

Corrosive Effect Eucalyptus and Chir Wood on Mild Steel Panels and its Prevention by VCIs Soaked Paper

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Abstract: Corrosion of mild steel caused by the different vapors of woods which are used in packaging of electronics and electrical material. They are heavy and made up of mild steel most of the heavy machineries are transported from wooden packing. These woods are vapors producing. These are acidic in nature. The vapors of acids are increasing corrosion rate at different RH from 20%RH to 100% RH. Some organic compounds are used as inhibitor of corrosion in mild steel made materials. Mostly electrical and electronic assemblies packed in wooden boxes if they treated with volatile corrosion in hiobitors

1. Introduction

As a consequence, differential aeration and corrosion occurs. It can be some time prevented by passivation by which a metal or alloys show high corrosion resistance due to formation of high protective, very thin film (about 0.0004 mm thick) and quite invisible surface film but it can take place in different environment. Passivation tends to maintain protective film on the surface as Ti, Cr, Al and Cr containing stainless steel alloys exhibit outstanding corrosion resistance in presence of oxygen. This is due to the formation of thin film on their surface the rate of corrosion is less when the area of cathode is smaller, when cathodic area is smaller, the demands for electrons will be less and this results in the decrease rate of dissolution of metal at anodic regions. (1)

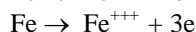
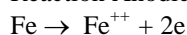
The concept of total corrosion control should be introduced in which corrosion control is more a daily activity at all stages of production than merely an afterthought. Good corrosion control. An inhibitor is a chemical substance. When added in small concentration to an environment, effectively decreases the corrosion rate there are several classes of inhibitors conveniently designated passivators 1. organic inhibitors 2. including slushing compounds and pickling inhibitors, and vapor phase inhibitors 3. The practice of corrosion inhibitors are greatly influenced by new regulations that have been developed because of toxicity in environment effect resulting from industrial effluents. There is a trend to replace some widely used inhibitor such as metadinitro benzene, in application where toxicity, environmental damage, and pollution caused by these chemicals are important considerations. The extent of chemical reduction on initial contact of passivators with metal, according to this view point, must be at least chemically equivalent to the amount of passive film formed as a result of such reduction. From the passive film on iron this is in the order of 0.01 cm² of apparent surface. The total equivalent of chemically reduced Anthraquinone is found to be of this order and it is probably also the same for the other passivators acting on iron [1-3]. The amount of Anthraquinone reduced in the passivation process is arrived at from measurements [4]. In the type of vapour phase process various types of material are widely used such as polyaniline [5-7], Polypyrrole [8] and polyacetylene [9]. Heavy effort has been deployed to find suitable corrosion

inhibitor for organic compounds. origin in various corrosive media. In acid media, nitrogen based materials and their derivatives, sulphur containing compounds, aldehyde, thioaldehydes, acetylenic compounds and various alkaloids are used in corrosion prevention process. [10]

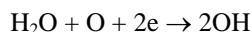
Mechanism of Corrosion

Corrosion is the deterioration of a material as a result of reaction with its environment, especially with oxygen. Although the term is usually applied to metals, all materials, including ceramics, plastics, rubber, and wood, deteriorate at the surface to some extent when they are exposed to certain combinations of liquids and/or gases. Common examples of metal corrosion are the rusting of iron, the tarnishing of silver, the dissolution of metals in acid solutions and the growth of patina on copper. Most research into the causes and prevention of corrosion involves metals, since the corrosion of metals occurs much faster under atmospheric conditions than does the corrosion of nonmetals. The cost of replacing equipment destroyed by corrosion in the United States alone is in the billion-dollar range annually. Corrosion is usually an electrochemical process in which the corroding metal behaves like a small electrochemical cell. Since the corrosion of iron by dissolved oxygen is, from an economic standpoint, the most important redox reaction occurring in the atmosphere, it will be used here to illustrate the electrochemical nature of the process. A sheet of iron exposed to a water solution containing dissolved oxygen is the site of oxidation and reduction half-reactions, which occur at different locations on the surface. At anodic areas, iron is oxidized according to the reaction.

Reaction Anodic



At the same time, oxygen molecules in the solution are reduced at the cathodic areas. Reaction Cathodic



2. Material and Methods

2.1 Metal Studied

Iron panels of the size 7.5 cm × 1.25 cm (cut from single sheet) of pickled cold rolled closed annealed (18 SWG) were used in all experiments. The composition of the mild steel sheet was iron 99.74%, carbon 0.07%, silicon 0.07%, sulphur 0.044%, phosphorus 0.049%, manganese 0.023%. All panels were carefully polished with successive grades of emery paper for removing all surface defects. The final surface was brought to standard finish by polishing with 000 grade emery paper. All cuts, edges, corners and suspension holes were rounded off and smoothened.

After surface preparation panels were degreased with sulphur free toluene. This was followed by treatment with methyl alcohol to remove sweat residue and finger prints. The specimens were dried and then transferred to a vacuum desiccators in which they were allowed to remain for a period of 24 hours.

Corrosion experiments

After surface preparation panels were weighed (weighing was done with the help of single pan weighing machine). For the identification of panels all the panels were numbered and suspension holes were made.

Weighed metal panels, were exposed to synthetic atmosphere of different humidity or corrosive vapours. The samples were withdrawn after a specified time and the extent of corrosion was determined by weight gain or weight loss method. The de rusting was done by using appropriate de rusting solutions. The de rusting solution used was conc. HCl containing 5% stannous chloride and 2% Antimony trioxide at room temperature. After removal of corrosion product, the metal panels were washed with distilled water followed by immersion in absolute alcohol or acetone, drying with hot air, cooling in desiccators and weighing. The weight losses of specimens due to corrosion were determined by subtracting the weights of derusted panels from their original weights.

The specimens were suspended in sealed desiccators (one liter capacity) by glass hooks with the help of glass rod fixed tightly on the inner walls of the desiccators. Care was taken to put grease on the lid properly so that once closed, the system was fully sealed.

In order to make sure that the un corroded metal was not removed from the panels by the de rusting solutions, blank was run in each case to check the amount of metal removed in the process of de rusting. It was found that metal removed from the blank did not exceed 0.1% of the total corrosion value.

It has been reported by Evans if the rust consists of Fe (OH)₂ and no other compounds, the loss in weight should be 1.69 of that of the gain in weight. Since in our study, other compounds were likely to be formed the weight increments might not give the true picture, as in many cases where the corrosion product were not of adherent type or where leaching of the corrosion product could have been possible,

the weight increments were not suitable as a method for assessment of the corrosion rate. The corrosion has been measure in mg/dm² of the surface area.

The amounts of dilute acid taken were 30cc in the desiccators of 1000 cc capacity. The sealed desiccators containing the solution were kept at room temperature for three days before the panels were introduced in them.

Preparation of other corrosive environments:

The acetic acid environment was created by taking 1cc of acetic acid of desired concentration soaked in cotton and hanging it inside the desiccators with the help of glass hooks. The environment of wood exhalations was created by hanging wet wood piece of size 1 inch × 1 inch × 2 inches with the help of cotton threads inside the desiccators for 7 days. Woods pieces were kept immersed in distilled water for 24 hours at room temperature before hanging.

Volatile corrosion inhibitor:

Few volatile corrosion inhibitors reported by Rajagopalan as very good inhibitors were tested at different RH. Those found excellent were used to prevent corrosion by vapours emitted by woods. They were also incorporated in ordinary brown paper to prepare VCI paper.

0.5 gm of VCI was taken in a glass plate and was kept inside the desiccators (IL) at required humidity with and without wood. The weight losses of the panels in the absence of VCI (W_u) and in the presence of VCI (W_i) were determined for different time durations. The inhibitor efficiency (I) was calculated by the following equation.

$$I = \frac{W_u - W_i}{W_u} \times 100$$

Majority of the state and Industrial standards, for evaluation of the performance of vapor corrosion inhibitors, used the Federal Standard No. 101C, Method 4031, (Corrosion inhibiting ability of VCI vapours). This test is applied for testing of the VCI films, papers and powders and is included in Japanese Industrial Standards JISZ 1519, JISZ 1535 JISK 2246. According to this test the VCI material is placed inside a Jar that serves as a test chamber. The Jar contains water glycerin solution of different strength, which produces different relative humidity. There is also a metal specimen inside the Jar. This specimen does not contact the VCI material. For non-VCI material this condition will cause corrosion. If the material contains an adequate amount of VCI, metal surface remains protected. According to German Military Standard TL 8135, Corrosion protection provided by the VCI material is graded by visual inspection of the metal specimen. Keeping in mind the above standard, we planned our experiment mild steel due to Anthracene for different RH

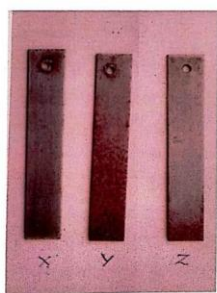
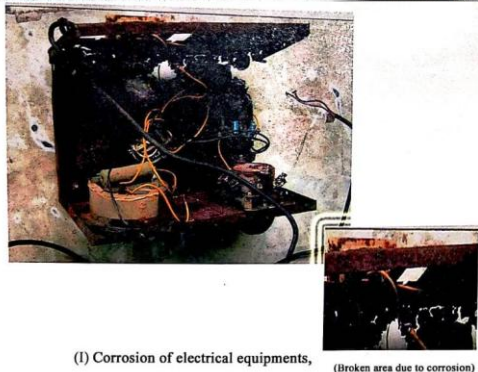
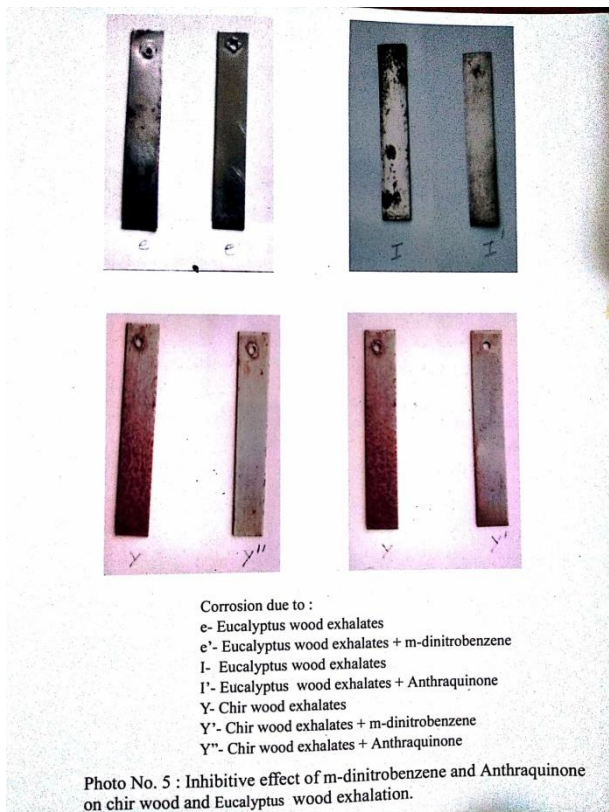


Photo No. 1: (II) Corrosion of mild steel at different RH.
 X = 100% RH;
 Y = 80% RH;
 Z = 60% RH

Table 1: Protective Effect of anthraquinone soaked paper on corrosion due to vapours emitted by Eucalyptus wood

S. No.	Time in months	80%RH		100%RH	
		Wt loss (mg/dm ²)	Protection in%	Wt loss (mg/dm ²)	Protection in%
1	1	0.0	100	2.4	87
2	2	3.6	92	9.5	71
3	4	4.8	94	14.3	71
4	6	9.5	91	18.2	62

Table 2: Protective Effect of anthraquinone soaked paper on corrosion due to vapours emitted by Mahua wood

S. No.	Time in months	80%RH		100%RH	
		Wt loss (mg/dm ²)	Protection in%	Wt loss (mg/dm ²)	Protection in%
1	1	21.9	77	9.2	65
2	2	26.1	82	12.9	73
3	4	31.7	83	14.2	77
4	6	34.8	84	32.9	56

Table 3: Protective Effect of anthraquinone soaked paper on corrosion due to vapours emitted by Chir wood

S. No.	Time in months	80%RH		100%RH	
		Wt loss (mg/dm ²)	Protection in%	Wt loss (mg/dm ²)	Protection in%
1	1	4.5	90	2.5	88
2	2	11.2	82	5.2	82
3	4	18.0	78	9.0	75
4	6	20.0	82	12.2	74

3. Results and Discussion

The Photo no.1 Depicted the corrosion of mild steel at different relative humidities (100%RH to 20%RH) for different time durations. The result shows that the corrosion of mild steel increased with exposure time (15 days to 60 days). The corrosion rate was maximum at 80%RH during entire exposure time. It was minimum at 20% RH. The corrosion rate at 100% RH was slightly less than that at 80% RH. The corrosion rate at 60% RH was less than that at 100% RH and corrosion rate at 40% RH was less than that at 60% RH. Photo no. 1 shows the same result i.e. the corrosion of mild steel at 80% RH is maximum. It has been reported that in the case of mild there are two critical humidities, one at 60% RH and second at 75%RH. Below 60% RH the corrosion is negligible at 75%RH corrosion increases sharply with rise in humidity.

Table 1 and photo.5 depicted protective effect of Anthraquinone on mild steel corrosion due to vapors emitted by Eucalyptus wood at 80% RH and 100% RH during a periods of one months to six months. Results show that Anthraquinone is very good volatile corrosion inhibitor for protection of mild steel by corrosion due to vapors of Eucalyptus wood, particularly at 80% RH. It afforded 91% to 100% protection during a periods of one months to six months at 80% RH. During one months it afforded 100% protection at 80% RH and 87% protection at 100% RH, during two to six months it afforded approx. 92% protection at 80% RH and 71% protection at 100%RH. The wt loss obtained at 100%RH was three time greater than that at 80% RH, Corrosive effect of Eucalyptus wood exhalants is shown in photo (I) and protective power of Anthraquinone is shown in (I').

Table 2 photo 5 depicted protective effect of Anthraquinone on mild steel corrosion due to vapor emitted by Mahua wood at 80%RH and 100%RH .during a periods of one months to six months. Results, Show that at 80%RH, protective power of anthraquinone increased with increased exposure time. the percentage protection was 77% during one months and 84% during six months. At 100%RH, percentage protection up to four months were satisfactory, being 65% during one

months and 77% during four months; It is very poor during six months being 56% only.

Table No 3 Photo 5 depicted protective effect of Anthraquinone on mild steel corrosion due to vapors emitted by Chir wood at 80% RH and 100% RH; during a periods of one months to six months. Results shows that percentage protection obtained with Anthraquinone slightly higher at 80% RH than that at 100% RH. During one months the protection was 90% at 80% RH and 88% at 100% RH; during six months the protection was 82% at 80% RH and 74% at 100% RH. Although the weight loss obtained at 80% RH was two time greater than that obtained at 100% RH.

4. Conclusions

VCI derivative shows good inhibition efficiency of corrosion by the formation of physical barrier between metal and corrosive environment by the interaction. The volatile corrosion inhibitor of mild steel carried out by using anthraquinone, wrapped craft brown paper soaked with these vapors producing organic compounds

Investigation shows that VCI soaked paper provides very effective corrosion prevention processes for the iron materials such as boilers and feeders. VCI can apply in the powder form at the time of manufacturing of Iron materials equipment.

It is confirmed that VCI provides protection to the metal located at few centimeters from the VCI source. These experiments are done inside the dessicators

As per to the testing data. VCI is compatible. and It can also lower the corrosion rate.

All types of the inhibitors can used in incorporated with VCI materials soaked in brown craft paper.

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