozoans –
  1. Vorticella sp.
  2. Carchesium sp.
  3. Zoothamium sp.

2. Animal Fouling

- **MOLLUSCS** -Mytilus - Perna -Patella - Ostrea These are animals with hard paired shells such as mussels and oysters adhered to submerged structures.
- They settle heavily especially in pipe systems carrying seawater on board and obstructs the flow of water.
- The constant flow of water is conducive to their large scale settling and rapid growth.

2. Animal Fouling

- **ANNELID** -Tubeworms These organisms live in easily recognizable calcareous tubes which protect their soft bodies.
- Tube worm larva can recognize their own species, resulting in large colonies being established.
- They tend to settle on stationary structures or on stationary vessels.
- They can proliferate on any area underwater hull including the flat bottom.

2. Animal Fouling

- **CRUSTACEANS** - *Balanus amphitrite* - *B. eburneus* - *Lepas anatifera* Among crustacean foulers, the barnacles are by far the dominant representatives of the fouling communities.
- They can inhabit any surface no matter how smooth it may be.
- Their shells are very hard and difficult to remove.
- They settle on moving ship hulls.

2. Animal Fouling

- **Bryozoans** - (Encrusting and dendritic fouling organisms.
- They show great variation in settlement.) *Bryptosula pallasiana, Bugula neritina B. flabellata*
- Tubularia Coelentrates Most species are found in marine waters, but some occur in brackish or even fresh water.
- Coelenterates may be either sessile or free swimming, depending on the species and/or stage of the life-cycle.
- Standard methods of introduction include ship fouling or transportation in ballast water of ocean-going vessels. -Tubularia -Pennaria -Campanularia

Boring organisms

- Certain group of animals like teredo, martesia etc., bore into the under part of the wooden hull and destroy the wood in the long run.
- They consume cellulose, a constituent of wood.
- The damage caused by marine borers is not so easily detectable till it has progressed to a dangerous level.
- Use of antifouling paints or use of under water sheathing made of copper, FRP or aluminum act as preventive measurers.

Boring organisms

- Besides, if vessel is fixed in fresh water for a few weeks or taken out of water altogether for about there weeks, they will die.
- If the damage caused is not very severe, the holes could be filled with wooden plugs or with any sealing compound.
- However it is advisable to replace a member in case of extensive damage.

Fouling and boring

Other factors causing deterioration of wood

Rot

- Rotting is natural phenomenon caused by micro-organisms like fungi, which cause decay in wood.
- Organic material of wood is absorbed by these fungi, which causes disintegration of the cell walls followed by changes in Colour, texture and strength properties.
- Wood becomes soft and spongy, due to rotting, besides other changes in the physical and chemical characteristics.

Fouling and Boring

Other factors causing deterioration of wood

- Use of untreated wood together with inadequate ventilation and drainage lead to decay.
- Most of the decay in boats in salt water occurs above the waterline where water can enter but not evaporate and at joints where grain is exposed.
- In fresh water, interior members below the water line are also often subject to decay.
- Some of the preventive measures to avoid rot are usage of heartwood, seasoned and treated wood, allowing proper ventilation of the wood surfaces possibly at all times and eliminating entry of water into the boat.

Corrosion

- Corrosion is the gradual disintegration of metal due to chemical or electro – chemical attack by atmosphere moisture or other agents.
- This phenomenon is prevalent in steel vessels and also wooden vessels having metallic sheath to the underwater part of the hull.
- The corrosion results in thinning of plates and reduction of speed of vessels due to roughness caused on the surface of boat.

Economic Impact

- Biofouling is economically significant on ships' hulls, where high levels of fouling can increase drag, reducing the overall hydrodynamic performance of the vessel and increasing the fuel consumption necessary to maintain a given level of performance.
- Biofouling can also occur in oil pipelines carrying oils with entrained water especially those carrying used oils.
- The removal of these organisms requires costly docking and loss of ship’s time.
- Accumulation of deposits owing to capsulated and slime forming bacteria reduces the heat transfer efficiency of condensers.
- They cause corrosion to the tubes and also jams them.

Preventive Measures

- Various types of coatings are used, such as:
- Pesticide based: – TBT (Tributyltin) – Copper – Arsenic – Mercury
- Pesticide free – Silicone – Epoxy
- Ablative – Self-polishing • Non-ablative
- In olden times, prevention of fouling was done by using copper sheathing in case of wooden hulls.
- In modern times, anti-fouling paints are formulated with toxic copper, organotin compounds, or other biocides-- special chemicals which impede growth of barnacles, algae, and marine organisms

Thank You