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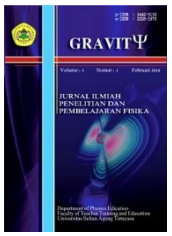

Analysis the rate of metal corrosion using dip-coating electrolyte solutions

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ABSTRACT

This study aims to determine how to test the rate of metal corrosion using dip-coating electrolyte solutions. The electrolyte solutions used are vinegar, lime juice, saltwater, and rainwater—this research conducted by the method of losing weight by dipping the electrolyte solution. The sample immersed for 27 days. The calculation results obtained and samples without coating have a high corrosion rate, so they destroyed quickly. The higher the value of the corrosion rate, the more easily destroyed it will be, and the sample will easily weather/ damaged. Likewise, on the contrary, the lower the corrosion rate, the less corrosion that occurs, and the better the sample is protected from rust.

Keywords: Corrosion rate, dip-coating, electrolyte solution, .

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INTRODUCTION

Metals are part of chemical elements that have strong, sturdy, and electrical and thermal conductors. Metal is widely using in daily life where its use is extensive. The nature of the metal is durable, heat-resistant. It can be forming into the primary material of various needs such as ships, cars, trains, motorbikes and building construction, and so forth. Metal is also straightforward to experience corrosion, where corrosion is known to be harmful because it is destructive and dangerous.

Corrosion is a quality degradation event that occurs in a metal caused due to chemical reactions with the surrounding environment (Trethewey & Chamberlain, 1991). The losses caused by corrosion are substantial, such as if a building whose construction made of steel damaged due to a corrosion event, you can imagine the losses that would arise if the building collapsed or collapsed. Injuries are not only material in nature, but human lives can also be lost.

Factors that affect corrosion on metals include an increase in temperature, which will accelerate the corrosion rate. The higher the temperature, the faster the kinetic energy of the reacting particles increases so that it exceeds the activation energy (Varde & Fogler, 1992). The stirring speed also affects the contact between the reactant and the metal

will be higher so that more metal ions will be released so that the metal will experience fragility (Kirk-Othmer, 1965). The concentration of corrosive material is related to a metal solution's acidity or basicity, which is in an acidic environment that will quickly destroy. At the same time, the base solution will be exposed to corrosion (Djaprie, 1995).

According to Trethewey & Chamberlain (1991), one of the factors influencing corrosion in the water environment is electrolytes' presence. Examples are sulfuric acid and sodium chloride, both of which are strong electrolytes. Durable electrolyte solutions are entirely ionized compounds when dissolved in water. Sustainable electrolyte solutions come from three types of solutions: water-soluble salts, strong acids, and strong bases. At the same time, a weak electrolyte solution is a partially ionized solution in water. Weak electrolyte solutions come from two types of solutions, namely, weak acids and weak bases.

To inhibit the process of corrosion caused by the electrolyte solution using plating. The coating is a coating that applied to the surface of an object. The coat consists of 2 types, namely liquid coating and concrete coating. Liquid coating is usually in the form of painting (painting), whereas a concrete surface is a coating using concrete (Afandi, Arief, & Amiadji, 2015).

This research discusses the corrosion rate's speed and compares the corrosion rate in nails submerged in each electrolyte solution media for 27 days. The test was carried out by using plating and without plating in the medium, soaking in vinegar, lime juice, saltwater, and rainwater. Vinegar is a weak electrolyte that partially ionized in the solvent. Lime juice is a weak electrolyte because it contains citric acid, which is a weak acid. Kitchen salt is including in strong electrolytes which are entirely ionized when dissolved in the solvent. Rainwater contains dissolved substances in the form of nitrogen ions, chlorine, and fluorine, including in the weak electrolyte.

RESEARCH METHODS

The material used in this study is nail specimens measuring 2 cm with a mass of 2.47 grams in 8 pieces. Four nails coated with paint and 4 nails without any coating. It was soaking for 27 days in a container that has been filling with each solution. The solution used is vinegar, lime juice, saltwater, and rainwater.

Figure 1. Immersion specimen media without coating

Figure 2. Soaking the specimen media using a coating

Corrosion rate calculation is doing using the weight loss method. The weight-loss plan is a calculation of the corrosion rate by weighing the mass of the nail specimen. The bulk of the final nail specimen is subtracting from the majority of the initial nail specimen after destroying, so the corrosion rate is obtained. This method uses a research period to get the amount of weight loss due to corrosion that occurs.

To get the amount of weight loss due to corrosion used the following formula:

$$Mpy = \frac{534W}{DAT} \quad (1)$$

Where *Mpy* (miles/year) is the rate of corrosion, *W* (gram) is the mass lost or *W* = Mass of final specimen - Mass of initial specimen;

D (g/cm^3) is the density of the corrosion test object, A (cm^2) is the surface area, T (hour) is the time, and K is a constant (534) (Widodo, Edi 2016). To get the density value of the object, measurements are taken using a 10 ml measuring cup. Fill the measuring cup with water as much as 6 ml, then put the nail into the measuring cup, and see the difference between the water before being put in the nail and water after being put in the nail. Simultaneously, to get the Surface Area of the nail in the cylinder surface area equation used.

RESULTS AND DISCUSSION

Table 1. Nail Mass After Soaking

Sample Name	Solvent Type	No coating (gram)		Using coating (gram)	
		Before	After	Before	After
Sample A	Salt water	2,52	3,04	3,66	3,71
Sample B	Rain water	2,68	3,2	3,43	3,49
Sample C	Lime juice	2,35	2,87	3,67	3,69
Sample D	Vinegar acid	2,13	2,65	3,53	3,54

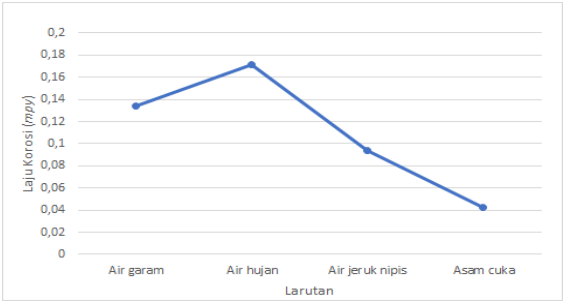

Figure 3. Corrosion rate without coating

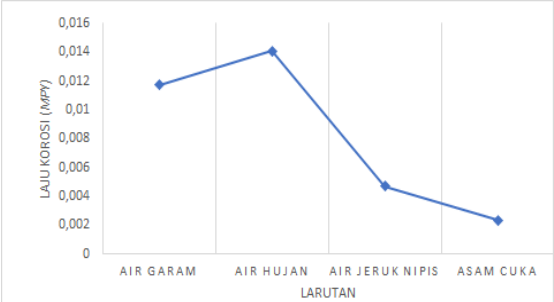

Figure 4. Corrosion rate using a coating

The corrosion rate testing using the weight loss method in each coated and without coating immersion media, has a different corrosion rate that can see in Figures 3 and 4.

Figure 3 shows the corrosion rate without plating. The corrosion rate value in sample A is 0.133 mpy. The corrosion rate value in sample B is 0.171 mpy. The corrosion rate value in sample C is 0.093 mpy. The corrosion rate value in sample D is 0.042 mpy. From the corrosion rate values obtained, it can be seen that in sample B, which uses a rain immersion media, the corrosion rate is very high compared to other immersion media. This is because the rainwater contains nitrogen, chlorine, and fluorine, which causes rapidcorrosion.

Figure 4 shows the corrosion rate using a coating. The corrosion rate value in Sample A is 0.011 mpy. The corrosion rate value in sample B is 0.014 mpy. The corrosion rate value in sample C is 0.004 mpy. The corrosion rate value in sample D is 0.002 mpy. It can be seen that by using corrosion rates, the corrosion rate can be lowered and can prevent rust.

From the results of the corrosion rate that has been obtained between samples using coating and without plating, got corrosion difference in the value of sample A is 0.122 mpy. The difference in the value of the corrosion rate in sample B was 0.157 mpy. The difference in the value of the corrosion rate in sample C is 0.089 mpy. The difference in the value of the corrosion rate in sample D was 0.039 mpy. The difference in the value of the corrosion rate in sample D is smaller than the others. This is because the vinegar acid media without plating obtained a low corrosion rate so that when corrosion is carrying out, the corrosion rate decreases. It can be concluded that corrosion in samples soaked using vinegar has only slight corrosion.

CONCLUSION

From the results of the study, it can be concluded that the high corrosion rate occurs in the immersion of the sample without using a coating. In contrast, the low corrosion rate occurs in the immersion of the sample using a sheet. This is because the immersion of the

sample using a coating can prevent corrosion or rust, the example is coating using paint so that it does not rust easily. The higher the value of the corrosion rate, it will be very easily destroyed, and the sample will be easily weathered/damaged. Likewise, on the contrary, the lower the corrosion rate, the less corrosion that occurs, and the better the sample is protected from rust.

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