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Socialization of Study on Application of Water Hyacinth Extract as an Inhibitor to Prevent Corrosion

Sosialisasi Studi Penerapan Ekstrak Eceng Gondok Sebagai Inhibitor Untuk Mencegah Korosi

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Abstract

Corrosion or rusting usually occurs in metal-based equipment due to a decrease in the quality of the metal due to electrochemical reactions with the environment. Metals are widely used in life, from household appliances to health equipment. This Community Service Activity has a theme Utilization of water hyacinth extraction as a corrosion inhibitor to overcome corrosion problems. Socialization of the method or process of corrosion, the losses that occur due to corrosion and the process/method of extracting water hyacinth to become a corrosion inhibitor and its application to reduce the rate of corrosion was carried out with the youth of Muhammadiyah Kampar, Batu Belah Village because the use of water hyacinth plants is still not optimal and is even considered to disturb the environment because it can reduce water discharge. This community service can increase insight and can be applied in life to prevent corrosion that occurs on equipment used in everyday life.

Keywords: corrosion, water hyacinth, inhibitor

Abstrak

Korosi atau perkaratan biasanya terjadi pada peralatan berbahan dasar logam karena penurunan kualitas logam akibat reaksi elektrokimia dengan lingkungan. Logam banyak digunakan dalam kehidupan mulai dari peralatan rumah tangga, hingga alat-alat kesehatan. Kegiatan Pengabdian Kepada Masyarakat ini mengangkat tema pemanfaatan ekstrak eceng gondok sebagai inhibitor korosi untuk mengatasi permasalahan korosi. Sosialisasi cara atau proses terjadinya korosi, kerugian yang terjadi akibat korosi dan proses/ cara ekstraksi eceng gondok menjadi inhibitor korosi dan aplikasinya untuk mengurangi laju korosi dilakukan bersama pemuda Muhammadiyah Kampar Desa Batu Belah karena pemanfaatan tanaman eceng gondok masih belum optimal bahkan dianggap mengganggu lingkungan karena dapat mengurangi debit air. Pengabdian kepada masyarakat ini dapat menambah wawasan dan dapat diaplikasikan dalam kehidupan untuk mencegah korosi yang terjadi peralatan yang dipergunakan dalam kehidupan sehari – hari.

Kata kunci: korosi, eceng gondok, inhibitor

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1. INTRODUCTION

Corrosion is an event of damage or decreased performance of a material caused by a reaction between the material and its deposition environment which will gradually damage the function of the tool. (Utami Wahyuningsih, Halim Rusdji 2017). Corrosion is a natural phenomenon that cannot be avoided, almost all materials that interact with their environment will sooner or later experience a decline in the quality of the material. (Nugroho, 2015). Corrosion occurs because of the air and water around the material (Fontana, 1986).

Factors that cause corrosion include: (Tri Indah S, 2021)

1. Temperature
2. Flow Speed
3. PH
4. Oxygen Level
5. Humidity

Air humidity describes the water vapor content in the air. Changes in air around steel/iron equipment can cause corrosion. Several factors that influence air humidity include: (Sandi 2017, Tika, 2010)

1. Place Height
2. Air Density
3. Air pressure
4. Solar Radiation
5. Wind
6. Temperature
7. Vegetation Density

The types of corrosion are as follows: (Budi Utomo 2009)

1. Uniform Corrosion
   This is corrosion that occurs due to chemical or electrochemical reactions that occur uniformly on the metal surface

Figure 1. Uniform Corrosion on ballast pipes
Source: Budi Utomo, 2009

2. Well Corrosion
   Corrosion that occurs in an area on a metal surface which causes holes to appear on the metal surface

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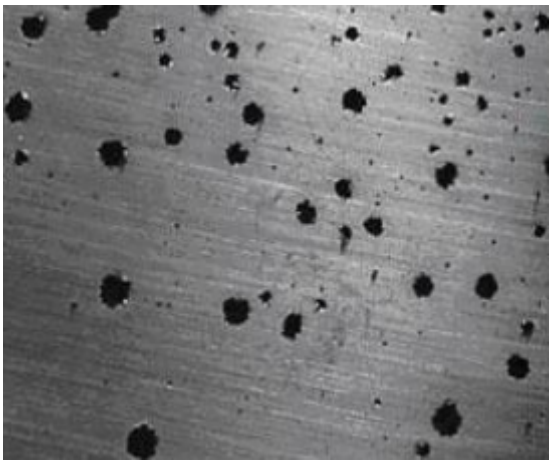

Figure 2. Pit corrosion
Source: Budi Utomo, 2009

3. Corrosion Erosion
   Corrosion occurs due to very fast fluid flow

Figure 3. Erosion corrosion
Source: Budi Utomo, 2009

4. Galvanized Corrosion
   Corrosion occurs when two dissimilar metals are connected and are in a corrosive environment. One of these metals will experience corrosion.

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Figure 4. Galvanic Corrosion
Source: Budi Utomo, 2009

5. Stress Corrosion
   Corrosion occurs because the material experiences cracks due to environmental influences

Figure 5. Erosion Corrosion
Source: Budi Utomo, 2009

6. Crevice Corrosion
   Local corrosion that occurs in the gap between two components

Figure 6. Crevice Corrosion
Source: Budi Utomo, 2009

7. Microbiological Corrosion
   Corrosion occurs due to the influence of microorganisms including bacteria, fungi and so on

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Figure 6. Microbiological Corrosion
Source: Budi Utomo, 2009

8. Corrosion Fatigue
   Corrosion occurs because metal is subjected to repeated loads so that over time the steel/metal will break

Figure 7. Corrosion Fatigue
Source: Budi Utomo, 2009

To prevent and reduce corrosion, there are several methods that can be used, including: (Ardi P,Y, 2016)

1. Change of Media/Work Environment
2. Material Selection
3. Cathodic Protection
4. Anodic Protection
5. Corrosion Inhibitor
   An inhibitor is a chemical substance that can inhibit or slow down a chemical reaction. A number of inhibitors inhibit corrosion through adsorption to form a thin, invisible layer with a thickness of only a few molecules, there are also those that, due to environmental influences, form visible deposits and protect the metal from attacks that corrode the metal and produce products that form a passive layer, and there are also eliminates aggressive constituents.
   Based on the mechanism of action, corrosion inhibitors can be divided into 5 types, namely (Gumelar, 2011):
   a. Inhibitor Anodic

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Anodic inhibitors make the metal polarized in the anodic direction so that it is in a passive area which creates a passive layer on the metal surface so that the corrosion rate can decrease

b. Cathodic Inhibitor
This type of inhibitor works by inhibiting the cathodic reaction of a metal due to the formation of a deposit which can increase surface resistance while limiting the reduction reaction to protect the metal.

c. Precipitation Inhibitors
This type of inhibitor works by forming precipitates that are relatively porous, thick, and less strongly attached to metal. This layer forms on the entire surface of the metal which acts as a protective layer to indirectly inhibit anodic and cathodic reactions of the metal.

d. Mixed Inhibitors (Organic Inhibitors)
Mixed inhibitors are basically organic compounds, they are classified as mixed inhibitors because they cannot be included in the anodic or cathodic groups. The effectiveness of organic inhibitors is related to the wide adsorption area that can protect the metal surface. The process used to protect metal is carried out by means of physical adsorption, chemisorption and film formation. (Pramana, 2012)

e. Volatile Corrosion Inhibitor
This type of inhibitor works by reducing the level of environmental corrosiveness of the metal that you want to protect as a compound that flows through a closed environment to the corrosive environment by evaporation from the source.

6. Coating (Coatings)
Coating is coating the parent metal with a protective substance or material. Types of coating include:
   a. Metallic coatings
   b. Paint /organic coatings
   c. Chemical conversion coatings
   d. Miscellaneous coatings (enamel, thermoplastics)

Based on observations, it is known that the Batu Belah community in particular and humans in general use iron-based tools in their daily lives. Iron is widely used because it has beneficial properties and is easy to modify, its processing is also relatively easy and cheap, besides that the supply of iron in the earth's crust is quite large. Tools or buildings made from iron are often found in everyday life, such as tools used for kitchen utensils such as dish racks, machines, bridges, fences, railings, iron pipes, telephone poles, etc. Apart from that, iron-based equipment is also used in various types of industry, such as the petroleum industry which uses iron pipes as a means of transporting petroleum to the surface and to production facilities.

However, as previously explained, iron has a weakness, namely that it corrodes easily. Corrosion can reduce the lifespan of items or buildings that use iron. Corrosion makes metal devices brittle, where the rust layer will peel off, and make the device more easily broken or perforated. Corrosion can also cause environmental pollution, especially water if the water is contaminated with corrosion-forming compounds.

Among the corrosion prevention methods is coating or painting using corrosion inhibitors. Painting is carried out to prevent the metal from coming into contact with air or water. Inorganic inhibitors and organic inhibitors can be used in the painting method. Inhibitors work as follows (Lyons et al., 2016):

1. Absorbs corrosion material into a thin film layer.
2. Induces the formation of thick corrosion, which forms a passive layer.

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3. Changing environmental characteristics by creating protective particles by eliminating or not activating aggressive compounds in the environment.

The use of inorganic inhibitors is widely used to inhibit corrosion, but the use of these inorganic inhibitors can cause problems because they are toxic, *non biodegradable*, and are expensive to synthesize (Benabdellah et al., 2006). The use of inorganic inhibitors has been banned in many countries and has shifted to the use of organic inhibitors. Organic compounds with hetero atoms such as oxygen, nitrogen, sulfur and phosphorus are the most frequently used inhibitors for metal corrosion. Organic inhibitors act as adsorption on metal surfaces to form a layer and reduce the corrosion rate (Tourabi et al., 2014).

The water hyacinth plant is one of the plants whose use has not been used optimally by the Indonesian people in general and the people of Batu Belah, Kampar Regency in particular. The water hyacinth plant (Eichornia crassipes) is a type of plant that lives quickly in water. Because water hyacinth plants grow faster, water hyacinth creates new problems for the lake's shallow biota environment. The growth of water hyacinth can reach 1.9% per day, so that water hyacinth plants are classified as aquatic weeds (bagir & Pradana, 2008). Water hyacinth is considered a nuisance in the agricultural sector because it can reduce water discharge. However, besides having weaknesses, the water hyacinth plant contains several compounds with high pharmacology as antioxidants, namely lignin compounds. Where lignin is an additive that can be used as an organic inhibitor to overcome corrosion problems. There is research that has been successfully carried out to prove the success of water hyacinth as an inhibitor to prevent and reduce the rate of corrosion.

Figure 8. Water hyacinth plant

2. METHODS

This Community Service Activity was carried out in Batu Belah Village, Kampar Regency with the community and youth of Muhammadiyah Ranting Batu Belah Kampar. This activity consists of several stages starting from a field survey, socialization stage and evaluation stage. The field survey is the initial stage of this program by conducting a survey of the community's understanding of the causes of corrosion and how to overcome it as well as community understanding regarding the processing and use of water hyacinth plants as corrosion inhibitors. Based on the survey, it was found that public understanding regarding the causes of corrosion, how to overcome corrosion and public understanding regarding the processing and utilization of water hyacinth plants is still minimal, so this PKM activity is a solution offered to overcome these problems.

The next stages carried out in this PKM activity are the preparation stage, counseling/socialization, and evaluation stage. The preparation stage was carried out by the PKM

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Team by visiting Batu Belah Village, Kampar Regency to provide information and explanations regarding time agreements and other preparations for the success of PKM activities. The outreach/socialization stage is carried out by providing lectures/counseling, dialogue and questions and answers regarding corrosion, the causes of its occurrence, household equipment and equipment used in daily life that are susceptible to corrosion, ways to overcome corrosion and socialization of the process or methods of plant extraction. Water hyacinth is a corrosion inhibitor. The evaluation stage of PKM activities was carried out by comparing the understanding of the community and youth of Muhammadiyah Ranting Batu Belah regarding corrosion, the causes of its occurrence, household equipment and equipment used in daily life that are susceptible to corrosion, ways to overcome corrosion and the process or methods of plant extraction. Water hyacinth becomes a corrosion inhibitor before counseling/socialization activities are carried out with the understanding of the community and Muhammadiyah Ranting Batu Belah youth after the counseling/socialization activities are carried out. Evaluate the success of the activity from the presence and activeness of the community in community service activities.

Figure 9. PKM preparation activities

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Figure 10. PKM Extension/Socialization Activities

3. RESULTS AND DISCUSSION

Community Service Activities (PKM) were held on Saturday, September 24 2022 in Belah Village, Kampar Regency regarding corrosion and methods of preventing it. Corrosion is an event of damage or decreased performance of a material caused by a reaction between the material and its deposition environment which will gradually damage the function of a tool (Utami Wahyuningsih, Halim Rusdji 2017). Equipment made from iron/steel is susceptible to corrosion because these materials have limited resistance to damage caused by various factors such as pH, high air humidity, high temperature and high oxygen levels (Tri I, S, 2021). Tools or buildings made from iron are often found in everyday life, such as tools used for kitchen utensils such as dish racks, machines, bridges, fences, railings, iron pipes, telephone poles, and others. To prevent and reduce corrosion, there are several methods that can be used, including changing the working medium/environment, material selection, cathodic protection, anodic protection, corrosion inhibitors and coatings. (Ardi P,Y, 2016).

Painting is carried out to prevent metal from coming into contact with air or water, where inorganic inhibitors and organic inhibitors can be used in the painting method. The use of inorganic inhibitors is widely used to inhibit corrosion, but the use of these inorganic inhibitors can cause problems because they are toxic, *non biodegradable*, and are expensive to synthesize (Benabdellah et al., 2006). The use of inorganic inhibitors has been banned in many countries and has shifted to the use of organic inhibitors. Organic compounds with hetero atoms such as oxygen, nitrogen, sulfur and phosphorus are the most frequently used inhibitors for metal corrosion. Organic inhibitors act as adsorption on metal surfaces to form a layer and reduce the corrosion rate (Tourabi et al., 2014). Water hyacinth plant (*Eichornia crassipes*) is one of the plants whose use has not been used optimally by the people of Batu Belah, Kampar Regency. Water hyacinth is considered a nuisance in the agricultural sector because it can reduce water discharge. However, water hyacinth contains lignin compounds. Lignin is an additive that can be used as an organic inhibitor to overcome corrosion problems.

The results of the service activities are increasing understanding among the community and Muhammadiyah Ranting Batu Belah Youth regarding corrosion, how to prevent it and making corrosion inhibitors based on water hyacinth. The results of the activity evaluation showed that participants in community service activities were able to understand the material presented by the community service team which came from lecturers from the Faculty of Engineering, Islamic University of Riau. Indicators of participant understanding are listed in the discussion and questions and answers provided during the activity. Implementation of activities uses lecture and dialogue methods as well as question and answer. The presenter presented material in the form of a presentation regarding the theory of corrosion, equipment that is susceptible to corrosion and the process and

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method of extracting water hyacinth to become a corrosion inhibitor. This activity was successful by measuring the number of participants who attended. Collaboration between the participants and the Activity Implementation Team went smoothly, activity participants enthusiastically participated in all series of outreach starting from material presentations to question and answer sessions.

4. CONCLUSION

The conclusions that can be obtained from the results of the implementation of Community Service Activities carried out in Batu Belah Village, Kampar, Muhammadiyah Ranting Batu Belah Community and Youth understand the material presented by the PKM Team, Faculty of Engineering, Islamic University of Riau regarding the theory of corrosion, equipment that is susceptible to corrosion and processes. and how to extract water hyacinth to become a corrosion inhibitor. Indicators of participant understanding are listed in the questions and answers conducted before the counseling/socialization activities are carried out and after the activities are carried out. Apart from that, several problems and misinformation faced by participants regarding corrosion and water hyacinth plants can be answered and explained well during the outreach/socialization activities for PKM activities.

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