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Metal Conservation Method in The Infinity Statue by Dunadi

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ABSTRACT

The Infinity Sculpture by Dunadi is a media representation of the idea of the eternal function of bicycles over time. The infinity statue is primarily made of ferrous metal, so it has the potential for damage in the form of patina and rust, especially when exposed to direct sunlight, rainwater, oxygen, and other substances that accelerate corrosion growth. The current condition of the infinity statue by Dunadi could be better because most of the paint has peeled off, and rust has grown on the entire surface of the metal that is not covered with paint. This article discusses the application of modern metal conservation methods to Dunadi's Infinity Sculpture. This study's contemporary metal conservation method compares several synthetic chemicals to clean rust on metal and then apply it to Dunadi's Infinity Statue. The synthetic chemicals used are some of the rust-cleaning agents available. Synthetic chemicals are available because they are easy to obtain and relatively safe. We tested Several brands of rust cleaners available on the market on metal objects similar to the material for making infinity statues. As a result, the most effective rust-cleaning chemicals contain hydrochloric acid.

Keywords: conservation methods; metal conservation; rust cleaner

ABSTRAK

Patung Infinity karya Dunadi merupakan representasi media dari gagasan tentang fungsi abadi sepeda dari waktu ke waktu. Patung infinity utamanya terbuat dari logam besi, sehingga berpotensi mengalami kerusakan berupa patina dan karat, terutama jika terkena sinar matahari langsung, air hujan, oksigen, dan zat lain yang mempercepat pertumbuhan korosi. Kondisi patung infinity karya Dunadi saat ini bisa lebih baik karena sebagian besar catnya sudah terkelupas, dan karat sudah tumbuh di seluruh permukaan logam yang tidak dilapisi cat. Artikel ini membahas penerapan metode konservasi logam modern pada Patung Infinity karya Dunadi. Metode konservasi logam kontemporer dalam penelitian ini membandingkan beberapa bahan kimia sintetis untuk membersihkan karat pada logam lalu mengaplikasikannya pada Patung Infinity karya Dunadi. Bahan kimia sintetis yang digunakan merupakan beberapa bahan pembersih karat yang tersedia. Bahan kimia sintetis tersedia karena mudah diperoleh dan relatif aman. Kami menguji beberapa merek pembersih karat yang tersedia di pasaran pada benda logam yang mirip dengan bahan untuk membuat patung infinity. Hasilnya, bahan kimia pembersih karat yang paling efektif mengandung asam klorida.

Kata kunci: metode konservasi; konservasi logam; pembersih karat

1. Introduction

Art is a representation of the artist's ideas. Presenting an artist's statements is carried out using specific techniques to create work that is sometimes unusual for ordinary people. To understand an artist's goal in creating a piece, it is better to understand the artist's techniques for creating and representing ideas (Gordon, 2005). Making different works of art produces various results. Artists use certain methods to produce specific shapes to represent the ideas they want to convey to other people.

One of the works of art representing ideas about sustainable life is the Infinity Statue by Dunadi. The Infinity statue by Dunadi is located in the courtyard of the ISI Yogyakarta Fine Arts Faculty. The infinity statue was created in 2017 and placed in the yard of the ISI Yogyakarta Fine Arts Faculty in 2020 at the JICAF 2020 Visual Art Collaboration event (https://jicaf2020.isi.ac.id/). Dunadi's Infinity statue is mainly made of metal, so it has the potential for damage in the form of rust or corrosion. Placing an infinity statue outdoors increases the potential for damage due to exposure to oxygen, direct sunlight, or rainwater. Currently, the condition of the Infinity statue could be better, and the paint is peeling and rusty on almost all parts. The infinity statue requires conservation measures as soon as possible to avoid further damage.

Metal works of art have their main enemy in rust or corrosion. Corrosion on objects is a change in metal elements due to exposure to foreign substances in the form of gas or radiation. Metal objects will easily corrode when exposed to oxygen, water, or solar radiation for a long time (McCafferty, 2010). Natural phenomena such as oxygen, sunlight, and rainwater are some of the factors that cause metal corrosion.

Humans have been trying to prevent and treat metal corrosion for a long time. Metal conservation in Indonesia is generally divided into two methods, namely traditional conservation methods and modern conservation methods. Traditional conservation methods are methods for preserving the heritage of the Indonesian ancestors, which have unique characteristics, namely using tools and materials available in the environment and involving local wisdom in the stages. Meanwhile, modern conservation methods have unique characteristics, namely the use of sophisticated tools and synthetic chemicals, and have the practical aim of maintaining the durability of conservation objects (Borobudur Conservation Center, 2012). Metal conservation methods have existed since ancestral times until today. From ancient times until now, metal conservation methods have emerged and developed along with the times.

Metal conservation methods have evolved from traditional to modern. This paper aims to apply modern metal conservation methods to Dunadi's Infinity Statue. The modern metal conservation method applied in this research is comparing several synthetic chemicals to clean rust on metal and then applying them to the infinity statue by Dunadi.

2. Literature Review

2.1. Metal Conservation

Metal is one of the majority of elements that humans need. The human need for metal is increasing due to developments over time, starting from minor characteristics, such as conductor lines in electronic devices, cooking devices, and household appliances, to the framework of skyscrapers made of metal. Metal is the choice of humans to help their lives because metal can conduct electricity and heat, is complex, malleable, and solid but can be shaped according to human desires. Some types of metal have unique physical characteristics, namely shiny, shiny metals, often called precious metals. Metal becomes clay and melts when exposed to very high temperatures, making it easy to shape into anything. When the metal cools again, the metal becomes hard again (Camm, 1944; Cob, 2012).

The majority of elements in the periodic table fall into the metal classification. 73 of the 92 natural elements in the periodic table are metals. Metals are divided into two types, namely ferrous and non-

ferrous. Ferrous metals consist of iron and several mixed metals; the rest are non-ferrous. Ferrous metals (Fe) contain iron elements, such as iron and steel. In contrast, non-ferrous metals are metals that do not contain iron elements, such as noble metals, radioactive metals, or refractory metals. Metals can be classified into physical and mechanical classes. Physical metal is metal's pure or essential character, while mechanical metal has undergone various changes. Traditionally, metals are divided into five types: gold, silver, copper, iron, and tin. Not all types of metal are solid; there are also liquid metals such as mercury and soft metals such as lead (Cobb, 2012).

Metal conservation is a set of efforts to protect metal objects from various types of damage. Metal conservation aims to maintain the durability of metal objects for as long as possible so that the message or meaning contained therein can be adequately conveyed to the next generation. The term metal conservation is often intended to care for metal objects of cultural value, whether archaeological, historical, industrial, or artistic. Metal conservation should be carried out appropriately, considering that the metal objects being conserved have essential value for the supporting community. Metal conservation practices must comply with the applied conservation rules and refer to international metal conservation standards (Watkinson, 2010).

Metal conservation standards are created based on metal conservation objectives. Metal conservation standards include resources, facilities, costs, and conservation methods. Conservation experts have carried out many metal conservation methods; these methods are divided into five main steps: condition survey, cleaning, stabilization, consolidation, and finishing. Condition surveys are observations of conservation objects and determining the steps or treatment needed. Cleaning is an effort to remove or eliminate dirt that infects conservation objects. Stabilization is carried out to re-stabilize the elements that make up the metal. Consolidation is an effort to strengthen the elements that make up the metal so that they are not easily separated so that the metal does not quickly produce patina, rust, or corrosion deposits. Finishing is the final stage of metal conservation; at the finishing stage, the conservation object is cleaned from substances that may have been left behind from the previous conservation stage. Then, the conservation object is treated to prevent damage-causing agents' return (Swe et al., 2019).

The first stage in metal conservation is a condition survey. Condition surveys can be carried out by taking pictures or photography, observing with the naked eye, and observing with laboratory equipment such as microscopes and X-rays. Conservators must have data on conservation objects' condition before conservation treatment is carried out. Initial data on conservation objects is in the form of photographs, data from temporary observations, and data from observations using laboratory equipment. Then, the conservator analyzes the level of damage to the conservation object and determines the conservation treatment based on the data that has been collected. Conservators are required to create a form containing the identity of the conservation object, observation data on initial conditions, and proposed conservation actions (Sadoun & Kareem, 2019).

The second stage is cleaning. The cleaning stage is divided into several methods, namely mechanical cleaning, chemical cleaning, electrochemical cleaning, and thermal reduction. *Mechanical cleaning* is a process that uses mechanical force from outside the conservation object, such as rubbing with a brush or sandpaper. *Chemical cleaning* is a process using certain chemicals, such as HCl or Acetone. Electrochemical cleaning is cleaning conservation objects using certain chemicals that carry electricity, for example, electrolysis techniques. Thermal reduction is cleaning a conservation object using heat, but this action has a relatively high risk of changing the shape and structure of the conservation object (Walker, 2008).

The third stage is stabilization and consolidation. Stabilization and consolidation aim to stabilize and strengthen the elements that makeup conservation objects at the atomic level. Stabilization and consolidation use certain chemicals whose quantity and composition are regulated based on the condition of the conservation object, environmental conditions, and conservation objectives (Swe et al., 2019). At this stage, in-depth knowledge of chemical processes, materials, and their use is required.

The final stage is finishing. The finishing stage consists of cleaning and preservation steps. The cleaning step is carried out with a fluid with the most neutral chemical content, such as distilled water. Cleaning with distilled water aims to remove remaining dirt and chemicals on conservation objects due to the previous conservation stage. The next step is coating; coating aims to avoid direct contact between conservation objects and damaging agents such as oxidation, acid, and radiation. Remember for conservators to provide recommendations for care and storage to protect conservation objects from destructive agents (Lois et al., 2020).

2.2. Rust and other Corrosion

Apart from having various advantages, ferrous metals have several weaknesses, namely corrosion and rust (Novikov, 2003). For example, the infinity statue by Dunadi, whose primary material is iron (Fe), has been infected with rust in almost all its parts. The rust on the infinity statue by Dunadi grew due to oxidation and contact with acids contained in rainwater over many years. The infinity statue by Dunadi was placed in the ISI Yogyakarta Faculty of Fine Arts courtyard in 2020 (https://jicaf2020.isi.ac.id/). Since then, oxidation and contact with various substances that cause damage to iron metal began.

Rust and other corrosion on iron metal (Fe) occurs due to contact between the surface of the iron metal and corrosion-causing substances such as oxygen and acid. Contact between iron metal and oxygen, acid, or both over a specific period results in the breakdown of atomic bonds. Atomic damage to iron metal results in the release of electrons into the air or water. When oxygen is reduced due to the electron release reaction, an oxide reaction occurs, which results in deposits on the surface of the iron metal. Oxide deposits on iron metal are generally referred to as rust (4FeO(OH)) (Howard, 1910; North & MacLeod, 1987: 68-69; Watson, 2010: 3310-3313). Humans have made various efforts to protect the iron metal from rust, for example, creating anti-rust iron alloys, coating it so that iron metal is protected from direct contact with oxygen and acids, and creating rust removers to prevent or protect iron. from rust can be termed as conservation of iron metal.

2.3. The Invinity Statue

The Infinity statue by Dunadi is located in the ISI Yogyakarta Faculty of Fine Arts and Design courtyard. The Infinity statue by Dunadi is a series of 20 bicycles arranged to form an infinity symbol. In mathematics, the infinity symbol is interpreted as something infinite. Through the infinity statue, Dunadi advised that bicycles will remain eternal even though times and cultures continue to change.

The infinity statue measures 7m x 2m x 4m, made of iron metal almost throughout. Some parts not made of ferrous metal are handlebar grips, pedals, seats, and tires. Dunadi's infinity statue is neon green; when the surrounding light dims, the infinity statue can emit light because the statue is painted with a phosphor mixture (https://jicaf2020.isi.ac.id/). Since 2017, the Infinity statue has been exposed to solar radiation, oxygen, rainwater, and various other damaging agents. This causes the paint to peel, and contact between the metal and damaging agents is inevitable. As a result, the condition of Dunadi's infinity statue currently needs improvement. The original paint has faded, and rust has infected almost all the metal parts of the statue.

3. Methods

The state of the Infinity statue is currently being used as a research object with an experimental research design. Experimental research is done by giving specific treatments to research objects and observing or measuring the results within a certain period. Experimental research is causal research (cause and effect) which is proven through comparisons between groups of objects that were treated and those that were not treated, as well as the condition of the objects before and after being treated (Jaedun, 2011).

Experimental research was chosen because it can observe causality between variables and the treatment given and provides high validity in observing the state of the research object before and after treatment. To obtain valid data, the research object before treatment, the treatment given, and the condition of the object after treatment must be recorded in detail and sequentially.

Recording in research is an observation. According to Hasanah (2016: 26), observation systematically records an event for empirical or other purposes. Scientific activities are recorded in detail and analyzed for research conclusions. The results of recording or observation activities are called data. In other words, observation is a series of activities to collect data. The observations used to collect data in this research were field observations and laboratory observations.

Field observations were conducted by visiting the research object directly, namely the Infinity Statue by Dunadi. The next step is to observe the condition of the research object, environmental conditions, and other matters related to the research object. Observation results are recorded systematically and in detail as field data. Meanwhile, laboratory research is carried out in the laboratory. The first step is to collect metal objects similar to the materials used to make infinity statues as research objects. Next, each research object is given a different treatment from others, and the results are observed for some time. The results of observations are stated in detailed and systematic notes as laboratory data.

The field data and laboratory data that have been collected are then analyzed to obtain research hypotheses. The method used to analyze data is the comparative method. The comparative method compares data with other data, and the comparison results are used to answer the research objectives (Sahir, 2021: 7). The results of the field research were the condition of the infinity statue, which was not treated as the primary data. Then, the main data is compared with laboratory data. The comparison results show differences between one data and another; then, the best data selection to answer the research objectives.

4. Results and Discussions

The infinity statue by Dunadi is now in quite a bad condition. The original paint is peeling, and the surface that is not covered with paint is covered with rust. The infinity statue must immediately receive conservation treatment, namely cleaning the rust and then coating it with an anti-rust coating. To reduce risks in the conservation process, feasibility tests are needed on the materials used in rust cleaning. The feasibility test was applied to the same material with the same conditions as the infinity statue, namely rusty iron pipes.

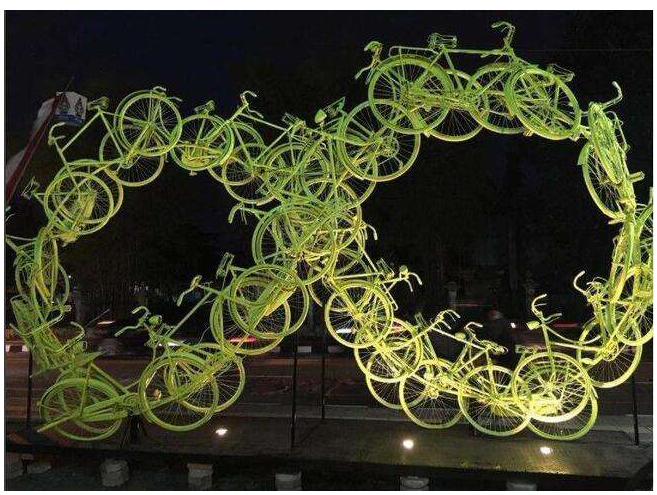

Figure 1: Infinity Statue by Dunadi
(Source: https://www.idntimes.com/travel/destination)

Figure 2: Samples

The sample used was an iron pipe from a bicycle covered in rust. The test sample is an iron pipe that is the same as the iron pipe used to make the infinity statue. The aim of choosing samples with the same material as the Infinity statue is to see the reaction of the Infinity statue material to rust cleaning chemicals. Test samples also aim to select the most appropriate cleaning agent before applying it to the conservation object. Cleaning agents that are less effective or those that are too strong in removing rust will be eliminated—the aim is to reduce the risk of additional damage due to the conservation process.

The sample was divided into four parts; each sample was cleaned with a different cleaning agent from one another. Observations of the samples were carried out from the beginning to the end of the cleaning process. Process observations are conducted to see the reaction between the sample and the cleaning agent. Then, the results are observed to see the final results of the entire cleaning process. The cleaning results were then compared to find the most appropriate material to be applied to Dunadi's Infinity Statue. Comparison of sample test results must consider sample safety, cleaning effectiveness, sample environmental safety, side effects of cleaning agents, and conservator safety.

4.1. Tools and Materials

Test samples were cleaned using mechanical cleaning methods and chemical cleaning methods. Mechanical cleaning is cleaning objects from rust using mechanical methods such as rubbing, prying, or shaking. Meanwhile, chemical cleaning uses chemicals (Swe et al., 2019, pp. 44-52). Mechanical cleaning can be scrubbed with sandpaper using a wire brush, compressor, or other equipment. Likewise, chemical cleaning can use rust cleaning chemicals, either brands available on the market or a mixture of several pure chemicals. The use of mechanical and chemical cleaning depends on the needs of the conservation object, the availability of materials, and human resources.

Mechanical cleaning in this study was carried out by rubbing the sample surface with sandpaper. Mechanical cleaning was only carried out on sample surfaces with thick rust. Mechanical cleaning aims to reduce thick rust on the sample surface and simplify the chemical cleaning process. The equipment used is sandpaper to rub the rust off the sample surface, and a brush to clean the rust dust stuck to the sample surface.

Treatment after mechanical cleaning is chemical cleaning. Chemical cleaning is done by smearing or soaking the sample in chemicals for several minutes so that a chemical reaction occurs between the cleaning agent and rust on the sample's surface. Then, scrub it with a brush to remove any remaining rust still attached to the object's surface, then clean it using soap to remove any remaining cleaning agent. The chemicals used are rust cleaning agents available on the market with different contents or concentrations.

Figure 3: Mechanical cleaning

Figure 4: Cleaning chemicals

The cleaning materials used in this research are cleaning materials that are available on the market and are widely used by the general public. The aim of selecting materials on the market is to consider several reasons: availability of materials, ease of use, relative safety, and environmental considerations due to the waste produced (Susetyo, 2015, p. 143). The first reason is availability; the cleaning materials used in this research are widely circulated in the community and readily available in stalls or minimarkets. The second reason is easy to use; the use of cleaning agents in this study took into account ease of use. Instructions for use are listed on the packaging label by the manufacturer. The third reason is that it is relatively safe; the active ingredients used in cleaning agents have been adjusted to the product safety thresholds implemented by the government. The final reason is related to the waste produced; the product used does not require exceptional waste management because it uses dangerous chemicals in low concentrations.

The chemical cleaning agent tested in this research was a cleaning agent with the Yuri Porstek brand made by PT. Joenoes Ikamulya, Jakarta, which contains 12% Hydrochloric Acid (HCl), Vixal Bathroom Cleaner is made by PT. Lotus Mas, Tangerang, which has an active ingredient content of 20% HCl, Pure HCl repacked by MGC has an HCl content of 100%, and WD-40 Formulated by WD-40 Company, USA, has an active ingredient content of Naphtha (Petroleum) Hydrotreated Light 65-75%.

Hydrochloric Acid (HCl) or liquid hydrochloric acid is a colorless liquid chemical, but some are bright yellow. At concentrations above 25%, hydrochloric acid produces gas vapors that have a pungent and corrosive odor. Acid gas can cause poisoning if inhaled significantly by humans or animals. *Liquid hydrochloric acid* is a strong acid that is very reactive to metals. Strong acid reactions can cause corrosion of metal. The reaction of acids and metals produces hydrogen vapor, which can burn or cause an explosion if the hydrogen is mixed with oxygen. However, some materials, such as latex, polyethylene, plastic, glass, and ceramics, are acid-resistant (Japan Soda Industry Association, 2006: 3).

Naphtha (Petroleum) Hydrotreated Light is a liquid chemical obtained from processing petroleum with water using a catalyst. Naphtha or naphtha is petroleum processed with water involving a catalyst to obtain a chemical liquid with a hydrocarbon content between C4 and C11. This chemical liquid is colorless, but some are bright blue. This liquid does not quickly evaporate, and burns if left below 40^0 C. Contact with human skin is relatively harmless. However, if it comes into contact with mucous membranes, you must immediately seek medical attention (https://echa.europa.eu/substance-information/-/substanceinfo/100.059.211).

4.2. Cleaning Steps

The first step in a laboratory test is to prepare a laboratory test method sheet or form. The laboratory test method form is used to record the entire process of laboratory test activities. The laboratory test method form was created to make it easier to observe sample development as an effect of the treatment given to the test sample. Every activity carried out in a laboratory test, and the impact of each activity are recorded in detail and structured in a laboratory test method form.

The second step is initial observations and recommendations for action. The initial observation aims to determine the condition of the sample. Based on the results of the initial observation, treatment recommendations will be decided to be given to the test sample. The sample taken for this laboratory test was a tubular metal object taken from a bicycle frame. The sample is infected with rust all over its surface. The surface characteristics of rusty samples are brownish with a rough, irregular texture. Based on the results of observations, samples must immediately undergo cleaning steps. If you do not immediately receive cleaning treatment, the rust layer will thicken and reduce the iron element in the rust-infected parts.

The third step is a cleansing treatment. The cleaning treatments used in this laboratory test are mechanical and chemical. Mechanical cleaning was carried out by rubbing the rusty surface of the sample

Table 1: Laboratory test steps

Preliminary observations	Mechanical cleaning	Chemical cleaning	Results
Sample 1			
 The metal surface is covered in rust, has a brownish color and an irregular texture	 Mechanical cleaning to thin thick rust and speed up chemical cleaning	 Chemical cleaning by soaking for 15 minutes in Yuri Porstek liquid containing 12% HCl	 The surface of the sample is still covered with quite a lot of rust
Sample 2			
 The metal surface is covered in rust, has a brownish color and an irregular texture	 Mechanical cleaning to thin thick rust and speed up chemical cleaning	 Chemical cleaning by soaking for 15 minutes in Vixal Bathroom Cleaner (HCl 20%)	 The rust covering the sample surface was almost completely removed
Sample 3			
 The metal surface is covered in rust, has a brownish color and an irregular texture	 Mechanical cleaning to thin thick rust and speed up chemical cleaning	 Chemical cleaning by soaking for 15 minutes in Pure HCl liquid containing 100% HCl	 Rust was removed entirely from the sample surface
Sample 4			
 The metal surface is covered in rust, has a brownish color and an irregular texture	 Mechanical cleaning to thin thick rust and speed up chemical cleaning	 Chemical cleaning by soaking for 15 minutes in WD-40 liquid containing the active ingredient Naphtha (Petroleum) Hydrotreated Light 65-75%.	 There is almost no change before and after soaking in cleaning fluid

with sandpaper. Mechanical cleaning is very effective in removing thick layers of rust, but mechanical cleaning cannot remove rust down to the very base layer. To overcome the shortcomings of mechanical cleaning, chemical cleaning is needed. Chemical cleaning can clean down to the base of the rust network. However, chemical cleaning procedures must be carefully considered because there is a risk of increasing damage to the test sample.

The procedure for chemical cleaning is to soak the sample in a chemical liquid for some time. The test sample, which had been cut into four parts, was then each soaked in a chemical liquid with a Hydrochloric Acid (HCl) content of 12%, 20%, 100% and Naphtha (Petroleum) Hydrotreated Light 65-75%. Sample 1 was soaked in a chemical liquid containing 12% HCl, sample 2 in 20% HCl, sample 3 in 10%, and sample 4 in 65-75% Hydrotreated Light Naphtha (Petroleum) liquid. The time required for immersion activities is only 15 minutes. If the soaking time is too long, it is feared that it will damage the sample because HCl is corrosive, especially in metal materials.

Observations of the impact of the cleaning fluid on the samples were carried out at 5, 10, and 15 minutes. The results of the observations were recorded in the observation table. Observations were made by looking at the area still covered by rust and estimating the thickness of rust still covering the surface of the sample. Estimating the thickness of rust on the sample surface is done by looking at the condition of the cleaning fluid used to soak the sample. The cloudier the condition of the cleaning fluid, the more rust will be eroded, meaning the rust on the sample's surface will become thinner.

Each sample gets different results depending on the cleaning agent used. As a result of the mechanical cleaning treatment, the thick rust covering the sample surface began to disappear. The surface of the sample becomes smooth and has no texture but is still brownish, meaning that the surface of the sample is still covered with a small amount of rust but evenly distributed. The following cleaning treatment is chemical cleaning. After chemical cleaning treatment, each sample obtained different results. Samples 1 and 4 experienced almost no change in form; rust deposits still covered the surface of the samples. Sample 2 is relatively clean; most of the surface of sample 2 is no longer covered with rust, but there are still small rust deposits left in several parts. Sample 3 received the cleanest title because rust deposits were wholly removed from the entire surface of sample 3.

Table 2: Chemical cleaning time comparison

Sample	Period		
	5 min	10 min	15 min
1	0%	10%	30%
2	25%	50%	75%
3	40%	80%	100%
4	0%	5%	10%

The difference in results between one sample and another is caused by the cleaning agent used. Sample 3, soaked in pure HCl for 15 minutes, obtained maximum rust-cleaning results. Sample 3 has seen rust erosion from its surface since the first 5 minutes. Meanwhile, sample 1, which was soaked in a solution containing 12% HCl, had almost no change in form. The speed of rust erosion on the sample surface depends on the HCl content in the cleaning agent. The higher the HCl level, the more rust decomposition reactions will occur. The higher the HCl content in the cleaning agent, the faster the time needed to remove rust on the sample surface.

Rust is a layer of iron oxide (FeO). Rust occurs due to the reaction of iron (Fe) with oxygen (O_2); chemically, it can be explained as $2Fe + O_2 \rightarrow 2FeO$. One way to remove rust is to break down the atomic bonds. The atomic bonds in rust can be broken down by reacting the rust with Hydrochloric Acid (HCl). The reaction between rust and HCl will produce iron rust deposits ($FeCl_2$) and water, $FeO+2HCl \rightarrow FeCl_2+H_2O$. Apart from sediment and water, hydrogen gas (H_2) often appears in the reaction of rust and HCl in high concentrations, $FeO+2HCl \rightarrow FeCl_2+H_2$ (Djatmiko, 1995: 4-5). In

this research, the reaction of rust with HCl, which produces sediment and water, occurred in samples 1 and 2, where the HCl content in the cleaning fluid was only 12% and 20%. Meanwhile, hydrogen gas was observed to appear in sample 3 because the rust on the surface of sample 3 reacted to HCl in very high concentrations.

4.3. Recommendations on Dunadi's Infinity Statue

The laboratory research results were then applied to the conservation object, namely the Infinity Statue by Dunadi. Of the four samples that have been observed, only the results from one of the samples will be applied. The selection of samples to be applied to the infinity statue by Dunadi is based on considerations of cleaning speed, effectiveness, and safety for the environment and conservators. As a result, the sample that will be applied to the infinity statue by Dunadi is sample 2.

Sample 2 was chosen because it met the criteria for cleaning speed, effectiveness, and environmental safety. Sample 2 cleaning agent could clean 75% of rust within 15 minutes. The HCl content of sample 2 cleaning material is only 20%, so it is safe for the environment and conservators when the conservation object cleaning process is carried out. Samples 1 and 4 were not selected because they needed to meet the criteria for speed and effectiveness of rust cleaning. Even though sample 3 meets the cleaning speed and effectiveness criteria, sample 3 does not meet the environmental and conservators' safety criteria.

Sample 3 cleaned 80% of the rust in 10 minutes and then cleaned the rust entirely in 15 minutes. Sample 3 does not meet the safety criteria because the HCl content in sample 3 cleaning fluid is too high, namely 100%. The high levels of HCl in sample 3 cleaning fluid give rise to hydrogen gas during the reaction process between sample 3 cleaning fluid and rust in sample 3. Hydrogen gas is colorless, odorless, and not easily palpable, and in low concentrations, it is not dangerous for living things. However, if hydrogen gas reacts with oxygen, the temperature can increase and become flammable (College of the Desert, 2001: 8). Apart from the emergence of hydrogen gas, the HCl content in sample 3 cleaning fluid exceeds the safety threshold. HCl, with levels above 25%, can evaporate and is dangerous for plants and the breathing of humans and animals (Japan Soda Industry Association, 2006: 3).

4.4. Application of the Infinity Statue by Dunadi

Based on the laboratory observations, the rust cleaning method in sample 2 was applied to the infinity statue by Dunadi. The cleaning method in sample 2 uses mechanical and chemical cleaning with cleaning agents containing 20% HCl. The conservation method for Dunadi's Infinity statue is divided into three stages: identification, cleaning, and coating or repainting.

Figure 5: Current state of the infinity statue

Figure 6: Rust on the metal surface of the infinity sculpture

The first stage is identification. Identification was carried out by directly observing the condition of the infinity statue by Dunadi. As a result, most of the original paint on the infinity statue by Dunadi has peeled off, and part of the surface is still covered with base paint. A layer of rust has grown in

varying thicknesses on the parts not covered by paint. The infinity statue by Dunadi must be conserved immediately to avoid further damage.

Figure 7: Mechanical and chemical cleaning

Figure 8: Repainting

The second step is cleaning. Cleaning is carried out in two stages: mechanical and chemical. Mechanical cleaning is done by rubbing the surface of the iron with sandpaper to reduce the thickness of the rust and remove the base paint. Meanwhile, chemical cleaning is carried out by pouring fluid containing 20% HCl and then leaving it for 15 minutes. After 15 minutes, the parts doused with cleaning fluid were scrubbed with a brush. To remove the remaining dirt and cleaning fluid that is still attached, wash with pure water or distilled water and soap. Ensure that any remaining dirt and cleaning fluid are removed from the metal surface. Otherwise, it will potentially cause corrosion.

The third step is painting. The painting step is carried out in two stages: coating with base paint and returning the original color with exterior paint. The primary paint coating coats the surface of the iron from direct contact with oxygen. The purpose of coating with primer is to minimize the potential for rust to appear. The second function of the primer is to create a base color so that when exterior paint is applied to a metal surface, it is easy, and you get the optimal color. The second stage is returning to the original color. This stage is carried out by applying neon green paint. The neon green color was chosen because the original color of Dunadi's infinity statue was neon green.

Figure 9: Comparison before and after

As a result, the rust that had infected the metal surface of Dunadi's Infinity Statue was successfully cleaned and then coated with primer to protect the metal surface and provide a base color. After being given the base color, the original color of the infinity statue by Dunadi, namely neon green, was returned by repainting the infinity statue by Dunadi in its original color.

5. Conclusion

Art is a medium for a person's expression. In this case, Dunadi expresses his idea, namely the use of bicycles, which remains eternal throughout time, through his work as an infinity statue. Unfortunately, due to environmental factors and lack of maintenance, the condition of Dunadi's Infinity Statue is

currently very worrying. The original paint is peeling, and the metal surfaces not covered with paint are infected with rust. This condition can be overcome by cleaning the rust on the metal surface and restoring the original color by repainting. Rust cleaning can be done with materials that are easily found.

Cleaning can be done in two stages, namely mechanical and chemical cleaning. Mechanical cleaning is carried out by scrubbing rust-covered metal surfaces. This is done to scrape off thick rust. The following cleaning is to use chemicals or chemical cleaning. Chemical cleaning can be done with porcelain cleaning fluid sold freely on the market. The best recommendation is a cleaning fluid containing 20% Hydrochloric Acid (HCl). Cleaning fluid containing HCl below 20% can also be used, but it takes longer to clean rust. Cleaning fluids containing HCl above 20% is not recommended because they are dangerous for the environment; conservators can even cause damage to the parts being cleaned.

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