Analysis of the Effect of Sea Water Salinity and Temperature on Propeller Corrosivity Rate On a Traditional Fishing Boat

P. Marcello Lapolalan[1]*, Andri Yulianto[1], Misra Jaya[2], Habibi Santoso[2], Riska Putri Nabella[1]

[1]Politeknik Transportasi Sungai, Danau dan Penyeberangan Palembang
[2]Politeknik Media Creativ, Jakarta

Correspondent Email: pmarcello66@yahoo.com, *andriplp@gmail.com, misrajaya@polimedia.ac.id, habibisantoso@gmail.com

ABSTRACT. This research was conducted to analyze the effect of salinity and sea water temperature on the rate of propeller corrosivity on traditional fishing boats. The research method used is experimental. The experimental process steps include testing the salinity of sea water at different temperatures, and continuing with testing and calculating the corrosion rate by varying the temperature and salinity of the sea water used. The experimental results show that the smallest corrosion rate value is 0.8857 MPY at a temperature of 280C with a seawater salinity of 30 ppt and the highest corrosion rate value is 0.9925 MPY at a temperature of 310C with a salinity of 33 ppt, large and small corrosion rate values for boat propellers Traditional fishermen are influenced by high and low sea water temperatures as well as the amount or lack of salt/salinity content in the sea water. From the results of this research it can be concluded that the temperature and salinity of sea water influence the speed and slowness of corrosion rates on traditional fishing boat propellers.

Keywords: Propeller, temperature, salinity

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1 Introduction

Sukadiri District is one of the sub-districts in Tangerang Regency and is in the southern part of Tangerang Regency, with an administrative area of 21,588 km2. Sukadiri District has the main function and task of carrying out the government authority delegated by the Regent to handle some regional autonomy affairs. Sukadiri District carries out its duties led by a sub-district head who is under and responsible to the Regent through the Regional Secretary. Sukadiri District consists of 8 villages orSubdistricts and regional boundaries, to the north - Java Sea, to the east - Pakuhaji District, to the south - Rajeg and Sepatan Districts, and to the west - Mauk District. Among the 8 villages in Sukadiri District is Karang Serang Villagewith an area of 3,200 km2 and a population of 6,597 people.Karang Serang Village is geographically located on the edge of the sea, one of the main incomes of its residents is fish. Based on BPS data from Tangerang Regency in 2019, 35% of the livelihood of the residents of Karang Serang Village is as fishermen.

Generally local fishermen use small boats which usually sail within 7-8 hours/day to catch fish in the sea using simple equipment for catching fish. These boats are driven by a petrol or diesel motor to drive the boat propeller. These boat propellers are generally made from corrosion-resistant materials because they are operated directly in seawater, which is a corrosive medium. The material used to make the propeller is aluminum alloy (AlSi).

The problem that exists is that many fishermen experience propeller failure, which generally occurs due to a break in the fin or blade of the propeller so that their plans for fishing will be disrupted by the propeller breaking or it could result in an accident on the ship. Apart from that, the propeller is also one of the ship's seaworthiness requirements based on Article 117 paragraph 2 of Law Number 17 of 2008 concerning Shipping, which means that the condition of the ship that meets the ship's safety requirements, one of which is the propeller. Propellers are one of the safety factors for ships and crew, therefore the propellers used must be able to guarantee safety when sailing or fishing. Failure of a fishing boat propeller is caused by damage or corrosion. Corrosion on the propeller can cause technical losses in the form of reduced ship speed and reduced mechanical properties of the propeller material [1].

Corrosion is the degradation of a metal by chemical reactions with its environment. Corrosion is the source of the greatest damage that occurs to ships because it results in fatigue life and reduced ship speed [2]. The material content contained in seawater media has a factor in rapid metal corrosion. There are two aspects that influence the corrosion process, namely the material itself (composition and treatment carried out) and environmental factors such as salinity (salt content), Ph effects (degree of acidity), temperature and speed [3]. The higher the salinity, the higher the corrosion rate that occurs. In actual conditions, waters that have higher salinity levels can cause higher corrosion [4]. Sea water has a salt content of 3-4% which is equivalent to a salinity of 30-40% [5]. Meanwhile, the surface temperature ranges from 0–300C [6].

From several problems and research conclusions found, the author concludes that it is necessary to conduct research to discuss in detail how salinity and sea water temperature influence the corrosion of traditional fishing boat propellers.

2 Research Design

2.1 Research Procedures

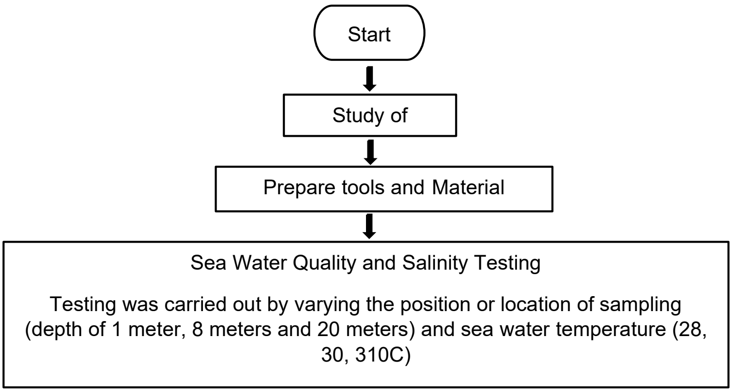
The method for determining the corrosion rate value used isweight loss method (Weight Loss). Test samples are placed in the system and allowed to corrode. After that, the corrosion rate is calculated through the weight loss that occurs in the test sample. The shape and dimensions of the samples to be tested may vary according to the test requirements. The equation for calculating the corrosion rate can use equation 1 [5].

$$Laju\ Korosi = \frac{K.W}{D.A.T} \quad (MPY) \qquad (1)$$

Where K is the corrosion rate constant (3.45 x 106) (MPY), W is the amount of weight loss of the test sample (gr), D is the specific gravity or density of the test sample material (gr/cm3), A is the surface area or cross-section test sample (cm2) and T is the variation of immersion time of the test sample (hours).

2.2 Research Stages

The research process steps include testing the quality and salinity of sea waterby varying the position or location of sampling (depth of 1 meter, 8 meters and 20 meters) and sea water temperature (28, 30, 310C), and continued with corrosion testing on fishing boat propellers by varying sea water temperature (28, 30, 310C) and sea water salinity (30 ppt, 33 ppt). The overall research flow diagram can be seen in Figure 1.



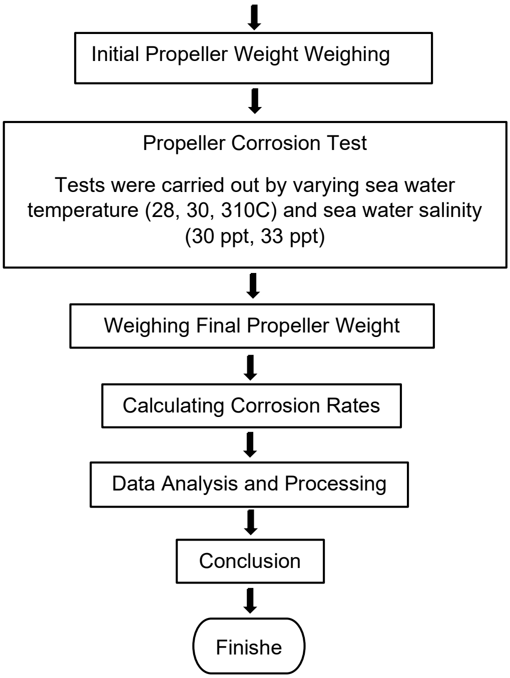


Figure 1. Research flow diagram

2.3Measurement and Testing Equipment

The measurements carried out are measurements of temperature, mass of the test object and immersion time. Meanwhile, the tests carried out were testing the quality and salinity of sea water as well as testing the corrosion rate.

To determine the initial weight before immersion and the final weight after immersion, the test specimens were weighed using an Ohaus AP110-00 type weight scale with an accuracy of 0.1 gram. Meanwhile, time measurement uses a CASIO HS-3 Stopwatch with an accuracy level of 99.99%. Testing the quality and salinity of sea water was carried out using a standard sea water calibration probe meter type HQ40D Portable Multimeter. Meanwhile, to test the corrosion rate using the NACE-RP0775-2005 method.

3Data Analysis and Research Results

3.1 Results of testing the influence of depth, temperature and salinity of sea water

Seawater salinity testing was carried out using test samples at three point positions taken, namely TA at a depth of 1 meter, TB at a depth of 8 meters and TC at a depth of 20 meters. The results of the seawater salinity test are shown in Table 1.

Table 1. Seawater salinity test results

No	Sea Water Samples	Temperature (0C)	Salinity (ppt)
1	TA (1 m depth)	31	29.10
2	TB (8 m depth)	30	29.60
3	TC (20 m depth)	28	33.27

Table 1 explains that the shallower the sea water depth, the higher the sea water temperature, conversely, the deeper the sea water depth, the lower the temperature. This is because the intensity of the sun entering sea water decreases as the depth of sea water increases. It can be seen that at a depth of 1 meter the sea water temperature reaches 310C, then the sea water temperature decreases at a depth of 20 meters to 280C. So it can be concluded that the depth of sea water influences the high and low temperatures of sea water.

Apart from influencing the high and low temperatures of sea water, the depth of sea water also influences the amount of salt (salinity) contained. At a depth of 1 meter the salinity of sea water is 29.1 ppt, which is smaller than at a depth of 20 meters of 33.27 ppt. In conditions of shallow sea water and close to the estuary, it causes more fresh water to spread, thereby reducing the salinity level of sea water. As in Figures 2 and 3. sea water is contaminated with river water and waste.

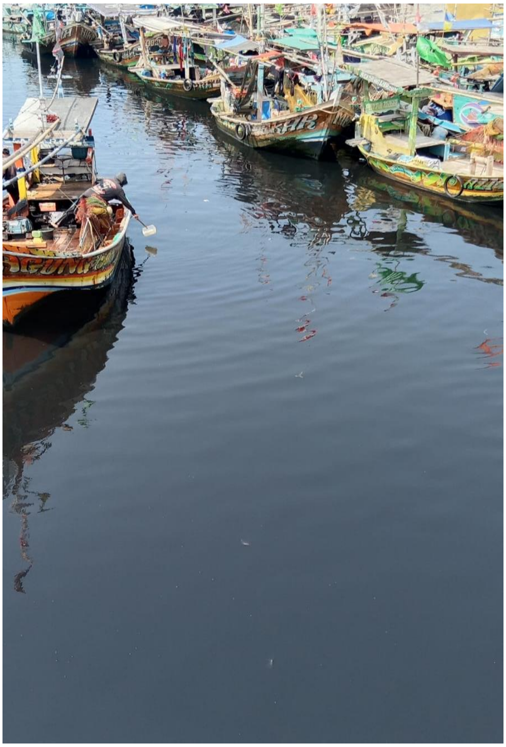


Figure 2. Sea water contaminated with waste.

Figure 3. Sea water contaminated with river water.

Due to the large amount of mixing of waste water and river water, this causes the salt content (salinity) contained in sea water to decrease at the sample positions at point TA and point TB.

Figure 4 shows a graph of the relationship between depth, temperature and sea water salinity, explaining that sea water temperature and sea water salinity have an inverse relationship to sea water depth.

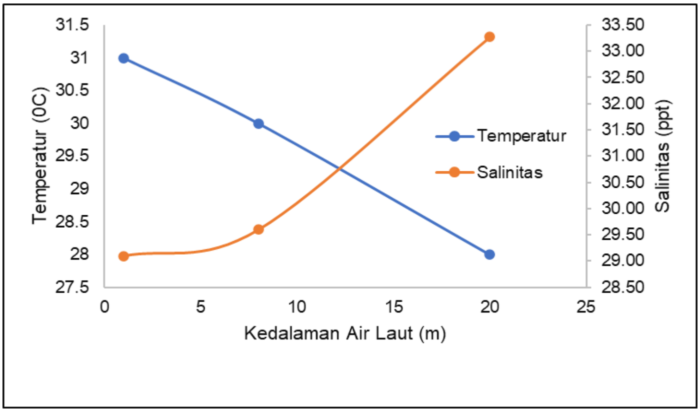


Figure 4. Graph of the relationship between depth, temperature and sea water salinity

The deeper the depth of the sea water, the lower the sea water temperature, conversely the salinity of the sea water will be greater as the depth of the sea water increases, so it can be concluded that the depth of the sea water affects the temperature and salinity of the sea water.

3.2 Test Results for Propeller Corrosion Rates of Traditional Fishing Boats

In this research, the corrosion rate measurement uses the weight loss method. This test was carried out on a 3-leaf propeller specimen with a diameter of 30 cm, for sea water temperatures of 280C, 300C and 310C and with a seawater salinity of 30 ppt and 33 ppt. More details can be seen in Table 2.

Table 2. Test results for propeller corrosion rate

No	Temperature (0C)	Salinity (ppt)	Corrosion Rate (MPY)
1	28	30	0.8857
	30		0.9136
	31		0.9276
2	28	33	0.9534
	30		0.9845

	31		0.9925

Based on Table 2, it can be explained that the higher the temperature and salinity of sea water, the faster the corrosion rate of the propeller. For example, at a temperature of 280C with a seawater salinity level of 30 ppt the corrosion rate on the propeller reaches 0.8857 MPY, when the seawater temperature increases to 310C and the seawater salinity level becomes 33 ppt the propeller corrosion rate becomes even faster to 0.9925 MPY. The corrosion rate on traditional fishing boat propellers has increased very significantly. So it can be concluded that the corrosion rate on the propeller will become faster as the temperature and salinity of sea water increases.

Figure 5 and Figure 6 explain that temperature and salinity of sea water have a significant effect on the corrosion rate of traditional fishing boat propellers. As temperature and salinity increase, the corrosion rate becomes faster, the propeller experiences the highest corrosion rate, namely 0.9925 MPY at a salinity of 33 ppt and a seawater temperature of 310C.

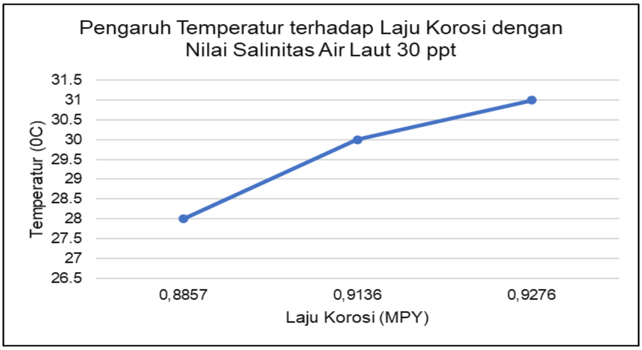


Figure 5. Graph of the relationship between corrosion rate and temperature with seawater salinity of 30 ppt

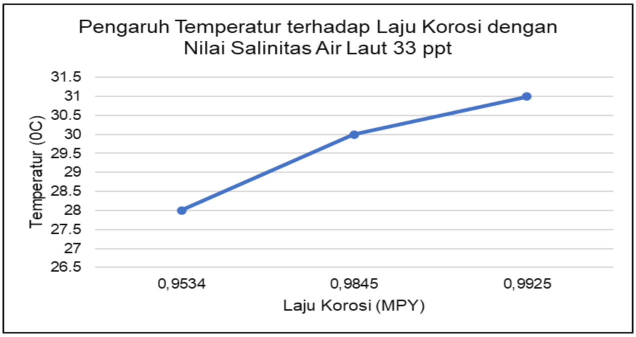


Figure 6. Graph of the relationship between corrosion rate and temperature with seawater salinity of 33 ppt

So it can be concluded that the increase in temperature and salinity is proportional to the increase in the corrosion rate on traditional fishing boat propellers.

4 Discussion

Based on the results of field observations and data processing results, several factors were found that influence the speed of corrosion on traditional fishing boat propellers. One important factor is the depth of sea water, where shallow sea water and deep sea water will influence the high and low temperatures of the sea water, apart from that it will also affect the amount of salt/salinity in the sea water. Observation results show that in 1 year there are 4 months when sea water will experience an increase in volume, such as in January-February and September-October. If the volume of sea water increases, it will also affect the high and low temperature of sea water and its salinity, which will automatically affect the rate of corrosion on traditional fishing boats. So it can be concluded that the factor that influences the rate of corrosion on traditional fishing boat propellers is the depth of the sea water which will also influence the high and low temperatures of the sea water as well as the amount of salinity in the sea water.

5 Conclusion

From the results and discussion it can be concluded that the temperature and salinity of sea water greatly influence how fast or slow the corrosion rate is on traditional fishing boat propellers, such as at a temperature of 280C with a salinity level of 30 ppt the corrosion rate is 0.8857 MPY, while at a temperature of 310C the corrosion rate increases to 0.9276 MPY. On the other hand, at a salinity of 30 ppt with a temperature of 310C the corrosion rate was 0.9276 MPY, while at a salinity of 33 ppt the corrosion rate increased to 0.9925 MPY.

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