Corrosion of mild steel due to vapours emitted by mango, Eucalyptus, Jamun of Acetic woods

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Abstract: Most of the packaging woods emitted acid vapours of acetic acid and formic acid because the cell wall is made up of cellulose. Failure of electronic equipments and assemblies in extremely adverse climate. e.g. having wide variation of temperature between day and night, high degree humidity(coastal areas),wide variation of temperature between day and night coupled with low humidity and dust laden atmosphere,focus the attention of the worker on the deterioration of electronic equipment. the earlier reports of climate deterioration of electronic equipments is fromAus tralian Army Mission to new Gusinea in 1943, where the electronic equipments dumped in packing cases by the Aus tralian Army completely failed .most of the cases are due to packaging woods it accelerate the rate of corrosion by emitting acid vapours

Keywords: packaging, climate, deterioration, equipments, corrosion
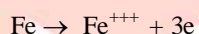
INTRODUCTION

Corrosion is mainly electrochemical process promoted by different type processes. Differential aeration such as accumulation of dirt, sand ,scale and other contamination because this part of metal is poorly oxygenated ,hence anodic where corrosion taking place., the area becomes lesser accessible to air and more corrosion leading to the formation of deep cavity or localized pitting in the metal. Some time partial cover of metal by block of wood and piece of glass these ara working as screen part of metal from oxygen access. 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 (about0.0004 mm thick).Passivation tend to maintain protective film on the surface as Ti, Cr, Al and Cr containing stainless steel alloys exhibits outstanding corrosion resistant 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 result is the decrease rate of dissolution of metal at anodic regions. Corrosion is the deterioration of metal by chemical attack or reaction with its environment. It is a constant and continuous problem, often difficult to eliminate completely.Prevention would be more practical and achievable than complete elimination. Corrosion processes develops fast after disruption of the protective barrier and are accompanied by a number of reactions that change the composition and properties of both the metal surface and the local environment, for example, formation of oxides, diffusion of metal cat ions into the coating matrix, local pH changes, and electrochemical potential. The study of corrosion of mild steel and iron is a matter of tremendous theoretical and practical concern and as such has received a considerable amount of interest. Acid solutions, widely used in industrial acid cleaning, acid descaling, acid pickling, and oil wellacidizing, require the use of corrosion inhibitors in order to restrain their corrosion attack on metallic materials. Over the years, considerable efforts have been deployed to find suitable corrosion inhibitors of organic origin in various corrosive media 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 substances that ,When added in small concentration to an environment, effectively decreases the corrosion rate there are several classes of inhibitors conveniently designated passivators1, organic inhibitors2,including slashing 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 .The extent 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 result of such reduction. From the passive
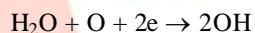
film on iron this is in the order of 0.01 c/cm2 of apparent surface. The total equivalent of chemically reduced chromate is found to be of this order and it is probably also same for the other passivators acting on iron. The amount of chromate reduced in the passivation process is arrived at from measurements [1-3]. In the type of vapour phase process various type of material are widely used such as polyaniline [4-6], Polypyrrole [7] and poly acetylene [8].Heavy effort have been deployed to find suitable corrosion inhibitor for organic origin in various corrosive media [9-13]. In acid media,nitrogen based materials and their derivatives,sulphur containing compounds,aldehyde,thioaldehydes,acetylenic compounds and various alkaloids.The acetic acid which is 98% pure can increases the rate of corrosion within 24 hours .if the humidity is 80% to !00% RH.[14]

MECHNISMS 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, deteriorates 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 $Fe \rightarrow Fe^{++} + 2e$

$$Fe \rightarrow Fe^{+++} + 3e$$

At the same time, oxygen molecules in the solution are reduced at the cathodic areas. Reaction Cathodic $\qquad H_2O + O + 2e \rightarrow 2OH$

The two processes produce an insoluble iron hydroxide in the first step of the corrosion process: Generally, this iron hydroxide is further oxidized in a second step to produce Fe (OH) 3, the flaky, reddish brown substance that is known as rust. Unfortunately, this new compound is permeable to oxygen and water, so it does not form a protective coating on the iron surface and the corrosion process continues. All metals exhibit a tendency to be oxidized, some more easily than others. A tabulation of the relative strength of this tendency is called the electromotive series of metals. Knowledge of a metal's location in the series is an important piece of information to have in making decisions about its potential usefulness for structural and other application

2. MATERIAL AND METHODS
Metal Studied
Mild steel 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 with drawn 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 de rusted 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 7.5 cm × 1.25 cm 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 (Wu) and in the presence of VCI (Wi) 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.Some material specimens are used in dessicator.

Table. No.1

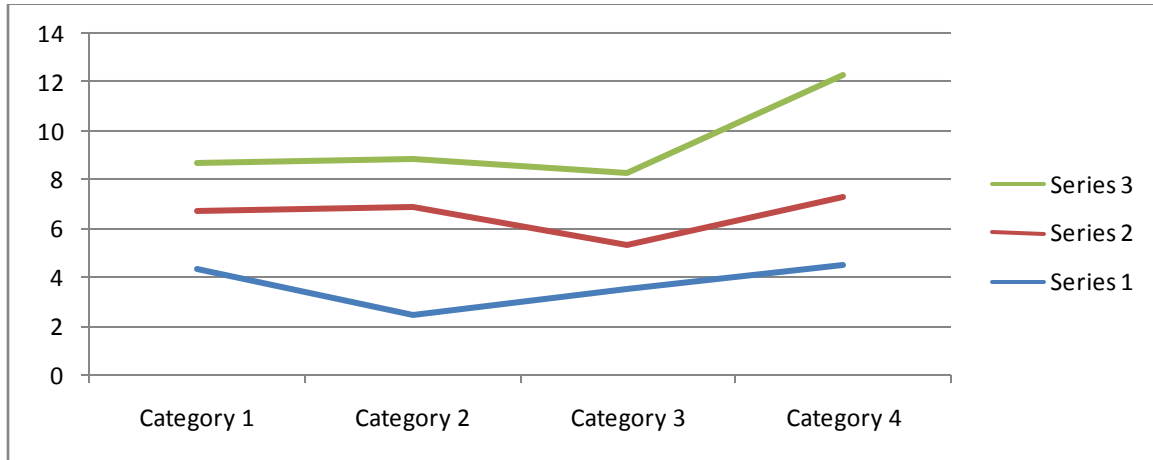**Corrosion of mild steel for different time durations at different RH.**

Table. No.2

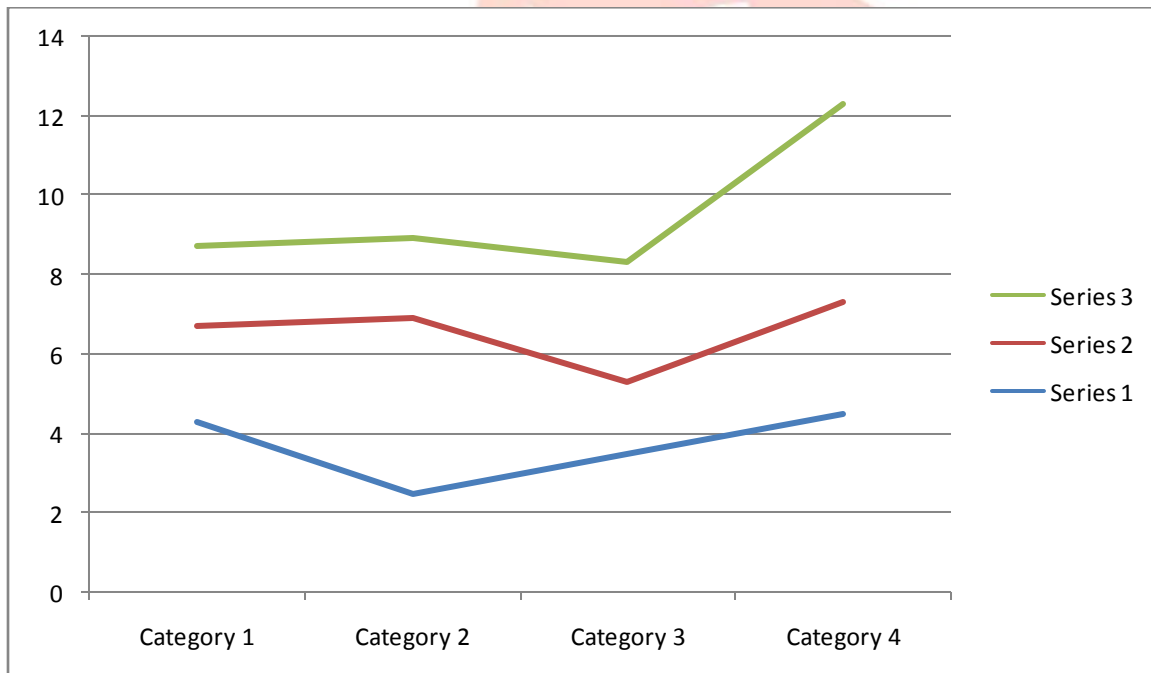**Protective effect of metadinitrobenzene on corrosion due to vapours emitted By mango   wood**

Table.No.3

Protective effect of metadinitrobenzene on corrosion due to vapours emitted by Jamun

s.no.	Time in month	80%RH		100% RH	
		Wt loss(mg/dm^2)	Protection %	Wt loss(mg/dm^2)	Protection %
1	1	9.7	72	9.2	61
2	2	10.4	79	14.6	50
3	4	14.9	83	16.0	61
4	6	19.5	87	21.0	64

woods

Table.No.4

Protective effect of metadinitrobenzene on corrosion due to vapours emitted by Eucalyptus woods

s.no	Time in months	80% RH		100% RH	
		Wt loss(mg/dm^2)	Protection %	Wt loss(mg/dm^2)	Protection %
1	1	0.0	100	9.7	51
2	2	7.8	83	13.4	60
3	4	7.3	92	15.8	68
4	6	12.2	88	24.8	50

RESULT AND DISCUSSION

Figure1   depicted that corrosion of mild steel at different relative humidities (100% RH to 20% RH) for different time duration.Result shows that corrosion of mild steel increased with exposure time(15 days to60 days). The corrosion rate is maximum at 80% RH during entire exposure time. It was minimum at 20% RH.The corrosion rate was slight 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 due all these data corrosion was maximum in between 75% RH to 90% RH

Figure 2   depicted protective effect of metadinitrobenzene on corrosion of mild steel due to vapours emitted by mango woods at 80% RH and 100% RH during aperiods of one months to   six months. results shows that at 80% RH metadinitrobenzene is highly effective. It afforded 93% to 96% protection up to four months.It afforded 84% protection during six months. At 100% RH complete protection was obtained during one month there after the percentage protection decreased.Its valve being 72% during 2to 6 months.

Table 3 dipicted protective effect of metadinitrobenzene on corrosion of mild steel due to vapours emitted by Jamun woods at 80% RH and 100% RH during the periods of one months to six months.Rsults shows that

percentage protection gradually increased with time At 80%RH metadinitrobenzene afforded 72% protection during one months and 87% protection during six months.In case of Jamun woods metadinirobenzene was not very good inhibitor at 100% RH.In this condition It afforded approximately 60% protection.It protected 61% during one months and 64% during six months from this result it is clear that metadinitrobenzene is not very good effect on vapours of Jamun woods

Table 4 depicted that protective effect metadinitrobenzene corrosion of mild steel due to vapours of Eucalyptus woods at 80%RH to 100% RH, during a periods of one months to six months.results shows that at 80%RH metadinitrobenzene is highly effective it afforded complete protection during shorter duration in one months approx.90% protection during longer duration four months to six months.The inhibitor was not so efficient at 100%RH,It afforded 50% to 60% protection at different time durations. The weight loss was obtained was approximately double at 100%RH than that obtained at 80%RH during exposure time from two months to six months.

CONCLUSIONS

From the above data it shows that mostly wood are vapours producing materials which contains cellulose on hydrolysis it produced the vapour of formic acid and acetic acids the vapours are corrosion accelerating materials. On packaging most of the woods materials are used which is compactable with transportation.Most of the electronic assemblies are transported and packed by wood which produced acidic vapours .mainly mango woods, Jamun woods, Mahua woods, Eucalyptus woods, kathal woods .If the vapours of protective materials are used so corrosion product will be least and materials can be protected.

ACKNOWLEDGEMENT

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