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Aloe-Vera: A Green Corrosion Inhibitor

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Abstract: ***Corrosion is a major problem in industries so corrosion control is technically, economically and aesthetically important. Corrosion inhibitors provide protection to metals and alloy against corrosion, but organic inhibitors are toxic in nature whereas green inhibitors are biodegradable and no toxic compound are promoted, they are inexpensive, readily available and are renewable. The paper discusses the effect of aloe-vera as green inhibitor on Galvanised iron in HCl and H_2SO_4 solution. The paper also compares the result in two solutions.***

Keywords: Corrosion inhibitors, HCl , H_2SO_4 , Aloe-Vera , Biodegrable , Galvanised Iron.

I. INTRODUCTION

Corrosion is the deterioration of materials by chemical interaction with their environment. The term corrosion is sometimes also applied to the degradation of plastics, concrete and wood, but generally refers to metals. The most widely used metal is iron (usually as steel) [1].Corrosion can cause disastrous damage to metal and alloy structures causing economic consequences in terms of repair, replacement, product losses, safety and environmental pollution. Due to these harmful effects, corrosion is an undesirable phenomenon that ought to be prevented [1], [2].There are several ways of preventingcorrosion and the rates at which it canpropagate with a view of improving thelifetime of metallic and alloy materials. Theuse of inhibitors for the control of corrosionof metals and alloys which are in contact with aggressive environment is one amongthe acceptable practices used to reduce and/orprevent corrosion. A corrosion inhibitor is asubstance which when added in smallconcentration to an environment, effectivelyreduces the corrosion rate of a metal exposedto that environment.

Corrosion inhibitors can be divided into two broad categories namely those that enhance the formation of a protective oxide film through an oxidizing effect and those that inhibit corrosion byselectively adsorbing on the metal surface and creating a barrier that prevents access of corrosive agents to the metal surface [1], [2]. Almost all organicmolecules containing heteroatoms such asnitrogen, sulphur, phosphorous and oxygenshow significant inhibition efficiency. Despite of thesepromising findings about possible corrosioninhibitors, most of these substances are notonly expensive but also toxic non-biodegradable thus causing pollution problems. Hence, these deficiencies have prompted the search fortheir replacement.

Plants are sources of naturally occurring compounds, some with complex molecular structures and having different chemical, biological and physical properties. The naturally occurring compounds are mostly used because they are environmentally acceptable, cost effective and have abundant availability. These advantages are the reason for use of extracts of plants and their products as corrosion inhibitors for metals and alloys under different environment.

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Different plant extracts can be used as corrosion inhibitors commonly known as green corrosion inhibitors. Some of them are:
Tannins and their derivatives can be used to protect steel, iron and other tools from corrosion. To protect mild steel in 2 M HCl solutions from corrosion, extracts from leaves can be used. Extracts of tobacco from twigs, stems and leaves can protect steel and aluminium in saline solutions and strong pickling acids [1]-[3].

Tannins, organic amino acids, alkaloids, and organic dyes of plant origin have good corrosion-inhibiting abilities. Plantextracts contain many organic compounds, having polaratoms such as O, P, S, andN.These are adsorbed on themetalsurface by these polar atoms, and protective films are formedand various adsorption isotherms are obeyed.

It was found that inhibition efficiency increases with increase in concentration of extract and decreases with increase in temperature.

The degree of inhibition depends on nature of metal and type of medium. For steel and nickel, the inhibitionefficiency increased in the order: alkaline <neutral < acidic, while in case of zinc, itincreased in the order: acid < alkaline <neutral, thereby reconciling with theobserved concept of the*Lawsonia* extract being a mixed inhibitor [1], [2], [4].

The present work investigated the inhibition efficiency ofan aqueous extract of plantmaterial, *Aloe vera* extract, in controlling corrosion of galvanised iron (GI)immersed in HCl and H_2SO_4 solutionin the absence and presence ofinhibitor, using mass loss method.

II.EXPERIMENTATION

Preparation of plant extract

An aqueous extract was prepared by grinding fresh extract of aleo vera gel, filtering and
making solution using distilled water.

Preparation of specimens

Galvanised iron specimens (iron + carbon alloy + zinc) of dimensions 5 * 5 cm were prepared.

Weight loss method

Three GI specimens were immersed in 150 ml of HCl and H_2SO_4 solutions containing various concentrations of the inhibitor for one day. The weightof the specimens before and after immersion were determined. In the end effect of aloe-vera as inhibitor is compared in HCl and H_2SO_4 solution by testing the presence of zinc in solution with the help of $K_4Fe(CN)_6$ solution.

After one day add $K_4Fe(CN)_6$ solution to test the presence of zinc. Filter the solution using wattman filter paper and measure final volume of solution collected and weight of the filterate.

The results are tabulated as below:

Galvanised iron (5*5cm) – initial weight = 8.55g

HCl solution :

TABLE 1:

READING FOR HCL SOLUTION

Aloe-vera coating	Initial volume		Final volume of solution collected (ml)	Weight (g)
	Volume of solution (ml)	Volume of aloe-vera (ml)		
Without coating (1)	150	-	132	3

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Coating with aloe-vera (2)	**140**	**10**	**138**	**2.85**
Coating with concentrated aloe-vera (3)	**120**	**30**	**142**	**2.36**

H_2SO_4 solution :

TABLE 2 :

READING FOR H_2SO_4 SOLUTION

Aloe-vera coating	**Initial volume**		**Final volume of solution collected (ml)**	**Weight (g)**
	Volume of solution (ml)	**Volume of aloe-vera (ml)**		
Without coating (1)	**150**	**-**	**130**	**6.24**
Coating with aloe-vera (2)	**140**	**10**	**136**	**0.71**
Coating with concentrated aloe-vera (3)	**120**	**30**	**140**	**0.5**

Following readings clearly depict the inhibition effects of aloe-vera, still for a much clear picture some comparative charts are drawn below:

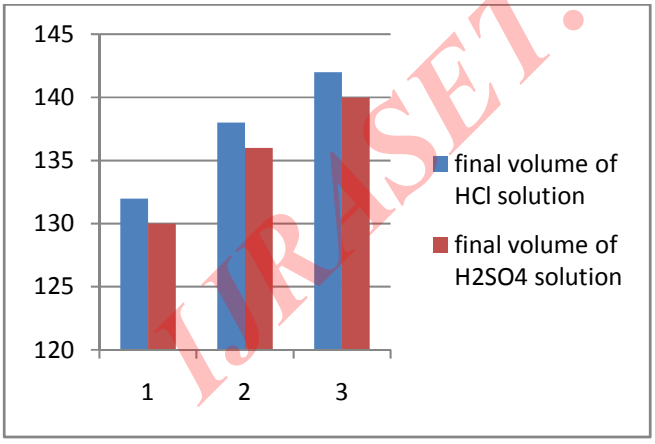

Figure 1: Final volume of HCl / H_2SO_4 solution obtained in the three different trails .

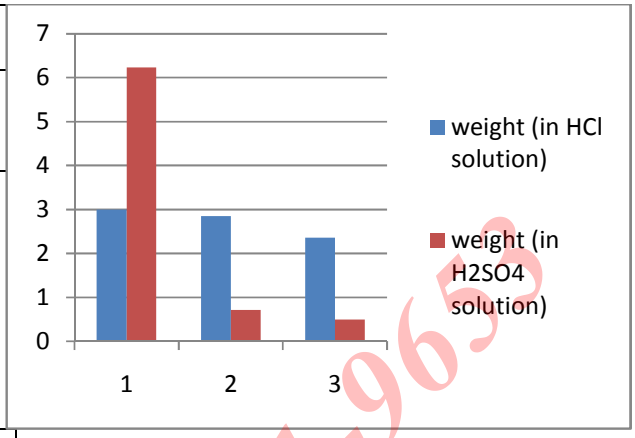

Figure 2: Weight of the filtrate obtained from HCl / H_2SO_4 solution in three different trails

III.RESULTS AND DISCUSSION

The graph shows that without inhibitor H_2SO_4 solution is more corrosive than HCl solution, but effect of aloe vera as inhibitor is also more in H_2SO_4 solution.

Thus, aloe-vera has high inhibition efficiency in H_2SO_4 solution.

IV.CONCLUSION

Corrosion inhibition is environmentally and economically important as it is a major problem in all industries. Green inhibitors are found to be effective due to environmental and ecological reasons as organic corrosion inhibitors are toxic in nature while green inhibitors are biodegradable, without any heavy metals and other toxic compounds and are inexpensive, renewable and readily available. The above work shows that aloevera is potential corrosion inhibitor. Mannose-6-phosphate is the main constituent of the aqueous extract of aloevera. It has excellent inhibition efficiency in controlling corrosion of galvanised iron in H_2SO_4 and HCl solution. Fe^{2+} aloevera complex is found in protective film. It is UV

fluorescent. Anodic reaction is predominantly controlled by formulation. Aloevera is more effective in H_2SO_4 solution.

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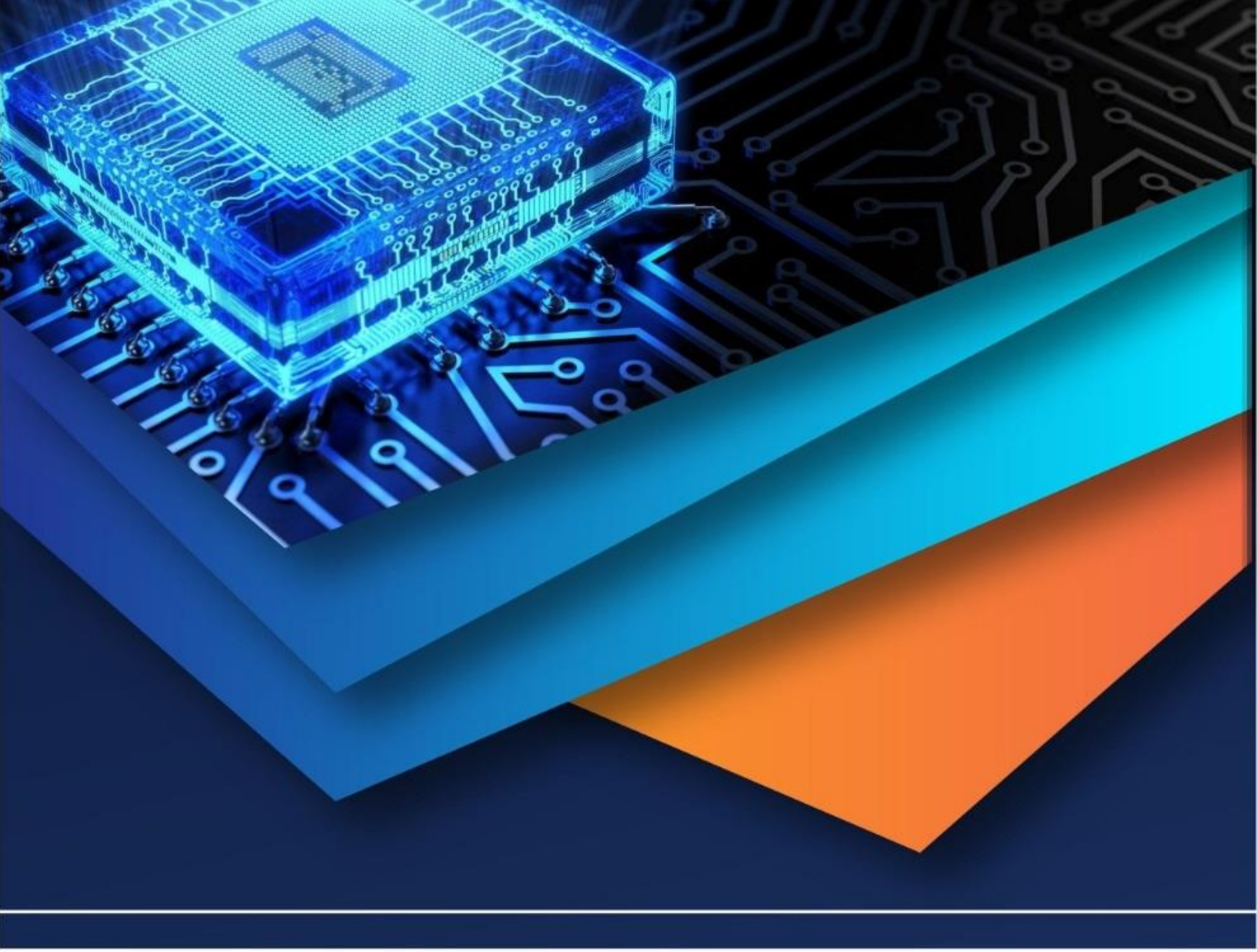

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