Available online at www.elixirpublishers.com (Elixir International Journal)

Applied Botany

Elixir Appl. Botany 39 (2011) 4654-4656

ISSN: 2229-712X

Effect of plant extracts (nyctanthes) on cu corrosion in chloride

Jinendra Singh Chauhan and D.K.Gupta

Motilal Vigyan Mhavidhyalya, Bhopal (M.P.), India.

ARTICLE INFO

Article history:

Received: 25 July 2011;

Received in revised form:

20 September 2011;

Accepted: 26 September 2011;

Keywords

Nyctanthes,

Nyquist,

Boad.

ABSTRACT

The use of *Nyctanthes* Cu corrosion behavior was tested in aerated aqueous solutions of NaCl and KCl for different pH values. Polarization resistance (R_p) measurements, polarization curves and AC impedance technique were used to obtain experim ental data. Nyctanthes found to exhibit ctionic type in acidic media solution of NaCl and KCl. The impedance spectra and curves at different potentials showed that the corrosion process of metal was characterized by two distinguishable capacitance loops. The charge transfer resistance R_t and polarization resistance, R_p values calculated from the interpretation of Nyquist and Boad plots were in agreement with the results of the other techniques.

Introduction

Since, AC *impedance* technique is one of the promising tools for the analysis of corrosion rate; it has increased in application to determine the rate of corrosion and its research. Theory of *impedance* of the mixed potential electrode indicates that the rate of corrosion can be measured with reasonable accuracy by measuring the interfacial *impedance* at two extreme frequencies Recast. Potassium chloride (KCl) has been used in the laboratory to measure *impedance* over a wide range of frequencies as well as measurement by two frequency corrosion monitor conducted on different metals under various conditions to analyze rates of corrosion. The main object of this work is to characterize the impedance behavior of corroded metal with special reference to corrosion analysis.

The corrosion of metals like carbon steel in chloride-containing solution is known due to the presence of dissolved oxygen (D.O.) but the effect of deoxygenation both in dc and ac electrochemical response has not been widely discussed So far, the reduction in corrosion rate due to the deaeration is well known which is analyzed.

The electrochemical impedance technique is well established method for the investigation of electrochemical analysis of corrosion rate. However, the analysis of the results remains difficult. The most common approach is based on the equivalent circuit concept, exemplified by the model. This study is concerned with the electrochemical measurements, both the AC measurement of metal corrosion deaerated with remove parenthesis solution at different temperatures

Technique of AC Impedance Method

The specimen's plates of size 1cm x1cm x1cm were prepared by polishing with 600 grit silicon carbide paper, rinsed with distilled water and finally dried in a stream of air. Recast. Corrosive media used were 0.1M KCl and NaF. The pH of solution was adjusted to different range values from pH 2, pH 4to pH 9.5 by adding dilute HCl and NaOH solutions. The electrolyte reference used was Fusayama Meyer artificial saliva (KCl-0.4gm/L, NaCl-0.4gm/L,$CaCl_2$-0.906gm/L,NaH_2PO_4-0.69 gm/L sodium sllphide-0.005gm/L and urea-1gm/L). N_2 gas was constantly purged to maintain deaerated condition. Metal electrode was than immersed in the sealed cell containing the test solution. A saturated calomel electrode and platinum electrode were used as reference and counter electrodes, respectively. AC measurement was carried out after 1 hour, when a constant potential was attained. The slope, $\Delta E/\Delta I$, at the corrosion potential, is defined as polarization resistance, R_p if we defined the constant B as:

$B= b_a b_c /2.3(b_a+b_c) R_p$

Were b_a and b_c are the Tafel slopes determined from E Vs $\log_{10}$ I plot.

The corrosion current density is given by:

The electrochemical *impedance* measurements were performed under the response analyzer, Solartron 1250 and 1287electrochemical interface using small amplitude sine wave signals, 10mV, over the 1 kHz frequency range of 1 kHz to 1 MHz with 5 points per decade. This tourniquet is based on the theories that describe the response of a circuit to an alternating current or voltage as a function of frequency.

Results and Discussion

Figure 1 shows the Nyquist and Bode plots of the metals in deaerated 0.1M KCl at 40 ^oC. In this plot the imaginary component (Z) is taken against the real-component at each frequency. Here, frequency is increased in counter clockwise direction. At high frequencies, *impedance* was almost entirely created by the solution resistance, R_s ,while at low frequencies, the *impedance* was almost entirely created by the combined polarization resistance and solution R_s, R_p. The [Z] Vs f plot also gave a value of R_s and R_p.

The value of [Z] is the high limiting value; R_p is the difference between low frequency limit and high frequency limit.

There was no variation and effect of R_s when the speed of rotation increased; this behavior indicates that the corrosion rate of reaction is strongly controlled by diffusion through a fluid boundary layer of inhibitor. Fig.1 shows the Nyquist and Bode plots of metal in deaerated 0.1M KCl solution at 40 ^oC and pH 9.5.These results also reveled.

The comparison in AC spectrum between pH 4 and pH 9.5 are correlated by Fig.2 .The analysis of *impedance* plot, through fitting results, is indicative that the equivalent circuit at pH 9.5 gave a better fitting of two circuits.

Tele: +919039337320

E-mail addresses: jine.schauhan@yahoo.com

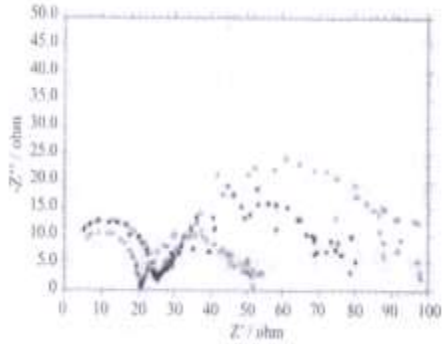

Fig. 1 Nyquist plots of metal in deaerated 0.1M KCl solution at 40 ^{o}C.

A parallel combination of capacitance and resistance as a series to the circuit of cathodic branch as a charge transfer resistance, with parallel charge transfer resistance-diffusion impedance for the anodic branch, the circuit after solution resistance is attributed to the passive film, which is found by the inhibitor on the metallic surface.

This the entire conclusion summarized in the Table-1, and Table-2, The impedance diagram obtained for the Cu in 0.5 N HCl in the presence of the bee root inhibitor are depicted in the Figure 1,2 They are perfect semicircles and this was attributed to charge transfer reaction. Impedance parameters derived from the Nyquist plots are tabulated in the Table 1 to 2.

It can be seen that as the concentration of inhibitor increases, C_{dl} value also decreases in the value of $C_{dl,}$ result of molecules function by adsorption at the metal- solution interface.

All the analysis earliar reported by the El-Etre A Y, *JColloidInterface Sci.*, (2007),Chetouani A, Hammouti B and Benkaddour M, *Pigment & Resin Technology*,*(* 2004) Pandian Bothi Raja and Mathur Gopalakrishnan Sethuraman(2008)and Ferreria E.S.,Giacomelli C.,Giacomelli F.C.,and Spinelli A., (2004).

The Nyquist representation of the impedance behavior of Cu, Al and mild steel in 0.5N HCl solution with and without the *Zenthoxylum aratum and Atonia scholarasis* shown in Figure-1 to 5.

The existence of a single semicircle shows the presence of single charge transfer process during corrosion which was unaffected by the presence of inhibitor molecule.

The slightly depressed nature of the semicircle, which has the center below the x-axes, is the characteristics for the solid electrodes and such frequency dispersion has been attributed to roughness and other electrode.

The charge transfer resistance (R_{ct}) and the interfacial double layer capacitance values were derived using the equivalent circuit shown in Figure 1.

The equivalent circuit elements calculated by Z view fitting program are given in Tables 1 and 2. The value of R_{ct} is increased from 32.8 to 458.6 Ω cm^2. With the decrease in CPE value from 7.78 x 10^{-5} to 2.1x 10 $^{-5}$ μFcm^2 for the *Bixin* and similarly for the other inhibitors, variation in these values is similarly shown in the Tables 1 and 2.

All the data show that the inhibition of Cu, Al and mild steel corrosion made by using plant extract inhibitors show good results and percent efficiency order of inhibitors can be given as such.

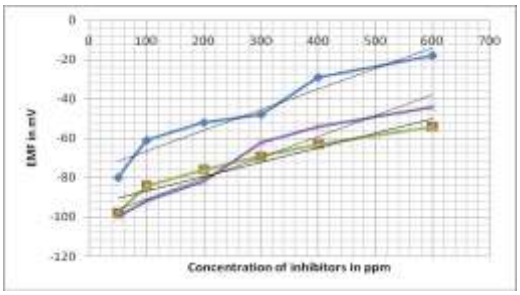

Figure 2: Change of EMF for Cu in different inhibitors.

Conclusions

AC Impedance method analyzed through LCR circuit is recently established method for most corrosion analysis. At pH and concentration of acidic material, it is find out that:

1. Nyctanthes and its extract show very good inhibitive property for the metals, its approximate efficiency calculated during the process was up to 98.7%.
2. Mixture of all the plant extracts utilised as a corrosion inhibitor.
3. The value of inhibition and maximum efficiency is obtained at 0.5M.
4. All the circuits used for the analysis the same results for inhibition.

References

[1]. Refaey S A M, Appl Surf Sci., 2005 , 240(1-4), 396-404,.
[2]. Quraishi M A and Sharma H K, Ashassi-Sorkhabi A, Shaabani B and Seifzadeh D, Appl Surf Sci., 2005,239(2), 154-164,.
[3]. Bouklah M, Ouassini A, Hammouti B and El Idrissi A, Appl Surf Sci., 252(6) [2006],2178-2185[2006],.
[4]. Oguzie E E, Okolue B N, Ebenso E E, Onuoha G N and Onuchukwu A I, MaterChem Phy., 2006,87(2-3), 394-401,.
[5]. Ali Sk A, Saeed M T and Rahman S U, Corros Sci., 45(2), 253-266[2003],.
[6]. Kalpana M and Mehta G N, Trans SAEST, 38(10), 40-42[2000],.
[7]. Oguzie E Corros. Sci., 2008.50: 2993-2998,.
[8]. Chauahn Jinendra singh and Gupta D.K., E-journal of Chemistry, 2009,6(4), 975-978,2009.

Table 1 Corrosion inhibition parameter for the Cu.

Inhibitor	EMF^2	Current	a and b parameter		%IE
Nyctanthes 00					
50	280	12.89	296	768	73.2
100	100	3.45	153	410	77.4
200	92	2.912	146	356	85.5
300	82	1.8970	157	342	90.5
400	62	1.2180	169	322	90.7
600	54	0.8189	168	301	95.1
	-44	0.6321	162	289	98.71

Table 2 Impedance parameter for Cu

Inhibitor	R_s Ωcm^2	R_{ct} Ωcm^2	CPE μcm^{-2}	%IE
Nyctanthes 00				
50	2.2	41.3	6.2×10^{-5}	------
100	1.8	182.8	5.6×10^{-5}	77.40
200	1.7	254.3	4.6×10^{-5}	83.75
300	1.6	348.1	2.8×10^{-5}	88.13
400/600	1.4	454.1	2.62×10^{-5}	94.90
	1.6	604.4	2.24×10^{-5}	98.6