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Corrosion Inhibitive Effects of Tylophora Indica (A Medicinanl Plant) on Tin in Acidic Media

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Abstract: *Corrosion can be considered either chemical or electro chemical in nature . Corrosion decays the metallic properties.Corrosion of metals may be prevented by either barrier protection , sacrificial protection , by alloying or by antirust solutions of ligands containing N , S, O, Se and P as hetero atoms. The naturally occurring plant product are eco-friendly, non-polluting , less toxic, easily available , biodegradable and economic to be used as corrosion inhibitor . Tylophora Indica is known as anantmul. This plant is distributed throughout southern and eastern part of India in plain and forest places. The plant has been reported to contain 0.2 - 0.46 % alkaloid viz, tylophorine flavonoids, wax, raisin , isotylocarbine , tylophorinicine and tannis. The plant has been traditionally used for the treatment of Bronchial Asthma, Jaundice, Antihistaminic, Hypotensive, antirehumtic activities are scientifically proven. Leaf and root of this plant are widely used in medicine. It is used for anticancer, antiamoebic activity. Extract of stem part of plant can be used as inhibitor to reduce corrosion rate of metal like Tin in acidic media. Corrosion inhibitive effects of naturally occurring plant Tylophora* I *ndica have been studied in three different acid like HCl, H_2SO_4 ,HNO_3, in four different concentrations like 0.5 N, 1N, 1.5N ,2N, solutions. Study was carried out by weight loss method and thermometric method in the presence of stem extract and the 0.1%, 0.3% , 0.5%, 0.7% concentrations of extract .Stem extract has been found more effective inhibitor for Tin in HCl acid. Maximum inhibition efficiency was found 95.20% in 0.5N HCl with 0.7% corrosion inhibitor.*

Keywords: *Tylophora Indica, Corrosion inhibition efficiency, Corrosion rate, Weight loss method, thermometric method, Tin metal etc.*

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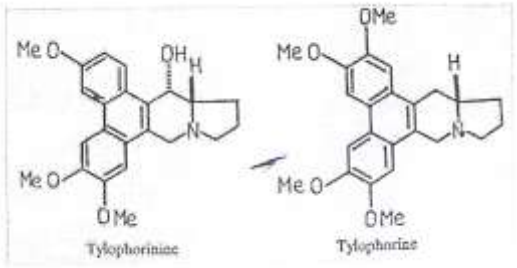
I. INTRODUCTION

Tin and its alloy are found useful for many engineering application because of their lightness, strength, thermal , electrical conductivity , heat , light reflectivity and hygenic and non-toxic qualities. Tin is a reactive metal according to the electrochemical series [Eo=-0.14V] ,But it is non-reactive in moisture due to the formation of a stable oxide film on its surface .Tin is not attacked by pure water but dissolves in aqueous acid with the libration of hydrogen gas . Acids like ,HCl, H_2SO_4, HNO_3 are used for drilling operation, pickling and descaling .Some researchers [1-4] have studied corrosion of tin in HCl solution.

Generally, the organic compound containing hetero atoms like nitrogen ,oxygen and sulphur have been found to be very effective corrosion inhibitors [5-15]. The effeciency of these compounds depends upon electron density of hetero atoms. The inhibition efficiency also depends upon the number of adsorption active centers in the molecule their charge density, molecular size, mode adsorption and formation of metallic complexes. In addition to the heterogeneous organic compounds like Schiff"s bases[15-16]. Mannic bases [17-20] which are synthesized in laboratory assists in inhibition , there are also some naturally occuring plant product like Ocimum sanctum [21], Caparies deciduas[22], Argemone maxicana [23], Prosopis julifforar[24], Delonix regia [25],Sanaevieria trifascinata [26], Ficus Virens [27] etc. have also been evaluated as effective corrosion inhibitors. Tylophora Indica is a very common plant in India. Survey of literature reveals that extract of Tylophora Indica is antibacterial , antifungal and it is widely used in medicine. The plant has been used as a traditional medicine and modern drug prepration. It is used to relieve the symtoms of asthma. The plant has been used for the treatment of jaundice, antihistaminic. It is also used to the treatment of cancer. It is used to prevent or inhibit the formation or growth of tumours. However its corrosion inhibitory effect is unknown as yet. In the proposed Investigation Tylophora Indica extract will be used as corrosion inhibitor in different acidic media like sulphuric acid , nitric acid and hydrochloric acid on tin. The importance of the study lies in the fact that natural plant product are non polluting,ecofriendly,economics,less-toxic and easily available. They are biodegradable and so can be used without any side effect.

PLANT DISCRIPTION:- *Tylophora Indica* is a very common plant. *It is known as anantmul. It is distributed throughout southern and eastern part of India in plain and forest places.*

The chemical composition of Tylophora Indica is highly complex containing many alkaloid tylophorincine, tylophorine, tylophorinine, tannins [29], pigments,glucose,potassium chloride etc.



Tylophora Indica

II. EXPERIMENTAL

The rectangular specimens of tin of dimensions of 2.0 cm x 2.0 cm containing a small hole of about 2mm dimeter near the upper edge were cut from a large sheet of pure tin. The solutions of HCl acid were prepared using double distilled water. All chemical were used of analytical reagent grade. Different inhibitor soluition were prepared in absolute ethanol. The extracts of dried stem in a soxhlet using ethanol as solvent for sufficient time.

Each specimen was suspended with a V shaped glass hook made of fine capillary and plunged in to a beaker containing 50 mL of the test solution (HCl acid) at room temperature. After sufficient exposure, the test specimens were taken out, washed with running water and dried with hot air dryer and then the final weight loss of each specimen was taken. The percentage inhibition efficieny was calculated using the following formula [30].

$$\eta\% = \frac{\Delta W_u - \Delta W_i}{\Delta W_u} \times 100$$

Where ΔWu and ΔWi are the weight loss of the metal in uninhibited acid and in inhibited solution respectively. The corrosion rate (CR) in mm/y can be calculated by the following equation [31]

$$\text{Corrosion rate (mm/y)} = \frac{\Delta \text{Wu x } 87.6}{\text{A x T x d}}$$

Where ΔW is weight loss in mg, A is area of specimen in cm^2 , T is time of exposure in hours and d is density of metal in g/cm^3

Inhibition efficiency was also determined by thermometric method. In this method a specimen was immersed in a reaction chamber containing 50mL of solution at an initial temperature of 25° C. Temperature change were measured using a thermometer. Inititially temperature increased slowly, Then rapidly and attain a maximum value before falling. The maximum temperature was recorded. Percentage inhibition efficiency were calculated as

$$RN = \frac{RN_f - RNi}{RN_f} \text{ x } 100$$

Where RN_f and RN_i are the reaction number in the absence and presence of inhibitor respectively and reaction number is defined as

$$RN = \frac{Tm - Ti}{t}$$

Where T_m and T_i are maximum and initial temperature and t is the time (In minutes) required to reach the maximum temperature.

III. RESULT AND DISCUSSION

Weight loss data , percentage inhibition efficiency ,corrosion rate for different concentration of HCl ,H_2SO_4 and HNO_3 solution with different concentration of inhibitors are given table 1 and 2. It is observed from the table that inhibition efficiency increases with increasing concentration of extract in each strength of acid solution. The maximum inhibition efficiency (95.20%) was obtained in 0.5N HCl at inhibitors concentration 0.7% for stem extract. The maximum inhibition efficiency in H_2SO_4 solution was obtained 81.87 % in 0.5N H_2SO_4 at an inhibitor concentration of 0.7%,wheras the maximum inhibition efficiency in HNO_3 solution was obtained only 78.12% in 0.5N HNO_3 at an inhibitors 0.7% the result show that stem extract have higher inhibition efficiency in HCl than H_2SO_4 and HNO_3. The variation of percentage inhibition efficiency with inhibitor concentration is depicted graphically in figure 1,2,3,4, for stem extract . It indicates that the inhibition efficency increases with increasing inhibitor concentration.From Table 1 and 2 it is clear that corrosion rate decreases with increasing concentration of inhibitor

Inhibition efficiencies were also determined by using thermometric method. Thermometric experiments were carried out at higher concentrations of acid i.e. 2N , 3N and 4N because no appreciable changes of temperature were observed at lower concentrations of acid. Results summarized in table 3 show a good agreement with the result obtained by weight loss method. The variation of reaction number (RN) with inhibitor concentration is depicted graphically in fig. 5,6 and 7 for HCl, H_2SO_4 and HNO_3 the maximum inhibition efficiency was obtained with the highest concentration of inhibitor at lowest concentration of acid. Inhibition efficiency increases with increasing concentration of inhibitor and decreases with increasing concentration of acid. Both methods (weight loss as well as thermometric) show same trends in corrosion efficiency and results are in good agreement with each others.

Table -1 Weight loss data and Percentage Inhibiton efficiency for tin in 0.5 , 1N HCl , H_2SO_4, HNO_3 With given Inhibitor addition of Stem extract.

Temperature $25^0C \pm 0.1^0$ C Area of Specimen 8cm^2

	0.5 N HCl (195 hrs.)			1 N HCl (142 hrs.)		
C.I. %	W	I.E.	Corrosion Rate	W	I.E.	Corrosiom Rate
Uninhibited	0.146		112.9	0.169		179.05
0.1	0.022	84.93	17.01	0.024	85.79	25.49
0.3	0.017	88.35	13.14	0.020	88.16	21.24
0.5	0.014	90.41	10.82	0.018	89.34	19.11
0.7	0.007	95.20	5.4	0.013	92.30	13.8
	0.5 N H_2SO_4 (358 hrs.)			1N H_2SO_4 (221 hrs)		
Uninhibited	0.149		62.77	0.162		110.56
0.1	0.053	64.42	23.59	0.064	60.49	43.67
0.3	0.047	68.45	19.8	0.059	63.59	40.26
0.5	0.042	71.81	17.69	0.048	70.37	32.75
0.7	0.027	81.87	11.37	0.036	77.77	24.56
	0.5N HNO_3 (1445 min.)			1N HNO_3 (110 min.)		
Uninhibited	0.224		1.4077	0.147		11.085
0.1	0.086	61.60	0.4839	0.052	64.62	3.9214
0.3	0.069	69.19	0.4336	0.049	66.66	3.6952
0.5	0.058	74.10	0.3644	0.043	70.74	3.2427
0.7	0.049	78.12	0.3079	0.036	75.51	2.7148

Table -2 Weight loss data and Percentage Inhibiton efficiency for tin in 1.5 , 2N HCl , H_2SO_4, HNO_3 With given Inhibitor addition of Stem extract.

	1.5 N HCl (120 hrs.)			2 N HCl (95 hrs.)		
C.I. %	W	I.E.	Corrosion Rate	W	I.E.	Corrosiom Rate
Uninhibited	0.132		169.5	0.247		392.1
0.1	0.033	75	41.47	0.090	63.56	142.8
0.3	0.029	78.03	36.44	0.068	72.42	107.9
0.5	0.021	84.09	26.39	0.058	76.51	92.08
0.7	0.011	91.66	13.82	0.042	82.99	66.68
	1.5 N H_2SO_4 (187 hrs.)			2N H_2SO_4 (155 hrs)		
Uninhibited	0.139		112.1	0.194		18.87
0.1	0.066	52.51	53.23	0.111	42.78	108
0.3	0.062	55.39	50	0.104	46.93	101.1
0.5	0.054	61.15	43.55	0.091	53.09	88.54
0.7	0.044	68.34	35.48	0.083	57.21	80.76
	1.5 N HNO_3 (45 min.)			2 N HNO_3 (25 min)		
Uninhibited	0.052		10.4573	0.177		64.0813
0.1	0.024	53.84	4.8264	0.143	19.20	51.7719
0.3	0.022	57.69	4.4242	0.141	20.33	51.0478
0.5	0.021	59.61	4.2231	0.140	20.90	50.6857
0.7	0.02	61.53	4.0022	0.135	23.72	48.8755

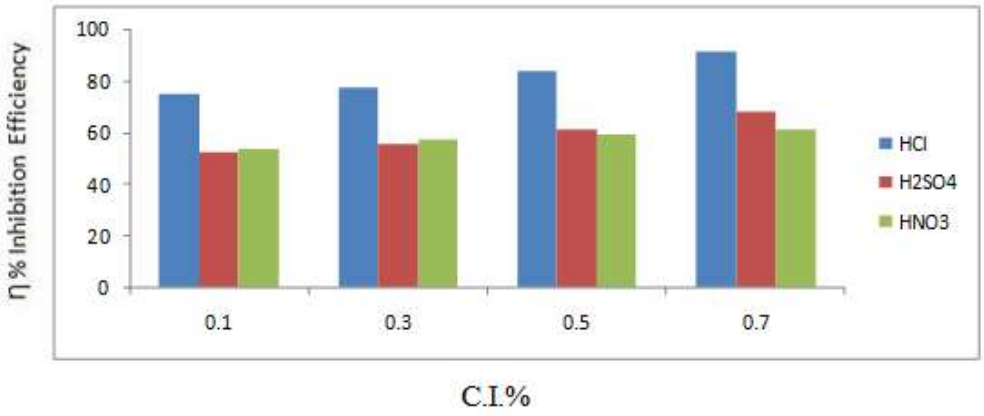


Figure 1. variation of inhibition efficiency with concentration of stem extract for tin in 0.5N(HCl, H_2SO_4, HNO_3).

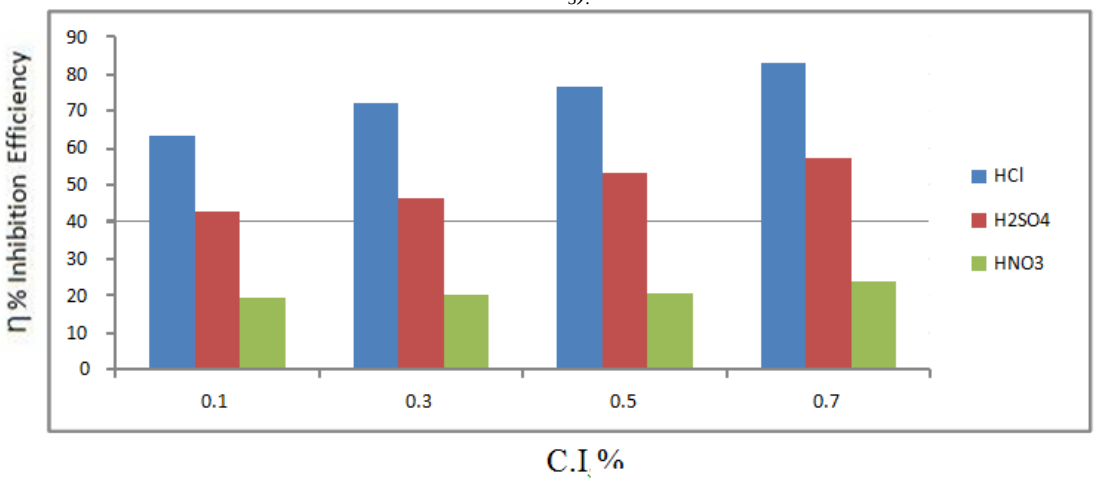


Figure 2. variation of inhibition efficiency with concentration of stem extract for tin in 1N (HCl , H_2SO_4 , HNO_3)

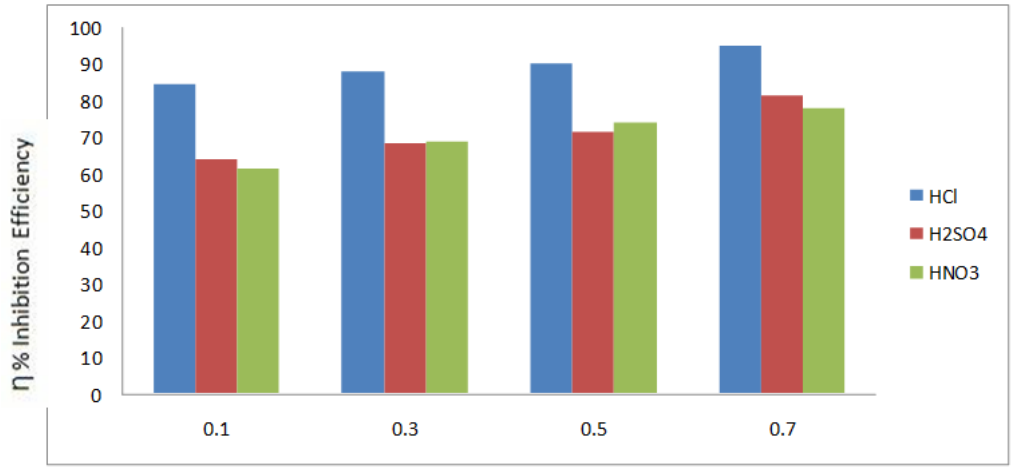


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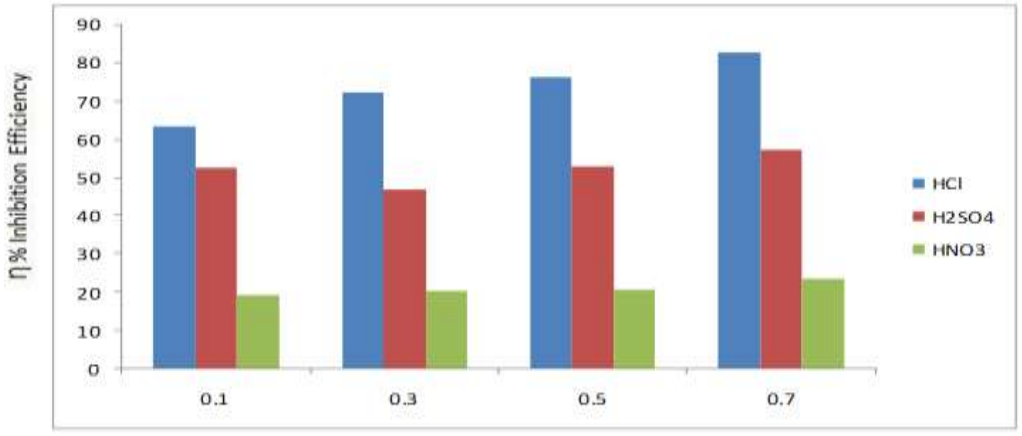
Figure 3. variation of inhibition efficiency with concentration of stem extract for tin in 1.5N (HCl , H_2SO_4 , HNO_3)



C.I.%

Figure 4. variation of inhibition efficiency with concentration of stem extract for tin in 2N (HCl , H_2SO_4 , HNO_3)

Table -3 Reaction number (RN) and inhibition efficiency for tin in 2N , 3N and 4N HCl , H_2SO_4 and HNO_3 with inhibitor of stem extract

	2N HCl		3N HCl		4N HCl	
UnInhibited	RN	I.E	RN	I.E	RN	I.E
0.1	0.0232	58.57	0.02138	45.17	0.04822	37.37
0.3	0.02116	62.61	0.02016	48.30	0.0466	39.40
0.5	0.01943	65.30	0.01905	51.15	0.04604	40.20
0.7	0.01848	67.00	0.01826	53.17	0.0448	41.81
	2N H_2SO_4		3N H_2SO_4		4N H_2SO_4	
UnInhibited	RN	I.E	RN	I.E	RN	I.E
0.1	0.0491	50.40	0.5868	39.19	0.5882	29.30
0.3	0.0461	53.43	0.5573	42.24	0.5699	31.50
0.5	0.04196	57.61	0.5377	44.27	0.5659	31.98
0.7	0.03896	60.64	0.5077	47.38	0.5566	33.10
	2N HNO_3		3N HNO_3		4N HNO_3	
UnInhibited	RN	I.E	RN	I.E	RN	I.E
0.1	0.3209	48.32	0.05428	37.60	0.7462	25.60
0.3	0.3043	50.99	0.0533	38.70	0.7251	27.70
0.5	0.2939	52.67	0.05202	40.20	0.7131	28.90
0.7	0.2747	55.76	0.05089	41.56	0.7081	29.40

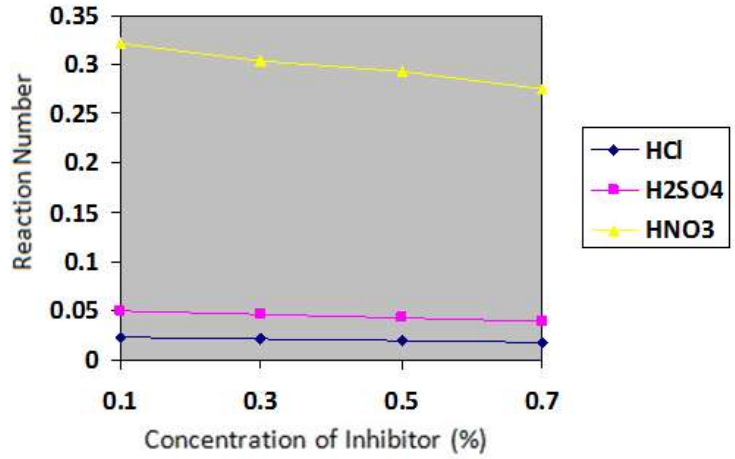


Fig.5 Variation of reaction number with concentration of Stem extract for tin in 2N, HCl , H_2SO_4 and HNo_3

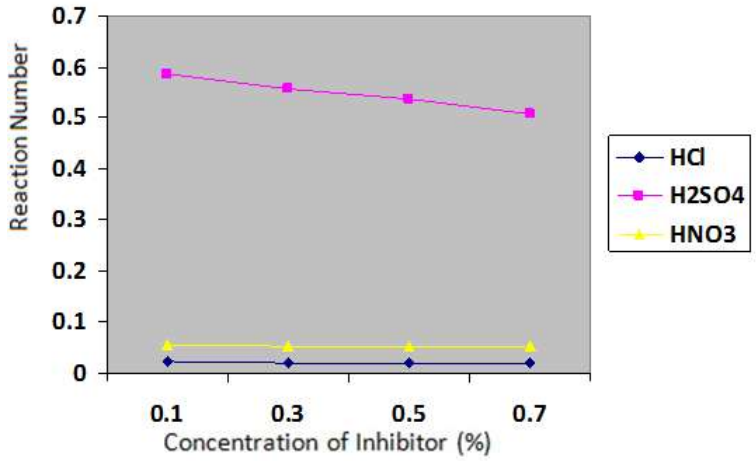


Fig.6 Variation of reaction number with concentration of Stem extract for Tin in 3 N, HCl , H_2SO_4 and HNo_3

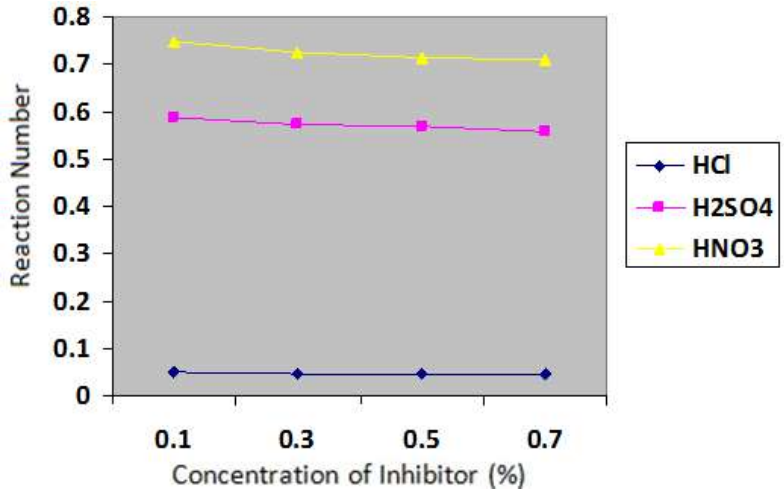


Fig.7 Variation of reaction number with concentration of Stem extract for tin in 4 N, HCl , H_2SO_4 and HNo_3

IV. CONCLUSION

A study of stem extract of Tylophora Indica has shown that to be better corrosion inhibitors for tin in HCl. Weight loss and thermometric methods were shown that inhibition efficiency of stem increases with incereasing inhibitors concentration over the range 0.1% to 0.7% the maximum inhibition efficiency was found up to 95.20% for tin in 0.5N HCl at a concentration of 0.7% for stem extract. wheras it was 81.87% in H_2SO_4

and 78.12% in HNO_3. with same of inhibitors Thus it was concluded that stem extract is a better corrosion inhibitor in HCl than in H_2SO_4 and HNO_3.

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