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Inhibition of Mild Steel Corrosion in Acidic Medium by Aqueous Extract of *Tridax procumbens* L.

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Abstract: The inhibition efficiency (IE) of an aqueous extract of *Tridax procumbens* L. in controlling corrosion of mild steel has been investigated by weight loss method in the absence and presence of corrosion inhibitor at different time interval at room temperature. The result showed that the corrosion inhibition efficiency of these compounds was found to vary with different time interval and different acid concentration. Also, it was found that the corrosion inhibition behavior of *Tridax procumbens* L. is greater in sulphuric acid than hydrochloric acid medium. So *Tridax procumbens* L. can be used as a good inhibitor for preventing mild steel material.

Keywords*:* Corrosion inhibition, Mild steel, *Tridax procumbens* L., Plant leaf 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 hydrochloric acid and 1 N H_2SO_4 solution was studied in the absence and presence of *Tridax procumbens* L.

Experimental

According to ASTM method as reported already[13], cold rolled mild steel strips were cut into pieces of 5 ×1 cm having the following composition (Table 2).

Table 1. Chemical composition of mild steel

Elements	Chemical composition, %	Elements	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 and washed with distilled water followed by 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.

Selection of inhibitor

Use of inhibitors is an important task in the protection of metals from corrosion. Till now the majority of metal corrosion inhibitors used is toxic for human beings and environment. Therefore the inhibitor is to be selected on the following consideration.

- It should be less-expensive
- It should be non-toxic
- Environmental friendly inhibitor

Preparation of flower extract

The plant leaf 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 *Tridax procumbens* L. leaf was prepared by boiling 20 g of dried leafs, 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 hydrochloric acid and sulphuric acid with *Tridax procumbens* L. 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 establishing that the additives are corrosion inhibitor for mild steel in 1 N hydrochloric 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,

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

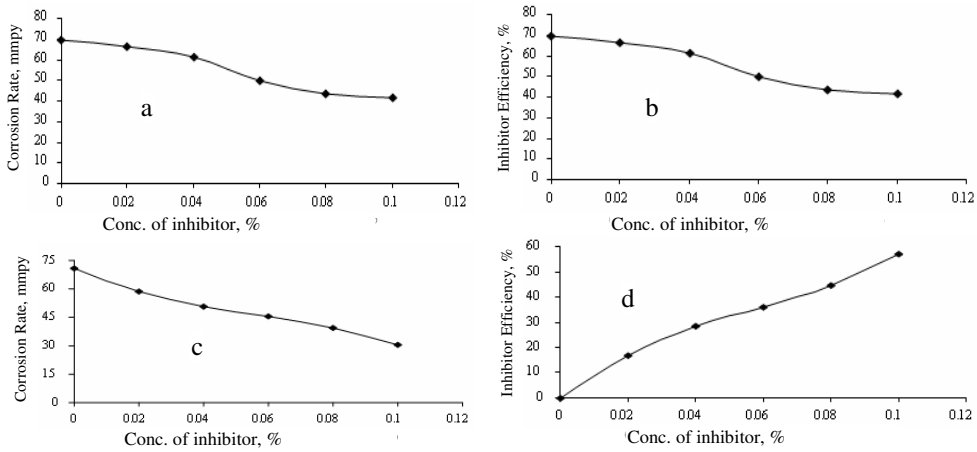

Figure 1 (a). Variation of corrosion rate (CR) with concentration of *Tridax procumbens* L. (in %) in hydrochloric acid solution in one hour at room temperature; (b) Variation of inhibition efficiency (IE) with concentration of *Tridax procumbens* L. (in %) in hydrochloric acid solution in one hour at room temperature; (c) Variation of corrosion rate (CR) with concentration of *Tridax procumbens* L. (in %) in H_2SO_4 solution in one hour at room temperature; (d) Variation of inhibition efficiency (IE) with concentration of *Tridax procumbens* L. (in %) in H_2SO_4 solution in one hour at room temperature

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 hydrochloric acid and 1 N H_2SO_4 solution at room temperature for one hour were given in Table 2.

From Table 2, it is clear that the corrosion rate is 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 *Tridax procumbens* L. was 40.00% at 1 N hydrochloric acid and 56.85% at 1 N H_2SO_4 respectively at 0.10% solution of inhibitor in one hour at room temperature. And also, it is concluded that the inhibitor was best inhibitor in mild steel corrosion in hydrochloric acid and H_2SO_4. But when comparing with acids the inhibitor efficiency was best in sulphuric acid than hydrochloric acid.

Table 2. Corrosion inhibition behaviour of mild steel in 1 N hydrochloric acid and 1N sulphuric acid solution in absence and presence of *Tridax procumbens* L. is studied by weight loss measurement

Corrosion inhibitors	Conc. of inhibitor, %	Corrosion Rate mmpy		Inhibitor Efficiency,%	
		1N HCl	1N H_2SO_4	1N HCl	1N H_2SO_4
Tridax procumbens.L.	Blank	69.0992	70.7709	-	-
	0.02	65.7557	58.7343	4.83	17.00
	0.04	60.8519	50.4870	11.93	28.66
	0.06	49.4839	45.2488	28.38	36.06
	0.08	43.2427	39.2305	37.41	44.56
	0.10	41.4595	30.5374	40.00	56.85

Comparison of corrosion inhibitory behaviour of Tridax procumbens L.

Tridax procumbens L. is a natural product but it has been used a best inhibitor in the field of corrosion. Hence, *Tridax procumbens* L. in both hydrochloric acid and H_2SO_4 shows goods inhibitory character. So, inhibition behaviour of *Tridax procumbens* L. increases tremendously in H_2SO_4 when compared to hydrochloric acid in one hour at room temperature.

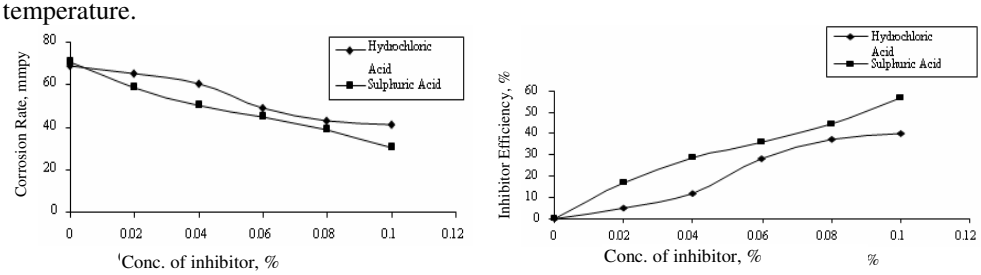

Figure 2(a). Comparison of corrosion rate (CR) with concentration of *Tridax procumbens* L. (in %) in hydrochloric acid and H_2SO_4 solution in one hour at room temperature; (b) Comparison of inhibition efficiency (IE) with concentration of *Tridax procumbens* L. (in %) in hydrochloric acid and H_2SO_4 solution in one hour at room temperature

Conclusion

The *Tridax procumbens* L. showed good performance as corrosion inhibitor in hydrochloric acid and H_2SO_4 solution medium. The inhibition efficiency increased with increase in concentration of inhibitors for 0.2% to 0.10% in one hour at room temperature. The maximum inhibition efficiency of *Tridax procumbens* L. were 40.00% in 1 N hydrochloric acid and 56.85% in 1 N H_2SO_4 respectively in room temperature [0.10%] for 1 h of immersion time. From the comparative studies, it was concluded that the inhibitor efficiency is better in H_2SO_4 than hydrochloric acid because sulphuric acid is a dibasic acid, so it stimulated the corrosion rate of mild steel.

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