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ADSORPTION STUDIES ON CORROSION INHIBITION OF EICHHORNIA CRASSIPES (WATER HYACINTH) ON MILD STEEL IN AQUEOUS MEDIUM

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Abstract: The effect of temperature on corrosion inhibition of *Eichhornia crassipes* (Water Hyacinth) leave extract with Zn^{2+} on the of mild steel was investigated by gravimetric method at the temperature range of 308 K to 348 K in 60 ppm Cl^- containing aqueous medium. The slopes and R^2 values, for the temperature ranges from 308 – 348 K, are very close to unity indicates the adherence to Langmuir adsorption isotherms Langmuir adsorption isotherm related to the monolayer formation on metal surface and is also characteristic of physical adsorption (or) electrostatic adsorption.

Keywords **– Water hyacinth, mild steel, Adsorption isotherm, corrosion inhibition**

I. INTRODUCTION

According to International Union of Pure and Applied Chemistry (IUPAC) "Corrosion is an irreversible interfacial reaction of a material (metal, ceramic, and polymer) with its environment which results in consumption of the material or in dissolution into the material of a component of the environment[1].The increasing ecological awareness, as well as the strict environmental regulations, and subsequently the need to develop environmentally friendly processes, attention is currently focused on the development of "green" alternatives to mitigating corrosion[2].So that, the researchers are in the condition to prefer suitable green corrosion inhibitors like plant extracts[3-7], which are easily available, renewable, bio-degradable in nature. In this present study, we analysed, the effect of temperature by *Eichhornia crassipes* (Water Hyacinth) leave extract (WHLE) with Zn^{2+} on the of mild steel from the range of 308 K to 348 K.

II. METHODS AND MATERIALS

2.1 Preparation of the Water Hyacinth Leaves (WHLE) extract

In the present work, the Water Hyacinth leaves were collected from Shanmuga River in Palani. Fresh leaves of this plant were cleaned, chopped into small pieces and shade dried. The extract was prepared by refluxing 25g of powdered leaves in 500ml dd water for 5hr and kept overnight. Then it was filtered and the volume of the filtrate was made up to 500ml using dd water and this was taken as stock solution.

2.2 Sodium chloride solution

Exactly 9.8g of Sodium chloride was dissolved in triple – distilled water and made up to one litre in a standard measuring flask. A hundred fold dilution yields 60ppm Cl^- ion concentration.

2.3 Zinc Sulphate solution

Exactly 4.4g of Zinc sulphate was dissolved in triple – distilled water and made up to one litre in a standard measuring flask. A hundred fold dilution yields 10ppm Zn^{2+} ion concentration.

2.4 Adsorption Isotherm

The dependence of surface coverage on concentration is studied through the following adsorption isotherm as shown in Table 2.1.

Table 2.1. Types of adsorption isotherms

Isotherm	Formula
Langmuir	Plot of log (C/θ) Vs log C ---------(1)
Temkin	Plot of θ Vs log C ---------(2)
Freundlich	Plot of log θ Vs log C ----------(3)
Frumkin	Plot of θ Vs ln [θ / C (1- θ)] ---------(4)
Flory – Huggins	Plot of log (θ/C) Vs log (1- θ) ---------(5)
Bockris-Swinkel's	Plot of θ log (θ /1- θ) Vs log C ---------(6)
El-Awady kinetic thermodynamic	Plot of log (θ/1- θ) Vs log C ----------(7)

Various adsorption isotherms were tested graphically to fit a suitable adsorption model for the inhibitor.

III. RESULTS AND DISCUSSION

3.1 Adsorption Isotherm

Adsorption isotherms are important in determining the mechanism of phyto – electrochemical reaction[8]. The surface coverage (θ) data are useful on discussing the adsorption characteristics when the fraction of surface cover is determined as the function of the concentration at constant temperature adsorption isotherms are Langmuir, Temkin, Frumkin, Freundlich, El Awady and Florry – Huggins. To obtain the adsorption isotherm, the degree of surface (θ) was calculated for various concentrations of the inhibitor system (WHLE – Zn^{2+}) from the weight loss data, listed in Table 3.1.

Table 3.1. Calculated values of degree of surface coverage (θ) for mild steel in various concentrations of WHLE + Zn^{2+} (50 ppm) mixture at different temperatures

Concn.of inhibitor WHLE (ppm)	Degree of surface coverage (θ)				
	Temperature (K)				
	308 K	318 K	328 K	338 K	348 K
2.5	0.5889	0.3364	0.3125	0.3000	0.2542
5.0	0.6444	0.4273	0.3438	0.3167	0.2917
7.5	0.7000	0.4545	0.3750	0.3333	0.3083
10.0	0.7556	0.5000	0.4063	0.3556	0.3333

The test revealed that the adsorption of WHLE on mild steel surface is best described by Langmuir adsorption isotherm. The parameters of Langmuir adsorption isotherm are presented in Table 3.2. The plot of log (C/θ) Vs log C was found to be linear as given in Figure 3.1, indicating the application of Langmuir model to the adsorption of the plant extract WHLE on mild steel.

Table 3.2. Parameters of Langmuir Adsorption isotherm

Inhibitor medium: various concn. of WHLE + Zn^{2+}(50 ppm) **Immersion time**: One hour

log C	log (C/θ)				
	308K	318K	328K	338K	348K
0.3979	0.6279	0.8711	0.9031	0.9208	0.9928
0.699	0.8898	1.0682	1.1627	1.1983	1.234
0.8751	1.03	1.2175	1.301	1.3522	1.3861
1	1.1217	1.301	1.3912	1.449	1.4772

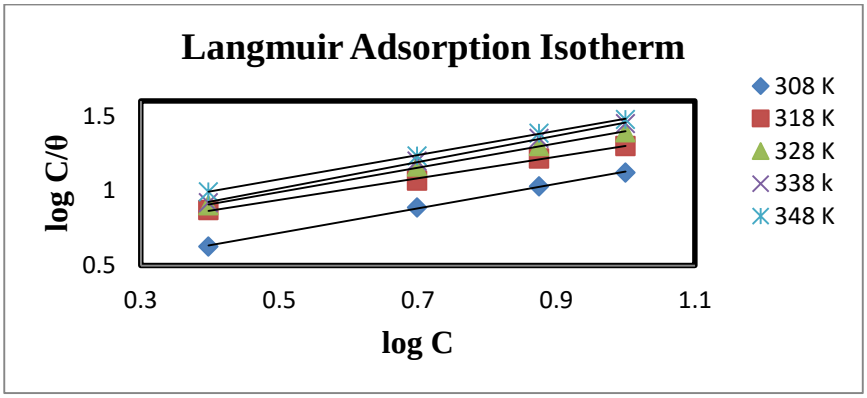

Figure 3.1. Langmuir Adsorption isotherm of WHLE – Zn^{2+} (50 ppm) in 60ppm Cl^- ion containing aqueous medium

The slopes and R^2 values are shown in Table 3.3, for the temperature ranges from 308 – 348 K, are very close to unity indicates the adherence to Langmuir adsorption isotherms[9,10]. The plots also support the mechanism of corrosion inhibition is due to the formation and maintenance of the protective film on the metal surface and that the additive covers both the anodic and cathodic sites through uniform adsorption[11]. Langmuir adsorption isotherm related to the monolayer formation on metal surface and is also characteristic of physical adsorption (or) electrostatic adsorption[12].

Table 3.3. Correlation coefficients deduced from Langmuir isotherm for mild steel in 60ppm Cl^- at various temperatures

Temperature (K)	Langmuir Isotherm		
	Slope	Intercept	R^2
308 K	0.823	0.305	0.998
318 K	0.721	0.578	0.997
328 K	0.814	0.584	0.998
338 K	0.882	0.574	0.998
348 K	0.810	0.670	0.999

IV. CONCLUSION

The aim of this research was to apply adsorption isotherms in corrosion inhibition Processes of temperature by *Eichhornia crassipes* (Water Hyacinth) leave extract (WHLE) with Zn^{2+} on the of mild steel from the range of 308 K to 348 K in neutral aqueous media. The results show that aqueous extract of of WHLE-Zn^{2+} effectively inhibited mild steel corrosion in 60ppm Cl^-ion. At higher concentration and lower temperature, the extract performed well as corrosion inhibitor. The experimental data were best fitted with the Langmuir adsorption isotherm.

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