JOURNAL OF ENERGY, MATERIAL, AND INSTRUMENTATION TECHNOLOGY

Journal Webpage https://jemit.fmipa.unila.ac.id/

Effect of Variation of Concentration of Ketapang (*Terminalia Catappa*) Fruit Extract on The Corrosion Rate of ASTM A36 Iron

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Article Information

Article history:
Received October 24, 2022
Received in revised form February 2, 2023
Accepted August 15, 2023

Keywords: *Ketapang Rind, Organic Inhibitor, ASTM A36, corrosion rate, NaCl*

Abstract

The aim of this study was to investigate the influence of varying concentrations of Terminalia catappa fruit peel extract on the corrosion rate during immersion periods of 2 days, 4 days, and 6 days for ASTM A36 steel. The ASTM A36 steel specimens were immersed in a corrosive medium containing 2% NaCl, with inhibitor compositions of 0%V, 1%V, 2%V, and 3%V being tested. Measurement results revealed that as the concentration of Terminalia catappa fruit peel extract increased, the corrosion rate proportionally decreased. The lowest corrosion rate was observed in samples with a 3%V inhibitor composition, subjected to a 4-day immersion, measuring at 0.02321 mmpy. Moreover, with the augmentation of fruit peel extract concentration, inhibition efficiency exhibited an augmented trend (83.02% for the 3%V composition, and the lowest at 41.84% for the 1%V composition).

Informasi Artikel

Proses artikel:
Diterima 24 Oktober 2022
Diterima dan direvisi dari 2 February 2022
Accepted 15 Agustus 2023

Keywords: Kulit Buah Ketapang, Inhibitor Organik, ASTM A36, Laju Korosi, NaCl

Abstrak

Penelitian ini dilakukan untuk mengetahui pengaruh variasi ekstrak kulit buah ketapang terhadap laju korosi dengan waktu perendaman selama 2 hari, 4 hari dan 6 hari pada logam besi ASTM A36. Besi ASTM A36 direndam dalam media korosif yaitu NaCl 2% dengan variasi komposisi inhibitor yang digunakan sebesar 0%V, 1%V, 2%V dan 3%V. Hasil pengukuran menunjukkan semakin besar penambahan ekstrak kulit buah ketapang, maka laju korosi akan semakin berkurang. Laju korosi terendah diperoleh sampel dengan komposisi inhibitor 3%V pada waktu perendaman selama 4 hari sebesar 0,02321 mmpy. Semakin besar penambahan ekstrak kulit buah ketapang, maka efisiensi inhibisi akan semakin bertambah, (83,02% pada komposisi 3%V dan paling rendah sebesar 41,84% pada komposisi 1%V).

1. Introduction

Iron is a type of metal that comes in various forms, usually mixed with carbon. Iron ore is a compound made up of oxides, carbonates, sulfides, and other elements like silicon. Iron ore is processed in furnaces to produce raw iron, which is used to make things like cast iron machinery, wrought iron tools, and steel. This method is commonly used in various applications (Amto & Daryanto, 2017). However, iron is prone to corrosion and easily gets oxidized, so special treatment is needed to maintain its strength and properties (Ramadhan, 2020).

Corrosion happens when metal deteriorates due to chemical reactions with the atmosphere or water vapor (Ojha et al., 2017). As mentioned by Uwiringiyimana et al. (2016), corrosion is an ongoing process that is hard to control completely. The negative effects of corrosion are noticeable, especially in the gas and transportation industries where steel and iron materials are used, leading to significant costs to prevent or replace corroded materials.

Efforts have been made globally to counteract corrosion, including using protective coatings. Using corrosion inhibitors is a practical and cost-effective way to prevent corrosion, especially in wet environments (Idora et al., 2017). Corrosion inhibitors are the preferred choice to safeguard metals. Some promising corrosion inhibitors are derived from organic compounds. These compounds, containing elements like nitrogen (N), sulfur (S), and oxygen (O), can

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Prabowo O, Syafriadi, and Suka E G, 2023, Effect of Variation of Concentration of Ketapang (Terminalia Catappa) Fruit Extract on The Corrosion Rate of ASTM A36 Iron, *Journal of Energy, Materials, and Instrumentation Technology* Vol. 4 No. 3, 2023

slow down the corrosion process of metals. These elements readily attach to metal surfaces, forming a protective layer that reduces corrosion (Kamal et al., 2014).

This study focuses on using corrosion inhibitors from Terminalia catappa fruit peels. This choice is based on the presence of tannins in the fruit peels, which are easy to obtain. Tannins are natural compounds found in various plant parts like bark, fruit, leaves, and roots, known for their corrosion-inhibiting properties (Arismendi et al., 2018). The extraction process involves using solvents like methanol, ethanol, acetone, and ethyl acetate. This research suggests potential applications for these inhibitors in protecting metal from corrosion (Sieniawska & Baj, 2017).

2. Research Methodology

The equipment and materials utilized in this research encompassed chemical glassware, a Saints grater, spatula, blender, oven, heat gun, and a balance scale. Analytical equipment such as measuring glasses, filter paper, sandpaper, aluminum foil, a Vernier caliper, UV-VIS spectrometer, ASTM A36 steel, 96% ethanol, Terminalia catappa fruit, 2% NaCl (sodium chloride), and detergent were also employed.

2.1 Preparation of Ketapang Fruit Peel Extract

The Terminalia catappa fruit is separated into its peel and seed by grating. Subsequently, the separated peel is dried in an electric oven until a constant weight is achieved, indicating the absence of moisture content. The dried peel is then pulverized into a powder form using a blender. A quantity of 20 grams of this powdered peel is placed into a 500 mL chemical glass and dissolved in 400 mL of 96% ethanol. Subsequently, a maceration process is carried out. The solution of the powdered peel is evaporated for 30 minutes. Following this, the solution is filtered using Whatman filter paper. The resulting filtrate is heated to evaporate the solvent, resulting in a thick, caramel-like substance.

2.2 preparation ASTM A36 iron

Metal iron is used with ASTM A36 standardization with a rate of 4% carbon, a thickness of 0.08 cm, and cut with size 2x2 cm. The surface metal is washed and then scraped with paper sand to remove substance impurities. Then clean and repeat with detergent and dry using a heat gun for about 10 minutes. Furthermore, metal iron was weighed, and the results were expressed as the initial mass.

2.3 Testing

ASTM A36 iron has been known mass at first soaked in 50 mL of NaCl 2% with the addition of inhibitors 0%, 1%, 2%, and 3%. ASTM A36 iron which has been soaked Then stored for two days, four days, and six days in drying, then weighed to get the final mass. Then the corrosion rate was calculated using the weight loss method, and the inhibition efficiency was calculated.

2.4 Corrosion Rate Calculation

Corrosion rate and inhibitor efficiency calculations can be performed using the weight loss method shown in equations 1 and 2.

$$CR=\frac{KW}{AT\rho} \quad (1)$$

where, CR = Corrossion Rate (mm/year), K = Corrosion rate constant (87600), W = Mass difference (mg), A = Surface area (mm^2), T = Immersion time (years), ρ = Density from each sample

$$\text{EI (\%)} = \frac{C_R^0 - C_R}{C_R^0} \text{ x } 100\%$$

(%), CR^0 = Corrosion rate without inhibitor (mm/year), CR = Corrosion rate with inhibitor (mm/year) (Mourya, 2014).

3. Results and Discussion

This study's research data were obtained in the form of surface area (*A)*, mass reduction, and density. The surface area was obtained from ASTM A36 iron measurements in the form of p (mm), l (mm), and t (mm) using calipers. Then calculate the mass reduction by weighing the initial and mass after the immersion sample.

3.1 Corrosion Rate

Calculation rate corrosion and inhibitor efficiency can be calculated using the method of lost weight shown in **Figure 1**.

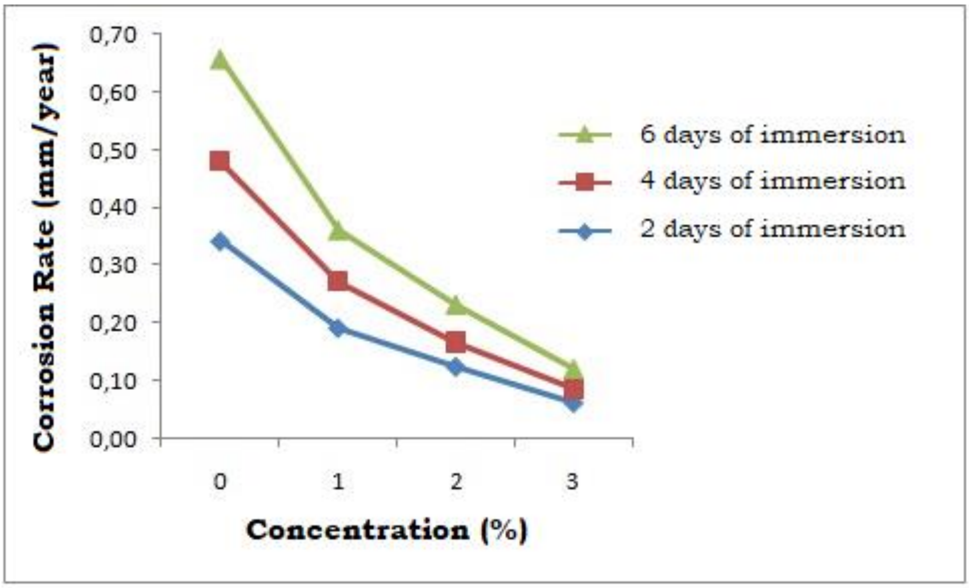

Figure 1. Effect of inhibitor concentration and immersion time against 2 % NaCl corrosive medium.

Figure 1 shows the calculation results of rate corrosion with variation concentration and immersion time variations, which show a decline with the additional inhibitor concentration. The presence of Cl- ions in NaCl is one of the aggressive ions that have the potential to cause corrosion on metals. NaCl solution media can potentially increase the occurrence of corrosion on metals (Dian et al., 2015). In the presence of oxygen, this complex turns into a tannin iron complex called tannate. This complex will be attached to the iron surface, preventing further corrosion because the complex will be absorbed on the iron surface and protect the iron surface (Ali, 2016). In this study, the tannins obtained were derived from ketapang fruit peel extract. The connection between inhibitor concentration and immersion time to extract inhibitor efficiency keta pang fruit skin *(Terminalia catappa)* is shown in **Table 1**.

Table 1. ASTM A36 Iron Corrosion Rate in 2% NaCl Solution with the addition of inhibitors

Sample	Soaking Time	Inhibitor Efficiency (%)
1% addition	48 hours	43.89
2% addition	48 hours	63.46
3% addition	48 hours	81.72
1% addition	96 hours	41.84
2% addition	96 hours	70.01
3% addition	96 hours	83.02
1% addition	144 hours	49.64
2% addition	144 hours	62.81
3% addition	144 hours	80.37

Based on **Table 1**. The addition of inhibitors affects the corrosion rate, which decreases and can increase the inhibition value depending on the concentration used.

4. Conclusion

Based on the study's results, adding ketapang fruit peel extract *(Terminalia catappa)* affected the corrosion rate of ASTM A36 iron. As the inhibitor concentration increases, the corrosion rate decreases. In contrast, the highest efficiency of the ketapang rind inhibitor in a 2% NaCl corrosive medium is found at a concentration of 3% soaked for 96 hours at 8.1.72 %.

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