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Comparison of Corrosion Rate on Paint Coated andUncoated SS400 Steel

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Abstract

Metal corrosion prevention requires ongoing, expensive measures, especially with regard to carbon steel. Yet, the cost of efforts is significantly cheaper when compared to the expenditures and losses incurred when the corrosion assault is improperly managed. The most common strategy for preventing corrosion attack is to cover metal with a beautiful finish. Low carbon steel strips (SS400) were coated with four different compounds in this study, and untreated SS400 steel strips were also used as a control. The steel strips were subsequently immersed for 15 (fifteen) days in an electrolite solution made up of 30% H2SO4 and NaCl dissolved in river water. The steel strips were then checked for mass loss after the predetermined amount of time had passed. The unpolished, uncoated object that had been soaked in H2SO4 and had a corrosion rate of 4,566.06 mpy had the maximum mass loss, it was discovered. The paint-coated object that was submerged in a solution of sodium chloride and river water had the lowest loss at 0.64 mpy.

Keywords: *corrosion rate; paint; uncoated; steel*

1. INTRODUCTION

Corrosion, in its broadest sense, is the chemical or electrochemical interaction between metals and their corrosive environment that results in the destruction of metal characteristics [1]. Internal corrosion and exterior corrosion are the two basic types of corrosion. The first one is a byproduct of petroleum's CO2 and H2S concentration, which when in contact with water, will create an assist that is the primary cause of corrosion. The latter occurs when an object's surface, such as a piping system or piece of equipment, comes into touch with acid on the ground or in the air [2].

The chemical composition of SS400 steel is 0.20% C, 0.53% Mn, 0.09%, and 0.04% Si [3]. The steel is very strong and ductile despite being somewhat soft and weak. This particular low carbon steel is simple to process, weld, and forge [4]. When in close touch with the air or in a corrosive environment, it rusted quickly. Corrosion can happen quickly when the air is very humid (greater than 70%) [1] [2] [3] [4].

Metal corrosion cannot be completely stopped; it can only be mitigated or controlled to extend the lifespan of the component or building. Financial and safety losses resulting from corrosion include weakening of material, thinned material, equipment downtime, cracks and pitting, leakage (of fluids), embrittlement degradation of surface quality of material, decline in product value, and alteration [5].

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It is necessary to adopt protection measures, such as the use of coating, in order to stop such corrosion attacks. The coating protects the steel surface from the environment, regulates the microenvironment of the steel surface, and also serves a decorative role (beauty and appearance). This technique can coat steel with paint, lacquers, varnish, or

i.e. able to withstand corrosive environment, is not an easy task to perform. It needs testingof the performance of the paint for the resistance in acid environment.

2. METHODOLOGY

This research was performed by experimental methods as a tool to search the causality of two factors influencing the observed phenomenon. The material for the research was low carbon steel strip (SS400) cut into speciments with dimension of 5 x 100 x 50 mm in thickness, length and width respectively. The variable for the experiment were paint coated steel srip and uncoated one. Also the other one was the electrolite which consisted of solution of H2SO4 and NaCl and river water with consentration of 30% for each solution. Serve as objective was corrosion rate. The flowchart of the experiment wasshown in Figure 2.1.

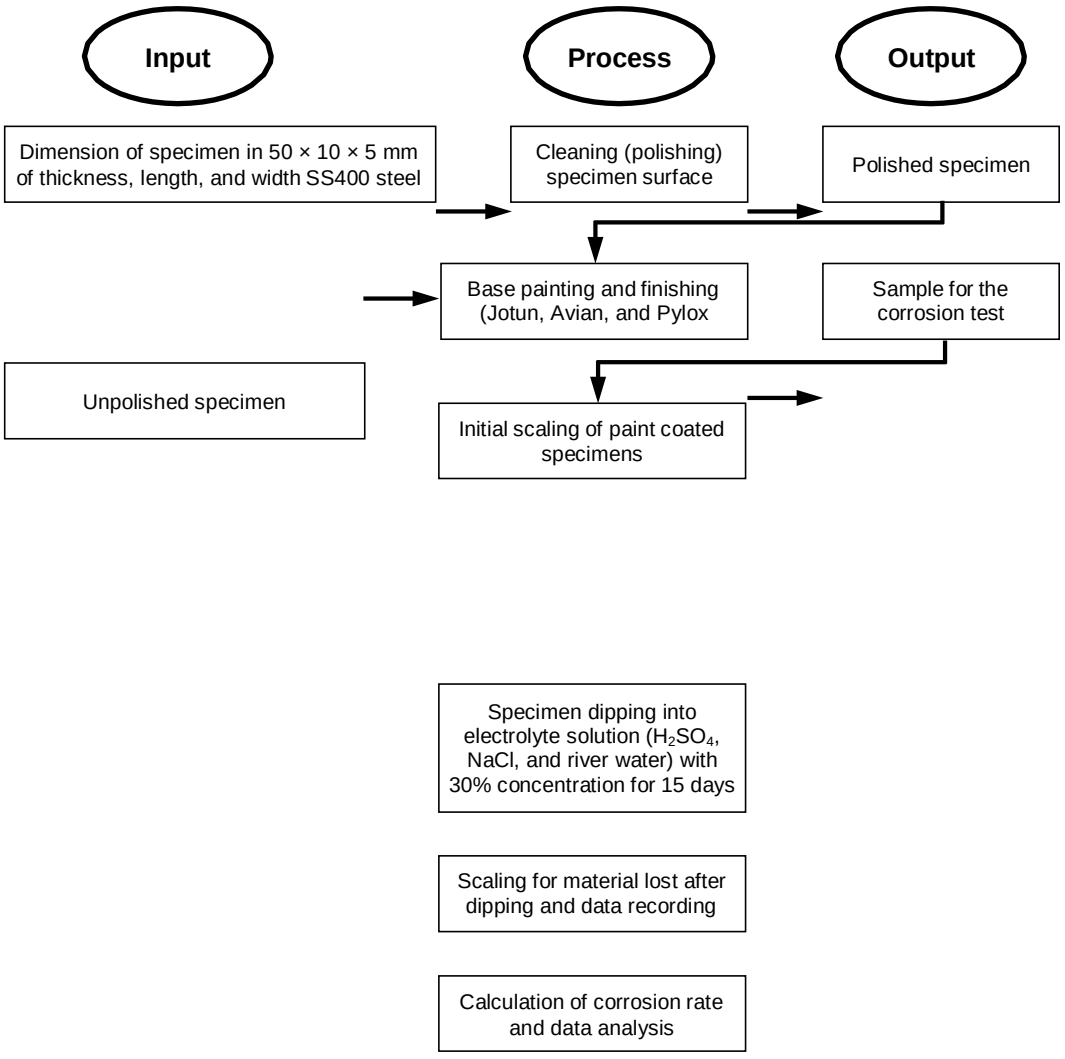

Figure 2.1 Flowchart of Experiment

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3. Results and Analysis

Data from the experiment on comparison of corrosion rate of paint coated and uncoated SS400 low carbon steel dipped in electrolite solution of Shulphid acid, salt, and river water showed certain trends as discussed in the following.

Corrosion rate in H_2SO_4 solution

In general, the corrosion rate for uncoated specimen was higher than coated ones both for polished and unpolished one. Also different paint gave different corrosion rate. Thisresult was in accordance with other research [6] [8]. The main cause was the paint consisted of platform, pyment, and additive so that able to control corrosion rate on the surface. Inert pygments make additional path for diffusion of oxygen and water droplets

trying to penetrate membrane and makes corrossion process delayed and also decreasing reaction rate [7].

According the data, the most effective one in decreasing of reaction rate was pylox for 1791.86 mpy. For unpolished specimens, the trends shows it was higer than polished one since in unpolished one the bonding of paint and metal surface is weak and paint cannot wet whole surface of metal when paint was applied. The one which has higher rate of corrossion was uncoated one for 4587.13 mpy and the lower one was Pylox coated one for28433.43 mpy as depicted in Figure 3.1.

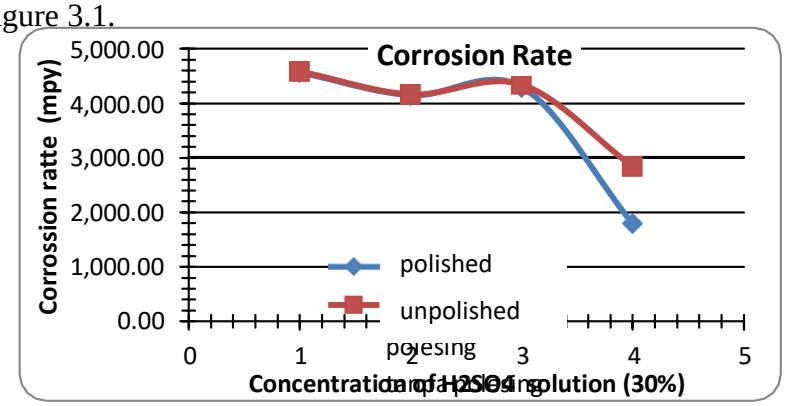

Figure 3.1 Corrosion Rate for Unpolished and Polished Speciment dipped in H2SO4 Solution

Note:

1. Uncoated specimen
2. Paint coated Jotun
3. Paint coated Avian
4. Paint coated Pylox

The result was in accordance with previous research [8] with corrosion rate of 62.51 mpy for uncoated specimen and 18.95 mpy for coated one. It also hown that coating/painting is able to protect speimen and has good resistant to corrosion [4].

Corrosion rate in NaCl solution

The data related to corrosion rate in 30% NaCl was given in Figure 3.2. It was found after 15 days that corrossion rate for uncoated specimen was higher than coated ones both for polished and unpolished ones. Also different made of paint gave different corrosion rate. This

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result was also in accordance with previous research [6] [8].

From the data, it was obvious that corrosion rate of Pylox coated one has the lowest one for 0.64 mpy. The highest one was for uncoated one for 5.40 mpy. It was caused by effect of paint coating which give protection against corrosion [4].

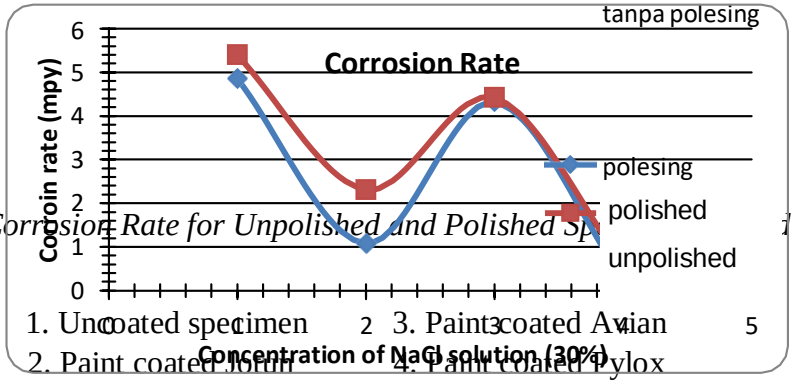


Figure 3.2 Corrosion Rate for Unpolished and Polished Sp[illegible]d in NaCl Solution

Note: 1. Uncoated specimen 3. Paint coated Avian
2. Paint coated Jotun 4. Paint coated Pylox

Corrosion rate in river water

Corrosion rate for river water solution gave the similar results. The corrosion rate for uncoated specimen was the highest both for unpolished and polished one. Different paint also gave different result on corrosion rate after dipped into 30% concentration of river water solution for 15 days as shown in Figure 3.3.

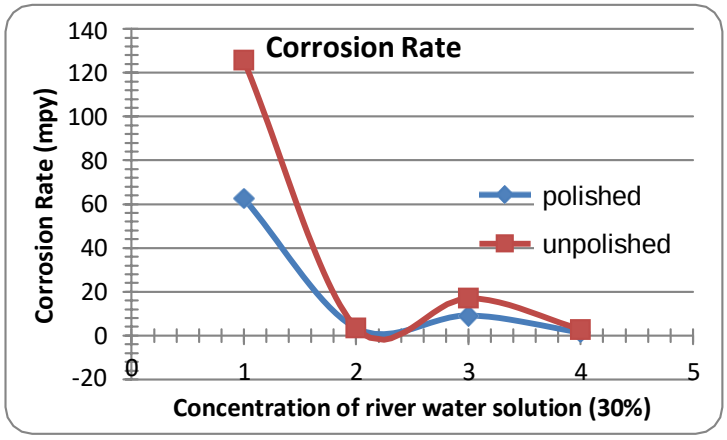


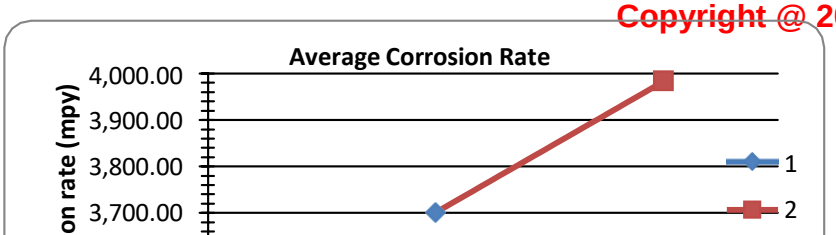
Figure 3.3 Corrosion Rate for Unpolished and Polished Speciment dipped in River Water Solution

Note: 1. Uncoated specimen 3. Paint coated Avian
2. Paint coated Jotun 4. Paint coated Pylox

Pylox coated specimen was most resilient againts corrosion for 1.33 mpy for polishedone and 2.75 mpy for unpolished one. The uncoated specimen was pronest to corrosion process for 125.68 mpy. The results were in accordance with previous research [8].

Average corrosion rate dipped in 3 (three) media

For H2SO4 solution, the highest average corrosion rate was for the unpolished SS400 steel dipped into 30% concentration of H2S04 solution for 3,983.64 mpy. The polished one



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had lower average corrosion rate for 3,700.80 mpy as shown in Figure 3.4.

Figure 3.4 Average Corrosion Rate for 30% Concentration of H2SO4 Solution

Note:
1. Polished specimen 2. Unpolished specime

Specimen dipped into HCl solution also show similar trend with the polished specimenhas lower average corrosion rate compare with unpolished one. The unpolished one has average corrosion rate of 3.19 mpy while the polished one has average corrosion rate for 2.64 mpy as shown in Figure 3.5.

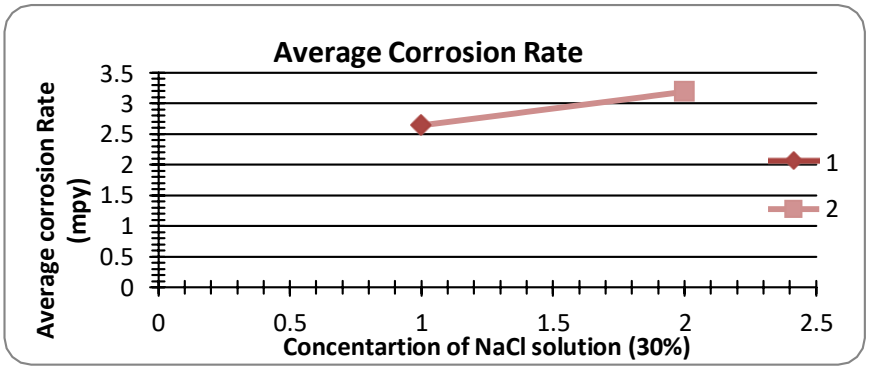

Figure 3.5 Average Corrosion Rate for 30% Concentration of H2SO4 Solution

Note: 1. Polished specimen 2. Unpolished specimen

For river water, the average corrosion rate for unpolished SS400 steel was 37.22mpy and for polished SS400 was 19.09 mpy as shown in Figure 3.6.

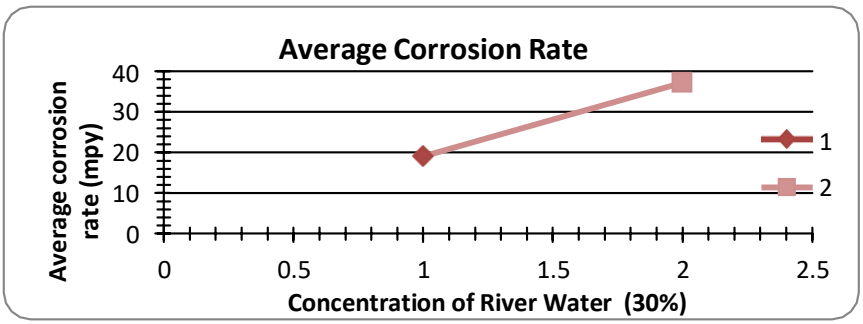

Figure 3.6 Average Corrosion Rate for 30% Concentration of River Water Solution

Note: 1. Polished specimen 2. Unpolished specimen

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4. CONCLUSION

According to research on the corrosion rates of coated and uncoated SS400 steels treated with different paints (Jotun, Avian, and Pylox), coated with different coatings, and dipped into several solutions (H2SO4, NaCl, and river water) of 30% concentration for 15 (fifteen) days, it can be concluded that the unpolished one show higher corrosion rate compared with the polished one for all dipping media (30% concentration of H2SO4, NaCl, and river. Pylox, Jotun, and Avian were the three paints that prevented corrosion the best, with uncoated paint coming in last. The quickest rate of corrosion is caused by solutions of H2SO4, NaCL, and river water. For all variations, corrosion occurs more quickly on unpolished SS400 steel than on polished steel. Unpolished SS400 exposed to a 30% concentration of H2SO4 solution corroded at the highest rate, while polished SS400 exposed to a 30% concentration of river water solution corroded at the lowest rate.

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