JCSE The Journal of Corrosion Science and Engineering
ISSN 1466-8858 Volume 14, Preprint 42 submitted 19 November 2011

Examining the Effect of extracted humic acid on Gag pipe Corrosion in sea water

A.R. Sardashti, R. Kafian

Department of chemistry, Faculty of Science, University of Sistan and Baluchestan, P.O.BOX.98135-167, Zahedan, Iran

alirezasardashti@yahoo.com

Abstract

The Effect of seawater and mixture of seawater with extracted humic acid on Mild steel gas tube by electrochemical polarization and measurement of reduction weight is studied. In electrochemical polarization survey, average of corrosion potential for sea water is -0.68 Volts and average of corrosion current is 0.40 μA and for the mixture of seawater with extracted humic acid, is -0.69 V and 0.65 μA(pH=7) respectively. With addition Benzoic acid as an inhibitor, potential and current corrosion is -0.64 Volts and 0.04 μA respectively decrease in the corrosion potential shows anodic effect. Reduction weight in seawater is 10 mg when ever in the same volume of seawater which is mixed with 5 mg of extracted humic acid, reduction weigh achieved 20 mg. so humic acid which is extant in seawater increases the corrosion.

Keywords: pipeline steels, corrosion, Extracted humic acid, Sea water

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Introduction

Corrosion, is an electrochemical process in which a potential – difference happens either between two metals or two different parts of a same metal. The created potential-difference can be measured in relation to standard electrode. Electrical potential of this metal may be more or less than standard limit [1].organic acids dissolved in water, such as humic acid, exist mostly with high concentration in water of marsh as well as, in waters which were not taken from such places. The lands, covered with plants mainly, and surface-fleeing waters, partly, possess such material [2]. One of new projects of gas-pipe lines passage, cross countries because of security reasons, may be performed through the bottom of seas and oceans. Since the Humic substances of certain water of humic acid have the properties of Rodox and ionic exchange, corrosion likelihood by humic substances is very great [3]. Because, pH of sea water, in most areas varies, ranging from 7.2 to 7.6, therefore, in usual temperature degrees and small changes pH has no effect of usual rate of steel corroding. This can be an economic loss. So, in this project along with examining the rate of corrosion, for preventing purposes tests of electrochemical polarization and SEM on water of Oman sea as well as a few preventers, were conducted.

Material and Method

Material

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HCl, NaOH, KOH, KCl, HF and CH_3COOH, NO3H all of them have been taken from Merck Germany Company.

Instrument

Extraction of humic acid was performed agitator (ELM 1400 rpm, Germany). IR Spectrum of the preparation sample by (disk), FT-IR apparatus Model 460 plus, made in JASCO Company (Japan). Acidic Functional groups of humic acid were determined using a digital pH meter CD620 with glacial calomel electrode (Zag shimi, Iran). Electrode sample (Mild steel), Flame Atomic absorption Philips (made in UK), ,Apparatus Of EG&MG model 1025(impedance), Apparatus Of CAMS CAN MV 2300 (SEM).potentiometer Consort P 614. Potentiostate model 263 A

Extraction of Humic acid

We extract humic acid from the soil of Nahakhoran Forest of Gorgan in north of Iran, according to IHSS (International Humic substances society) protocol [4,5]and then purify it.

Technique of experience

To conduct the examination of electrochemical polarization and cycle voltamer, providing a surface-having electrode which plays the role of work-procedure electrode, is necessary. At first, we prepare an electrode sample which is made of the materials involved in gas pipe, with surface of 1 cm2 and set it with (twins) glue, then smooth it sand paper, wash it with distilled water and dry it, finally. Then we sink the electrode-sample in sea-water or other mixture with stable pH, or having inhibtator, so that the corrosion takes place. Now, we putthe electrode sample along with reference electrode (Ag/Agcl) and opposite electrode in 50 ml water of sea or other mixtures that form our electrochemical cell. At this time, we provide the cell with gas for 15 minutes. Now draw the

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polarization curve and record the voltamgram CV of corroded piece. in experiments of weight-reduction, we do as the same and then, get out the sample from solution and after drying, we will weigh it depositions have brown colour).in element decomposition of electrode sample, by solving 0.02g of it, in concentrated clorohydric acid inside a joujet balloon and in water of two-times distillation, we reach it to desired volume. Content elements of prepared solution are defined by technique of Flame Atomic absorption.

Results and Discussion

The results of elemental Analysis of steel sample (forming substances of gas pipe) are showed in Table 1. In measuring the weight reduction in sea water, it is 10 mg. In mixture of sea water and 5mg extracted humic acid, the reduction reaches to 20mg. Average potential of
corrosion, resulted from some electrochemical polarization curves, in sea-water is E= -0.68volts and I=0.40 µA (time of half-hour) (Table 2,Fig 1) .By adding Benzoic acid(0.20 g)as a inhibitor potential of corrosion in a time of half-hour, is E=- 0.69volts(Fig2) and I=0.65µA and in period of one-hour, becomes E=-0.84 volts I=1.9µA. Brown-colour deposits would disappear. By adding 10 mg humic acid to 50 ml sea water, corrosion potential becomes E=-0.64volts I=0.04 µA (Fig3).in other word, by increasing humic acid, corrosion increases. This result can be approved by experiments of weight-reduction. average potential of corrosion, resulted from few curves of polarization of electrode sample, in Buffer pH=7, will be - 0.82 volts .By putting 5 mg humic acid in Buffered solution ,corrosion potential becomes -0.81 volts.pH shows the effect of humic acid on corrosion of electrode sample[6,7].The Figures 4and 5 shows Nyquist diagrams of Mild steel in the solution of sea water and with humic acid and Benzoic acid electrolyte.After the corrosion tests, the sample were analyzed using Scanning electron microscopy (SEM).The analysis of the corrosion morphology after short

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exposure shows that corrosion always as sociated with the presence of inclusions for three electrolyte(figures 6,7,8).

Table1. Elemental Analysis of steel sample

Element	Al	Cr	Fe	Ni	Cu	Zn	C d	Pb
(w/w)%	19.8	19	63.92	0.005	0.76	0.52	0	0

Table2. potential and current of corrosion obtianed in Electrochemical polarization

Electrolyte	$E_{corrosion}$(volts)	$I_{corrosion}$(μA)
In sea water	-0.68	0.40
In sea water with 0.20 g /L Benzoic acid	-0.69	0.65
In sea water with 10 mg humic acid	-0.64	0.04

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Table 3.obtianed resistances from Nyquist digrams of Mild steel

Electrolyte	$R_{solution}(\Omega)$	$R_{polarization}(\Omega)$
In sea water	10.52	2532.48
In sea water with 0.20 g /L Benzoic acid	9.25	3034.75
In sea water with 10 mg humic acid	14.06	1756.94

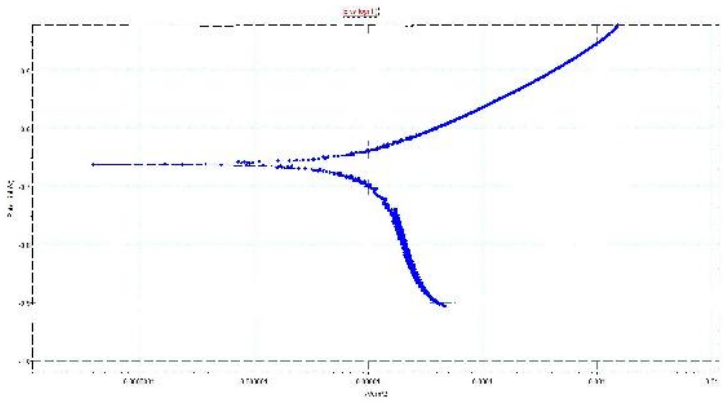

Figure 1. Electrochemical polarization of electrode sample in sea water (in period of half hour)

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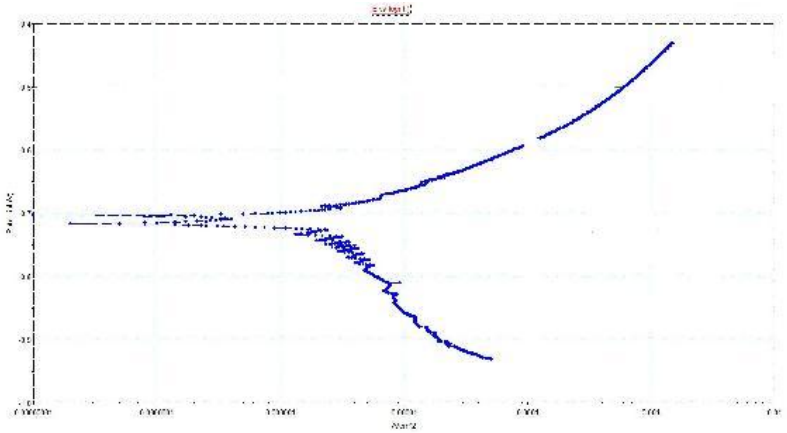

Figure 2. Electrochemical polarization of electrode sample in sea water content 0.20 g of Benzoic acid(in period of half-hour)

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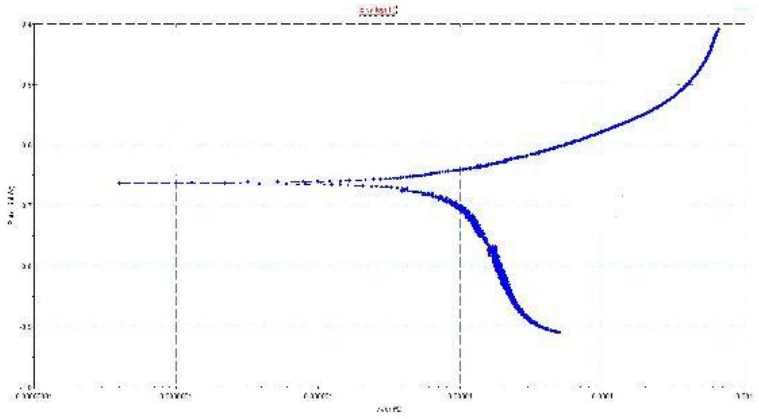

Figure 3. Electrochemical polarization of electrode sample in sea water content 10mg of humic acid (in period half hour)

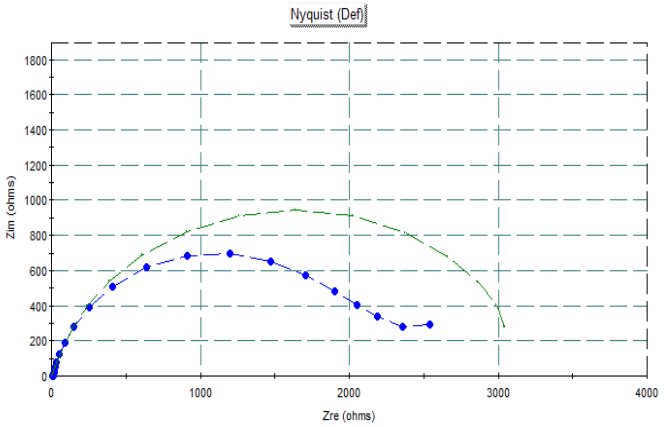

Fig4.Nyquist diagram,

A) Electrochemical polarization of electrode sample

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ISSN 1466-8858 Volume 14, Preprint 42 submitted 19 November 2011

in sea water : (• – • – •)

B:) Electrochemical polarization of electrode sample

in sea water content 0.20 g of Benzoic acid (– – –)

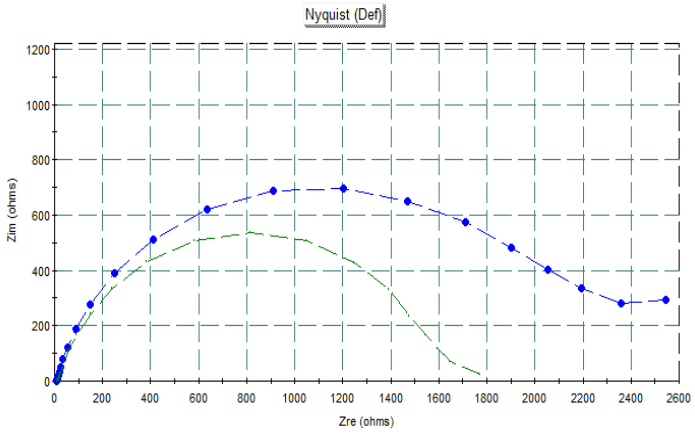

Fig5.Nyquist diagram,

A) Electrochemical polarization of electrode sample

in sea water : (• – • – •)

B:) Electrochemical polarization of electrode sample

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in sea water content (--)10mg of humic acid

A) Study of Spectrums of electronic microscopy

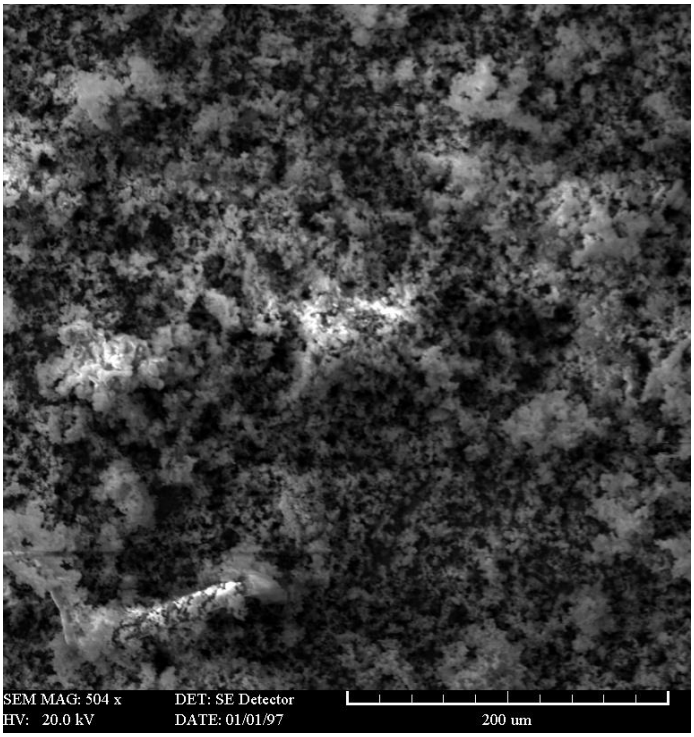

Figure 6.Mmorphology of corroded steel surface in sea water

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ISSN 1466-8858 Volume 14, Preprint 42 submitted 19 November 2011

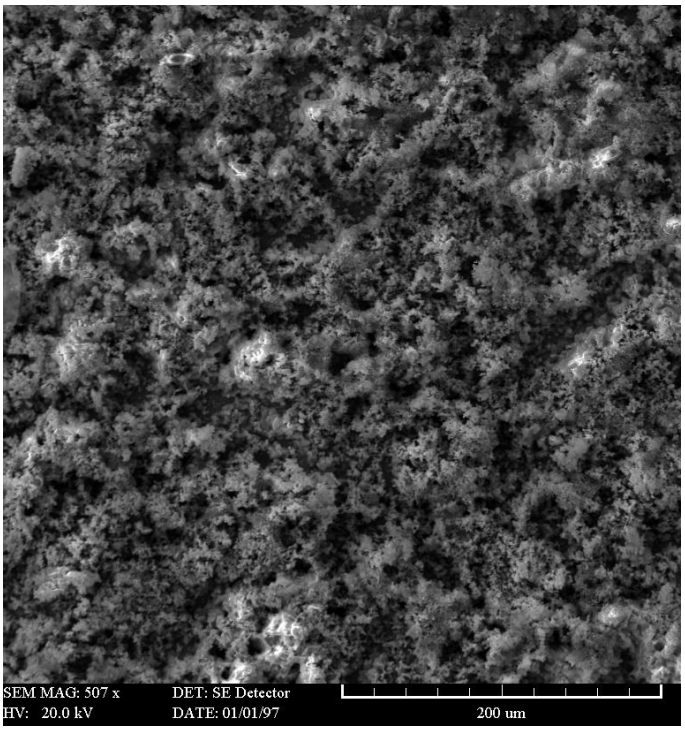

Figure7.Morphology of corroded steel surface in sea water in presence of Benzoic acid

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ISSN 1466-8858 Volume 14, Preprint 42 submitted 19 November 2011

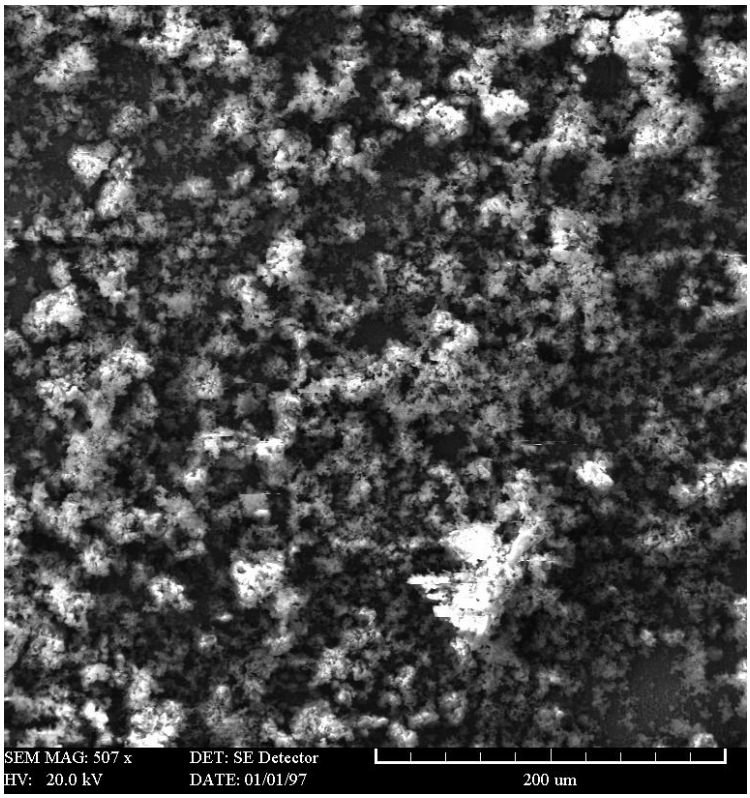

Figure 8.Morphology of corroded steel surface in sea water in presence of Humic acid

Acknowledgments

The author's is grateful to Dr. Hussein from university of Kerman (Faculty of Science) for Corporation in this work

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