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Corrosion Behaviour of Mild Steel in Acidic Medium in Presence of Aqueous Extract of *Allamanda Blanchetii*

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Abstract: The inhibition efficiency (IE) of an aqueous extract of *Allamanda blanchetii* (Purple) in controlling corrosion of mild steel which has been evaluated by weight loss method in the absence and presence of corrosion inhibitor at different time intervals at room temperature. The result showed that the corrosion inhibition efficiency of *Allamanda blanchetii* was found to vary with different time interval and different acid concentrations. Also, it was found that the corrosion inhibition behavior of *Allamanda blanchetii* is greater in sulphuric acid than citric acid medium. So *Allamanda blanchetti* can be used as a good inhibitor for preventing mild steel material. The surface analysis study confirms the corrosion of the mild steel and its inhibition by the inhibitor *Allamanda blanchetii*.

Keywords*:* Corrosion inhibition, Mild steel, *Allamanda blanchetii*, Plant extract, Weight loss method, Environmental friendly inhibitor.

Introduction

Mild steel (MS) has been extensively used under different condition in chemical and allied industries in handling alkaline, acid and salt solution. Chloride, sulphate and nitrate ions in aqueous media are particularly aggressive and accelerate corrosion. One way of protecting MS from corrosion is to use corrosion inhibitors[1-5]. The known hazardous effects of most synthetic corrosion inhibitors are the motivation for the use of some natural products. Most of the natural products are non-toxic, biodegradable and readily available in plenty[6-12]. Therefore, in this investigation, the corrosion inhibition of mild steel in 1 N citric acid and 1 N H_2SO_4 solution was studied in the absence and presence of *Allamanda blanchetii* at room temperature by weight loss method.

Experimental

According to ASTM method as reported already[13], cold rolled mild steel strips were cut into pieces of 5 cm × 1 cm having the following composition (Table 1).

Table 1. Elemental analysis

Elements	% of chemical composition	Elements	% of Chemical composition
Iron	99.686	Phosphorus	0.009
Nickel	0.013	Silicon	0.007
Molybdenum	0.015	Manganese	0.196
Chromium	0.043	Carbon	0.017
Sulphur	0.014		

They were pickled in pickling solution (5% H_2SO_4) for 3 minutes, washed with distilled water then the specimens were polished with various grades of emery papers and degreased using trichloroethylene. The weight of specimen were noted and then immersed in test solution containing various concentrations of inhibitors at room temperature. After the duration of one hour in hydrochloric acid and sulphuric acid, the specimens were removed from test solutions and pickled in pickling (5% sulphuric acid) solution, dried and finally weighed. The differences in weights were noted and the corrosion rates were calculated.

Preparation of flower extract

The plant was collected, shaded dried and powdered. The material was dried in shade to enrich the active principle in them, by reducing its moisture content. An aqueous extract of Purple *Allamanda blanchetii* was prepared by boiling 20 g of dried flower petals, with distilled water and making up to 100 mL, after filtering the suspending impurities.

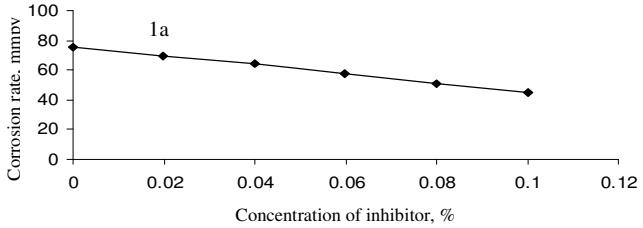
Results and Discussion

Weight loss method

The corrosion behaviour of mild steel in citric acid and sulphuric acid with *Allamanda blanchetti* was given in Figure 1, which was studied by weight loss method at one hour at room temperatures. From the graph, it was observed that the weight loss of mild steel in the acid decreases with increasing concentration of additives, which is suggesting that the additives are corrosion inhibitor for mild steel in 1 N citric acid and 1 N sulphuric acid. From the data of weight loss method, the corrosion rate (CR) was calculated using the equation:

$$CR = (87.6 \times W) / (D \times A \times T)$$

Where W, D, A and T are weight lose (in mg), density of mild steel (7.86 g/cc), area of the specimen in cm square and exposure time in hours respectively. Similarly, Inhibition efficiency was calculated using the equation:



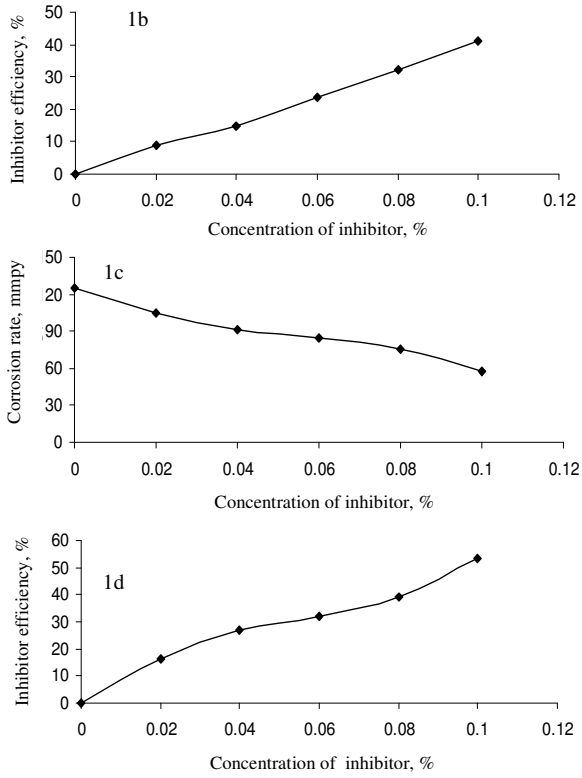


Figure 1(**a**). Variation of corrosion rate (CR) with concentration of *Allamanda blanchetii* in citric acid solution; (**b**) Variation of inhibition efficiency (IE) with concentration of *Allamanda blanchetii* in citric acid solution; (**c**) variation of corrosion rate (CR) with concentration of *Allamanda blanchetii* in H_2SO_4 solution; (**d**) variation of inhibition efficiency (IE) with concentration of *Allamanda blanchetii* in H_2SO_4 solution

$$IE\ \% = [(W_o - W_i)/W_o] \times 100$$

Where W_o and W_i are the values of the weight loss (in g) of mild steel in the absence and presence of inhibitor respectively. The values of corrosion rate and inhibition efficiency in absence and presence of difference concentration of inhibitor used in 1 N citric acid and 1N H_2SO_4 solution at room temperature for one hour were given in Table 2.

Table 2. Corrosion inhibition efficiency of mild steel in 1 N citric acid and 1 N sulphuric acid solution in absence and presence of *Allamanda blanchetii*

Corrosion inhibitors	Conc. of inhibitor, %	Corrosion rate mm/y		Inhibitor efficiency,%	
		1 N Citric acid	1 N H_2SO_4	1 N Citric acid	1 N H_2SO_4
Allamanda blanchetii	Blank	75.786	124.824	--	--
	0.02	69.099	104.763	8.820	16.07
	0.04	64.641	91.389	14.70	26.78
	0.06	57.954	84.702	23.52	32.14
	0.08	51.267	75.786	32.35	39.28
	0.10	44.580	57.954	41.17	53.57

From Table 1, it was clear that the corrosion rate was decreased with increasing concentration of inhibitor and inhibition efficiency increased with increasing the concentration of the inhibitor. In addition, the maximum corrosion inhibition efficiency of *Allamanda blanchetii* was 41.17% at 1 N citric acid and 53.57% at 1 N H_2SO_4 respectively at 0.10% solution of inhibitor in one hour at room temperature. And also, it was concluded that the inhibitor was best inhibitor in mild steel corrosion in citric acid and H_2SO_4. But when comparing with acids the inhibitor efficiency was best in sulphuric acid than citric acid.

Comparison of corrosion inhibitory behaviour of Allamanda blanchetii

Since, *Allamanda blanchetii* is a natural product it has been used a best inhibitor in the field of corrosion. Hence, Allamanda Blanchetii in both citric acid and H_2SO_4 show good inhibitory character. So, inhibition behavior of *Allamanda blanchetii* increases tremendously in H_2SO_4 when compared to citric acid at room temperature.

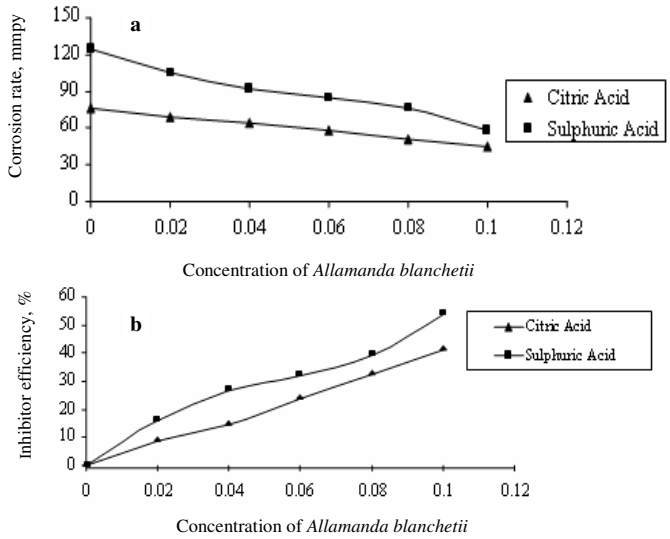
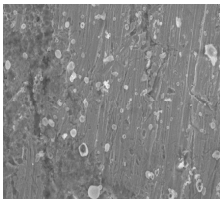


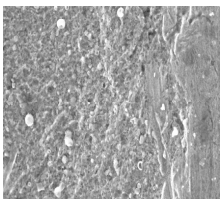
Figure 2 (**a**). Comparison of corrosion rate (CR) with concentration of *Allamanda blanchetii* (in %) in citric acid and H_2SO_4 solution at room temperature; (**b**) Comparison of inhibition efficiency (IE) with concentration of *Allamanda blanchetii* (in %) in citric acid and H_2SO_4 solution at room temperature

Surface analysis

The polished specimen (MS) and the test specimens were immersed in the blank (1 N citric acid and 1 N H_2SO_4) and in the inhibitor *Allamanda blanchetii* for 48 h, then the specimens were observed under Scanning. Electron Microscope (SEM) The specimens are shown in the Figure 3 & 4 (plate 1 and 2). Plate 1 (a & b) shows polished specimen which was kept in the blank solution of 1 N citric acid and 1 N H_2SO_4, which is associated with polishing scratches. Plate 2 (c & d) shows specimen which was kept in the 0.10% concentration of inhibitor solution with 1 N citric acid and 1 N H_2SO_4 depends upon the concentration of the inhibitor solution suggesting that the presence of adsorbed layer of the inhibitor on mild steel surface which impedes corrosion rate of metal appreciably.

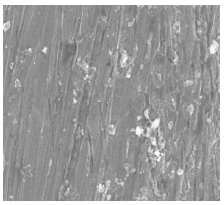


(a) 1 N citric acid (Blank)

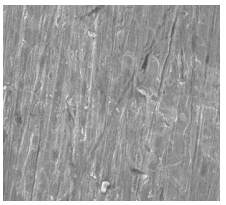


(b) 1 N suphuric acid (Blank)

Figure 3. (Plate 1) MS samples immersed in blank Solution



(c) 1 N citric acid (with inhibitor)



(d) 1 N suphuric acid (with inhibitor)

Figure 4. (Plate 2) MS samples immersed in inhibitor solution

Conclusion

The *Allamanda blanchetii* showed good performance as corrosion inhibitor in citric acid and H_2SO_4 medium. The inhibition efficiency increased with increase in concentration of inhibitors for 0.2% to 0.10% at room temperature for one hour. The maximum inhibition efficiency of *Allamanda blanchetii* (0.10% solution) was 41.17% in 1 N citric acid and 53.57% in 1 N H_2SO_4 respectively at room temperature for 1 h of immersion time. From the comparative studies, it was concluded that the inhibitor efficiency was better in H_2SO_4 than citric acid because sulphuric acid is a dibasic acid, so it stimulated the corrosion rate of mild steel. Surface analysis study confirms the corrosion of mild steel and its inhibition effect by the inhibitor *Allamanda blanchetii*.

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