

# Effect Of Sea Moisture Content On Corrosion Hull Of A Warship Made By Pt Pal Indonesia

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## **Abstract.**

Seawater temperature ranges from -2 0 c to 300 c. Low temperatures are usually found in seawater around the poles and on the deep seabed. Meanwhile, high seawater temperatures are found in the sea in the Arid area. The Red Sea and Bab El Mandeb have temperatures of about 290 c to 300. Corrosion is a subject matter that concerns various disciplines, or in other words, it connects elements of physics, chemistry, metallurgy, electronics and engineering. This study uses the literature review study method to collect, identify, evaluate the effect of seawater content on the corrosion of the hulls of warships made by PT Pal Indonesia. An effective corrosion control strategy should be selected with the selection of suitable coatings for the marine environment. Hull plating with paint has a special function to protect the construction of the hull, especially those located below the waterline and the construction of the ship above the waterline.

**Keywords:** Seawater, corrosion and hull.

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## **I. INTRODUCTION**

Sea water is water from the sea or ocean. Seawater has an average salt content of 3.5%. This means that in 1 liter (1000 mL) of seawater there are 35 grams of salt (but not all NaCl table salt). Seawater temperatures range from -2 0 c to 300 c. low temperatures are usually found in seawater around the poles and on the deep seabed. Meanwhile, high seawater temperatures are found in the sea in the Arid area. The Red Sea and Bab El Mandeb have temperatures of about 290 c to 300. Because in the sea water moves both horizontally and vertically, the temperature of the water is divided into far / deep parts. Also heat is always used for evaporation. Although most seawater in the world has a salt content of about 3.5%, seawater also has different salt content. The most unsalted are east of the Gulf of Finland and north of the Gulf of Bothnia, both parts of the Baltic Sea. The saltiest is in the Red Sea, where high temperatures and limited circulation make high evaporation and little water input from the rivers.

Salt levels in some lakes can be even higher. Most of the components of seawater are variegated salts. The amount of each salt contained in the 14 seawater is different. In fact, the composition of salt between seawater in one area and another is different. The main salts found in seawater are chloride (55%), sodium (31%), sulfate (8%), magnesium (4%), calcium (1%), potassium (1%), and the rest (less than 1%) consisting of biocarbonate, bromide, boric acid, strontium and flouride. Sea water has salt content because the earth is filled with mineral salts found in rocks and soil. For example, sodium, potassium, calcium, etc. When river water flows into the ocean, it carries salt. Ocean waves hitting the beach can also produce salt. Fresh water is lighter than salt water. To get fresh water from seawater can be done by reverse osmosis, a process of filtration of seawater using pressure flowed through a filter membrane. This system is called SWRO (Seawater Reverse Osmosis) and is widely used on marine vessels or coastal clean water agencies with seawater raw materials.

### **Theoretical Studies**

Corrosion is a subject matter that concerns various disciplines, or in other words, it connects elements of physics, chemistry, metallurgy, electronics and engineering. Most of those involved are those who have a background in one of those sciences but not all of them. So an electrochemical expert does not have to delve into aspects of corrosion in terms of metallurgy or engineering, and vice versa (Tretheway and chamberlain, 1991). Gustavo, 2003 defines corrosion as a chemical/electrochemical reaction between materials, which is often metal or its mixture and environment that produces detonation of the material and its properties. Another definition of corrosion is the collection of the whole process with a path in which the

metal or alloy used for structural materials changes shape from being metal to some combination of conditions caused by interaction with its environment. Thus corrosion is also defined as damage or wear of the material due to the occurrence of reactions with the environment supported by certain factors (Supomo, 2003). From the various opinions of the definition of corrosion above, it is explicitly different based on the development of corrosion science. However, it can be said to have the same essence, namely the phenomenon of material degradation (generally in metals) because it is adjacent to the environment.

## II. METHODS

This study uses the literature review study method to collect, identify, evaluate the effect of seawater content on the corrosion of the hulls of warships made by PT Pal Indonesia. The data source used in this study is a secondary data source, where the data obtained through databases from Pubmed, Elsevier and Google scholar are used to search for relevant journals. The journals obtained are selected based on the title created by the author. The selection of the journal was carried out in accordance with the linkage of the title with the conclusion that tells about the effect of seawater content on the corrosion of the hull of a warship made by PT Pal Indonesia. The search results showed that there were 15 journals then sorted that met the criteria for review as many as 6 journals. This research also uses other methods in the form of literature reviews from various sources such as articles, books, newsletters, news, and other documents that describe the state of knowledge in the past and present about the research topic.

## III. RESULTS AND DISCUSSION

### Effect of Sea Water Content

#### ▪ Evaporation

The more frequent evaporation occurs, the saltier the water will be. Remember that even fresh water contains organic mineral compounds, one of which is salts. When the water evaporates, deposits occur on the seabed. The more salt settles, the saltier the water becomes.

#### ▪ Freshwater intake

The more fresh water that enters, the lower the salt content. In the open ocean, fresh water comes from rainwater. In coastal areas, fresh water comes from rivers and swamps. Whereas at the poles, fresh water comes from melting ice.

#### ▪ Water mixing

The mixing of surface water and water from the inside with different salt levels can reduce the salt content of seawater.

### Hull

The hull is the body of a boat or ship. The hull provides buoyancy that prevents the ship from sinking. The design of the hull is important in making a ship because it will affect the stability of the ship, the speed of the ship's plan, fuel consumption, the depth required in relation to the port pool to be stopped and the depth of the shipping channel traversed by the ship.

(Figure 1).

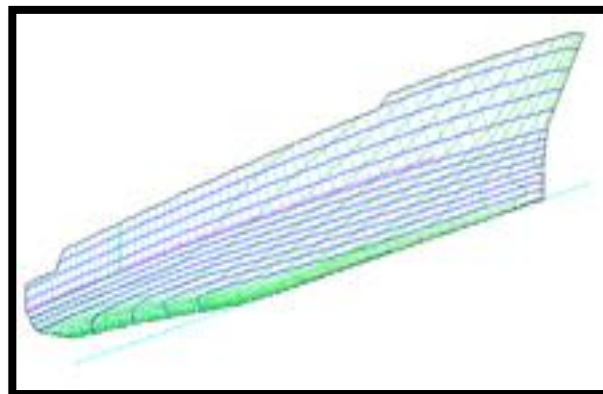


Fig 1. Hull

### Hull Shape

- V-shaped hull, otherwise known as V-shaped hull, is a hull shape for ships at high speed or for use through rough seas, such as on warships.
- Round shape otherwise known as round shaped hull
- Flat bottom hull, otherwise known as flat bottom hull, is a hull shape for ships with low speed and high transport volume as in fishing boats. (Figure 2)

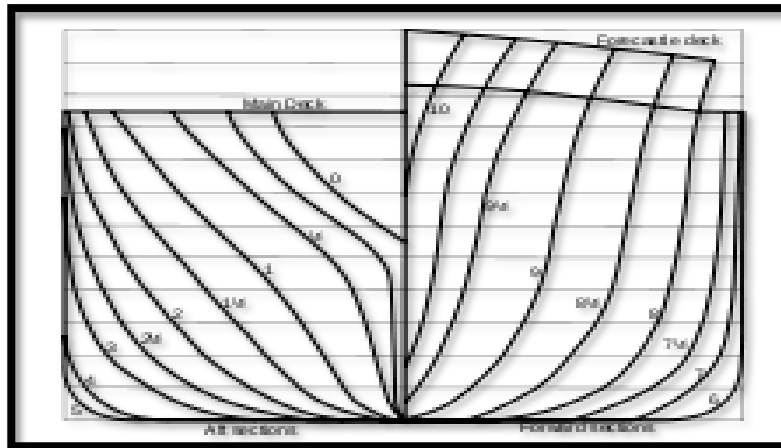


Fig 2.Hull Shape

### PT.Pal Indonesia

PT PAL Indonesia is a subsidiary of Len Industri which is engaged in shipbuilding. Through its subsidiaries, the company also provides ship management, ship manning and leasing services, shipping agents, and ship maintenance planning. To support its business activities, the company also has a representative office in Jakarta. Production of Naval Ships as follows:

- 14 Meter Fast Patrol Boat
- 28 Meter fast patrol boat
- 38 Meter fast patrol boat
- Fast Patrol Boat 57 meters
- Fast Ship Missile 60 meters
- 15 Meter Fast Patrol Boat
- PAL Landing Platform Dock 12
- PAL Motor Yacht 28 meters
- Changbogo-Class Submarines
- Tugboat 29 meters

### Types of Corrosion

- Uniform Attack

It is usually characterized by chemical or electrochemical reactions that take place uniformly over the entire exposed surface or over a large area. The chemical reaction occurs due to the low pH of the water and humid air, so the longer the steel plate is thinner. This type of corrosion can be prevented by, among others, the selection of the right steel plate material along with its coating (coating), given a protective layer containing inhibitors and cathodic protection.

- Galvanic or Two-Metal Corrosion

This corrosion occurs due to the presence of 2 different metals in one electrolyte so that metals that are more anodic will be corroded

- Crevice Corrosion

Corrosion that occurs in metals that are adjacent to other metals and among them there are gaps that can hold dirt and water so that there is oxygen concentration. This type of corrosion is usually caused by small holes, and cracks under the bolt head and rivets.

- **Pitting Corrosion**

This corrosion gives rise to localized holes on the metal surface. These holes may be small or large in diameter, but in most cases they are relatively small. The holes are sometimes insulated or so close together that they look like rough surfaces. Generally, the hole can be described as a cavity or hole with almost the same surface diameter. Pitting is one of the most destructive and dangerous forms of corrosion.

- **Intergranular Corrosion**

Intergranular is a corrosion localized within a narrow area and occurs at the grain boundary. Metal is an arrangement of crystalline grains such as grains of sand that make up sandstone. The granules are tied together which then forms a microstructure. The presence of corrosion causes the granules to be weak, especially at the grain boundary so that the metal loses strength.

- **Selective leaching**

It is the process of removing one element from a solid alloy by a corrosion process.

- **Erosion Corrosion**

Erosion corrosion is the acceleration of the degree of damage or attack on the metal due to the relative movement between the corrosive liquid and the metal surface. Generally, this movement is quite fast, and is related to abrasion Corrosion that occurs due to friction between corrosive liquids in metal surfaces or due to very heavy fluid flow that can erode the protective layer or wear on the metal. This corrosion usually occurs in pipe and propeller sections.

- **Stress-corrosion cracking**

The stress corrosion mechanism occurs due to the relationship of 3 component factors, namely the material is susceptible to corrosion, the presence of an electrolyte solution (environment) and the presence of voltage. For example, copper is susceptible to ammonia compounds, mild steel is susceptible to alkaline solutions and stainless steel is susceptible to chlorides.

### **Corrosion Control**

An effective corrosion control strategy should be selected with the selection of suitable coatings for the marine environment. Hull plating with paint has a special function to protect the construction of the hull, especially those located below the waterline and the construction of the ship above the waterline. Painting on ships is usually called marine coatings, and there are 4 types including Anti-fouling coatings, Anti-corrosion coatings, Foul release coatings, Self-cleaning & self-polishing coatings.

## **IV. CONCLUSION**

- Factors Affecting Seawater Salt Content are Evaporation, Freshwater Intake, Water mixing. And what often happens to the hull is evaporation and intake of fresh water.
- The hull is the body of a boat or ship. The hull provides buoyancy that prevents the ship from sinking. The shape of the hull is a V-shape of a round shape and a flat shape.
- Corrosion Control is Marine corrosion has a significant impact on the life of ships. Therefore an effective corrosion control strategy should be selected with the selection of suitable coatings for the marine environment. Hull plating with paint has a special function to protect the construction of the hull, especially those located below the waterline and the construction of the ship above the waterline.

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