International Journal of
Science and Engineering Investigations vol. 1, issue 10, November 2012
ISSN: 2251-8843

Investigating MIDEA Corrosion Treatment on Carbonic Simple Steel in Amin Unit of Isfahan Refinery

Amir Samimi[1], Babak Almasinia[2], Esmaeil Nazem[3], Rohollah Rezaei[4], Abbas Hedayati[5], Mahbobeh Afkhami[6]
[1] Young Researchers club, Central Tehran Branch, Islamic Azad University, Tehran, IRAN
[2, 3,4,5,6] Isfahan Oil Refinery Company, Research and Development Office, Isfahan, IRAN
([1]amirsamimi1161@gmail.com, [2]babakalmasinia@hotmail.com, [3]nazem1958@yahoo.com, [4]dinani1376@yahoo.com, [5]abbas.hedayati@gmail.com, [6]mahboob_afkhami@yahoo.com)

Abstract: α-MDEA corrosion characters in addition to operatory situation depend on its density. In this survey we investigate applying density effect of 10% to 30% weight on solvent corrosion situation on carbonic simple steel on collision or temperature different situation. Results shows that carbonic simple steel corrosion Rate is minimum in 10% density, but its passio film is unstable. Pasio film for stable in 37% density and stable on different temperatures and even on collision, because it's produce low corrosion rate in different temperature, density or collision, in this phase show that α-MDEA density minimum for creating acceptable situation of pasio film is equal to 31 wt%. In this density there is not any possibility for making Iron oxide and creating flow increase on the polarization curves passio Region.

Keywords: *Corrosion, Density, Pasio Film, α-MDEA*

I. INTRODUCTION

Effect parameters on corrosion speed in Amin units.

Amines in refinery are used for cleaning sour gas small relative flowing. In contrast Amin units in natural gas factories are major process units. Amines in refinery are applying for removing CO_2 & H_2S of gas. α-MDEA is one of the new Amines.

CO_2 removing by α-MEDA is chemical / physical attract process that act as a physical attractor in high CO_2 little pressure, yet is chemical attractor in low CO_2 little pressure. This CO_2 gas again exit with clearing and we use again this solvent, that lead to very low energy consumption and corrosion of this Amines is very little in contrast with other amines. CO_2 removing with little circulating speed need to little compenstate and have little side-effects. Although corrosion can change for short time period, but this amount of corrosion can lead to solvent immediate pollution, fooling, cmpredictable events in factory that finally we should change factory valuable facility, Because any of 2 amines units don't handle same, there is not possibility for rational and accurate comparison of them. And they believe that below process parameters and variables effect on corrosion.

Consumption Amin solvent kind
Sour gas load
Solvent power
Proportion of H_2S to CO_2
Feeding pollutions
Applying temperatures and pressures
Different and undefined products of Amin dissalvation
Solid particles in solvent
Mechanical designing details that effect on moving gas of solvent
Chaos and solvent circulation Rate
Surface passio
Inhibitor present

It's obvious that many of variables are interdependent. For example when we are going to mechanical designing and certain solid particles loading, circulation Rat increasing lead too much turbulences and free attractive gas in local point. This provide much mechanical energy for cutting Iron sulfides cortex on facilator surface that finally lead to rapid corrosion. We should pay attention to this point that in rich side of circular pirot passio layers are Anorf sulfide curve with little Macnavit. Usually this curve has poor coheresive and readily cutting. These passio layers in solvent that are in the surface become finally monotony and decrease corrosion Rate. Systems with much load of passio layers cannot convert to monotony barrier without helping inhibitors.

In the active side of these layers there are much pirit and pirotit that provide better protection for sub layer. Also determined that H_2S in sufficient amount or high density of its Acidic property lead to corrosion that in danger pasio layers monotony in rebuilders and regenerators, Increasing water level of Amin solvents lead to much loading of sour gas and more evaporation of rich Amin sovents. Increase in circulation Rate can decrease loading and can increase gas in flashing gas in damaging borrier and increase local corrosion possibility.

For interdepency between parameters it's possible that changing some of operatory parameters can decrease corrosion in some part of unit and increase in other part. Experiments show that usually units with low load have less corrosion. Also low speed, temperature & pressure have same role. Not existing of pollutions, and solid particles and specially we of resistance alloys to corrosion lead to decreasing operatory issues such as fooling corrosion and restraining in rich are of system. Except in Rib oiler complex, Active Amin corrosion is very low of rich Amin corrosion. It's interesting that Active Amin corrosion is related to similar variables to rich Amin corrosion. It means that if we observed much corrosion Rates in rich area of factory; subsequently we saw such increase in Active area.

Investigation shows that carbonic simple steed corrosion in Amin solvents in little than water and there is not different temperature Between Amines when there isn't any acidic gas. But when CO_2 Amines attract, they have not any differences via corrosion. Earlier Amines are power full Lewis than to sconolly Amines and thirdly Amines are not the same. One thirdly Amines like MDEA can make one $FeCo_3$ protective layer on steel surface in presence of CO_2 that provide little corrosion Rate. Corrosion via CO_2 occur in Amin unit by un dissolved Acid carbonic survive in chaos regions that cannot make Iron carbonate passio curve. Acid carbonic can precede one of below reactions:

$H_2CO_3 + e = HCO_3 + HC$ corrosion cathodes

$H_2CO_3 = CO_2 + H_2O$ (CO_2 gas evaluation)

H_2S corrosion Reaction is direct:

$Fe + H_2S = FeS + H_2$

Corrosion Reactions are entirely complex in mixing acidic gas service. Corrosion different experiments are depended on not similarity of Iron sulfide film. Some of films are much adhesive yet anthers are like Gully.

II. Effect of MDEA density

Deviation in operatory parts of normal amounts in one sweating unit of wour gas without considerable increase in corrosion can have much economical benefits that included decreasing energy consumption on processing gas volume unit and have increase income with little investment. Corrosion product layer composition change with MDEA density, MDEA dilution solvents like 0.1 M, Hydroxide and Iron oxides shape with $FeCO_3$, Although corrosion product layer is entirely $FeCO_3$ in MDEA intensive concentration, in this situation catholic survive reaction is occur in metal is in effect of ions penetration form width layer via layer cracks. So corrosion rate is minimum, although solvents become corrosive with Increasing Amines concentration but this is not true for MDEA.

III. Corrosion kinds in Amin units

General corrosion:

This kind of corrosion is extensive corrosion in regions that are exposing to solvent. Although this kind of corrosion destruct very amount of material every year we can monitor facilities life precisely or predict them via corrosion tests. These tests are including corrosion probes in line, coupons or ultrasonic thickness test. Unfortunately most of destruction in Amin systems are not monotony corrosion but also are local corrosion. This kind of corrosion is local and dangerous and can bore & material penetrate of limitedness regions. Hollid ions especially chloride lead to holly corrosion promotion. Carbonic steel in contrast with rust proof steel is resistance to this kind of corrosion.

Furry Corrosion: This kind of corrosion is when creating one concentration cell is made between 2 metal surface of 1 metal and nonmetal. Concentration cell shaped with exigent exiting, Acid site or corrosion inhibitors exiting of furry inside. Chloride ions have effective correspondence in corrosion. Furry corrosion is in tubes that attach to thermal transformation tube surface. And is less common in boilers, Also this kind of furry is under sedimentary in system and filtration is one of ways against particles sedimentary.

IV. Corrosion between grains

This corrosion is in metal grains border as selectly and is common in rustproof steels. Karbid penetration can increase worm-eaten in grains border this sediment is due to improper thermal operations or applying insufficient welding technics. Thermal operation out of senility region and applying rust proof low carbon steel Lake 316L & 304L can help to decreasing between grain corrosion.

V. Galvanic corrosion

When to metal that their quality is not same attach each other and place in one conductive solvent, there is electricity potential between 2 metals that cause metal with less resistance have low corrosion. For example when rustproof steel tray attach to each other with small carbonic steel pins, occur galvanic corrosion, Small carbonic steel pins act like Anode and corrosion preferably, Another example of galvanic corrosion are pump shafts and ruddy valve, that is made of steel.

VI. Friction corrosion

This kind of corrosion is by corrosion flow movement on metal surface. Solid particles or gas bubbles on liquid intense this kind of corrosion. Friction corrosion is in knee-joint, shields & downers. Level of friction corrosion is depending on turbulence speed and protective film resistance.

VII. Tension corrosion

Tension corrosion is due to pulling tension effect and one corrosive environment also tension can be remaining internal tension in metal or external applying tension.

Tension corrosive cracking intensive with chloride is one of the common kinds of this corrosion. Other factors influencing on SCC extensive are operatory temperature, Amin solvent chemical composition, metal composition or its structure.

VIII. Hydrogen damage

Hydrogen damage is kind of mechanical damage that is occur hydrogen presence hydrogen damage in Amin uints limited to blister, fragility or corrosion. Amin solvents contain suffid or hydrogen ciyanid can create hydrogen fragility or craching due to sulfide tension. Hydrogen blister is on corrosion Amin solvents that are contain hydrogen freeing poison such as sulfides, Arcinic compositions, phosphorus ions and ciyanid Main factor of corrosion on Amin units is free acidic gas and temperature. Corrosion in operational units of alkanolamin is concrete on rich part of keral tranformator, tubes contain rich Amin after keas transformation, distillation and rib oiler, and cause of it is free acidic gas and high temperature that act as corrosion driving force.

IX. CONCOLUSION

Thermal Stable Amin Salts: Making thermal stable Amin salts in Amin salts that apply in Amin units is very important issue especially in refinery systems or place that oxygen is in unit feeding gas. Because this HSAS salts called thermal resistance, and not again produce in Amin unit striping section such as sulfides salts, carbonates B-Carbonate or carbamid. HASA salts are Oxalts, Estats, Ciyanibls, and Sulfats & Chlorides.

This sults reduce capacity of acidic gas carring of Amin solvent and increase solvent riscozite. As a result decrease managing costs of Amin unit. Investigations show that HSAS present increase Amin solvent corrosion.

In survey of firs phase we investigate density effect of 10 to 37% of weighting on solvent corrosion situation on carbon simple steel in different situation of temperature. Results show that density effect has considerable effect on corrosion rate and passio film on carbon simple steel. Carbonic simple steel corrosion Rate is minimum in 10% density but resulted film is unstable. Fission film is shaped unstable in 37% density and is stable in different temperature and even on collision.

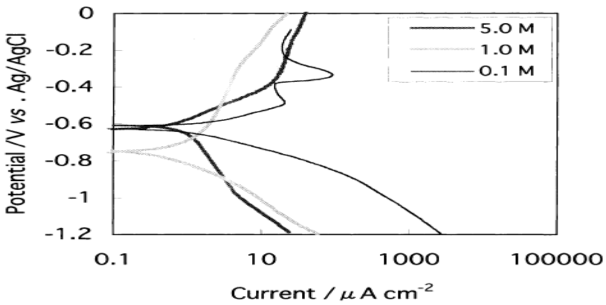

Figure (1): Simple Polarization Curve of Carbon Steel in MDEA Solution at 4.5 MPa Co_2 Gas in 100 ^{0}c

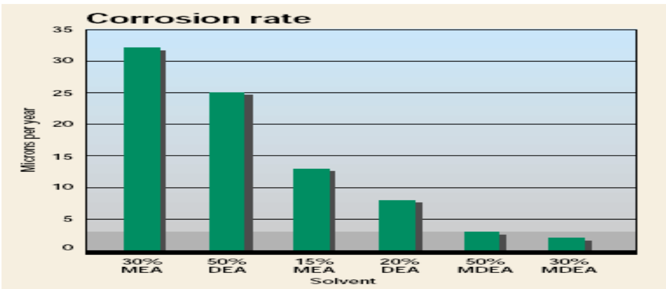

Figure (2): Plain Carbon Steel Corrosion Test Results After 7 Days of Immersion in a Solution of Amine at 210 ^{0}F

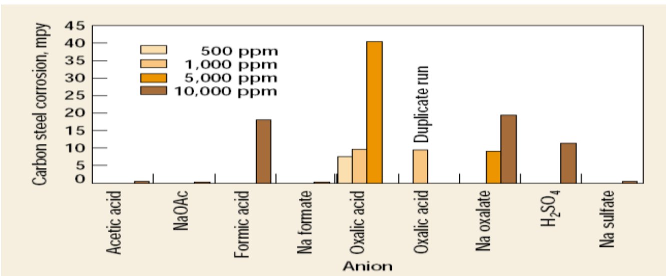

Figure (3): Various Anions on Corrosion at 180 ^{0}F of Carbon Steel Plain

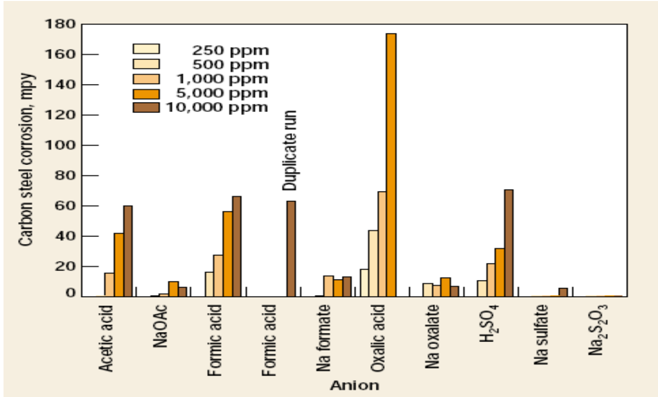

Figure (4): Various Anions on Corrosion at 180 ^{0}F of Carbon Steel Plain

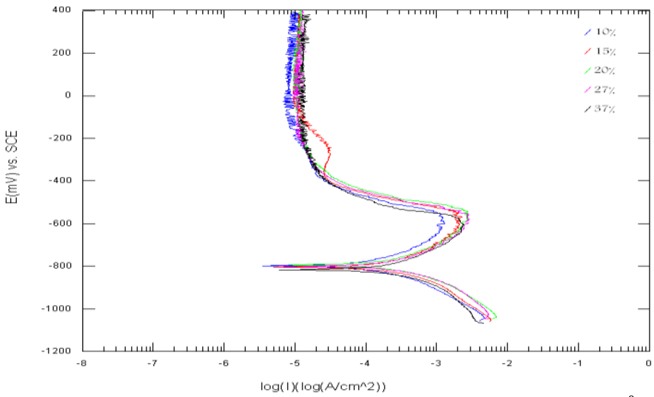

Figure (5): TOEFL Polarization Emerges from Plain Carbon Steel at 50 ^{0}c Laminar Flow

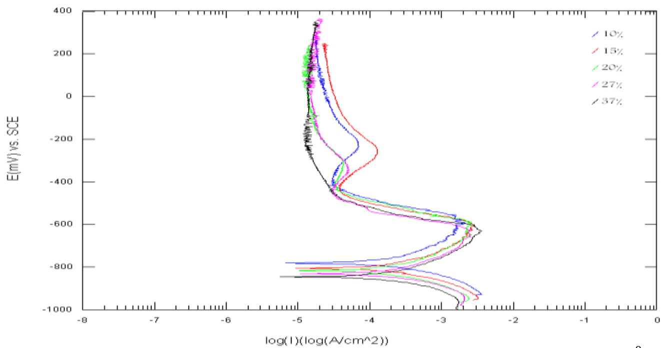

Figure (6): TOEFL Polarization Emerges from Plain Carbon Steel at 65 ^{0}c Laminar Flow

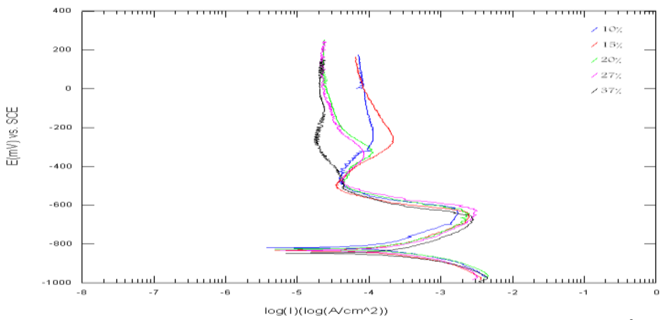

Figure (7): TOEFL Polarization Emerges from Plain Carbon Steel at 80 ^{0}c Laminar Flow

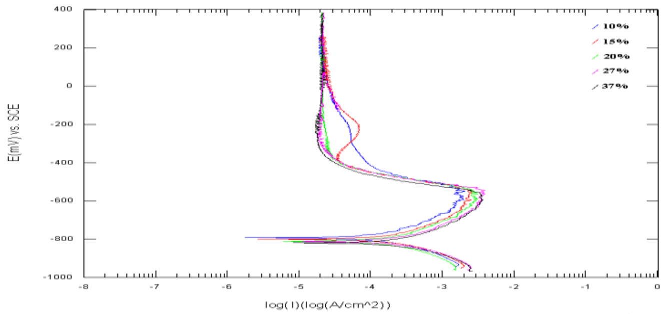

Figure (8): TOEFL Polarization Emerges from Plain Carbon Steel at 50 ^{0}c – Turbulent Flow

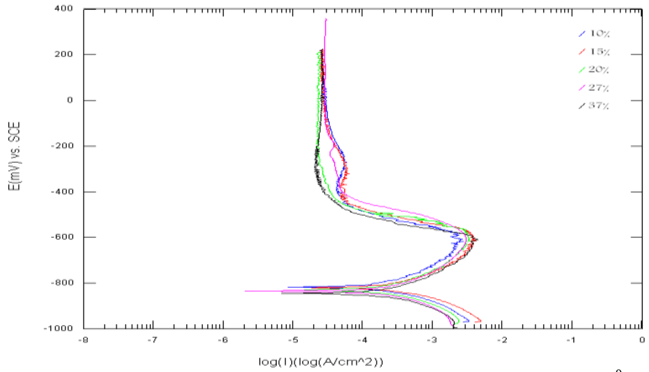

Figure (9): TOEFL Polarization Emerges from Plain Carbon Steel at 65 ^{0}c – Turbulent Flow

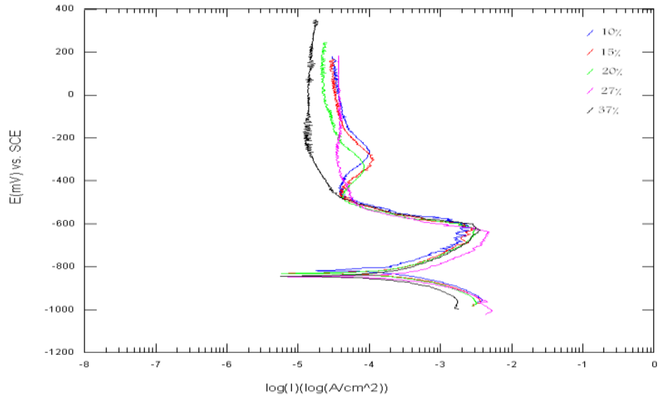

Figure (10): TOEFL Polarization Emerges from Plain Carbon Steel at 80 ^{0}c – Turbulent Flow

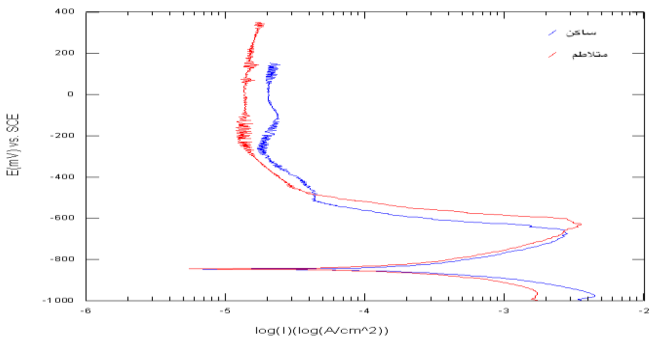

Figure (11): TOEFL Polarization Emerges from Plain Carbon Steel at Density 37 WT% in Turbulent and Laminar Flow

Table (1): The Values of the Corrosion Current Density and Corrosion Potential of Carbon Steel Plain-the Laminar

Temperature °C	**Density** (Wt %)	**i_{corr} ($\mu A/cm^2$)**	**E_{corr} (mV)**
۵۰	۱۰	۱۶۳/۹	-۸۰۰/۲
۵۰	۱۵	۴۲۱/۶	-۸۰۶/۵
۵۰	۲۰	۳۵۰/۷	-۷۹۵/۸
۵۰	۲۷	۴۶۳/۰	-۸۰۱/۵
۵۰	۳۷	۷۴۵/۷	-۸۱۸/۶
۶۵	۱۰	۲۱۱/۷	-۷۸۲/۶
۶۵	۱۵	۲۴۹/۱	-۸۰۶/۷
۶۵	۲۰	۲۳۲/۹	-۸۱۷/۰
۶۵	۲۷	۲۲۲/۱	-۸۳۲/۹
۶۵	۳۷	۲۵۰/۲	-۸۴۶/۵
۸۰	۱۰	۲۸۷/۸	-۸۱۹/۵
۸۰	۱۵	۱۶۲/۶	-۸۳۳/۷
۸۰	۲۰	۲۲۹/۴	-۸۲۷/۵
۸۰	۲۷	۲۵۴/۹	-۸۳۳/۴
۸۰	۳۷	۲۵۰/۶	-۸۴۸/۵

Table (2): The Values of the Corrosion Current Density and Corrosion Potential of Carbon Steel Plain-the Turbulence

Temperature °C	**Density** (Wt %)	**i_{corr} ($\mu A/cm^2$)**	**E_{corr} (mV)**
50	۱۰	۲۱۱/۶	-۷۹۴/۳
50	۱۵	۳۰۹/۵	-۸۰۱/۷
50	۲۰	۲۹۶/۰	-۸۱۲/۲
50	۲۷	۴۰۱/۴	-۸۴۵/۵
50	۳۷	۴۹۴/۵	-۸۲۰/۷
65	۱۰	۲۶۷/۴	-۸۱۸/۶
65	۱۵	۴۰۹/۳	-۸۲۰/۹
65	۲۰	۳۵۴/۵	-۸۳۰/۹
65	۲۷	۵۵۹/۰	-۸۳۶/۸
65	۳۷	۲۷۷/۱	-۸۴۴/۹
80	۱۰	۲۳۰/۹	-۸۲۰/۴
80	۱۵	۲۶۱/۲	-۸۳۲/۴
80	۲۰	۳۳۴/۳	-۸۳۱/۸
80	۲۷	۴۵۶/۲	-۸۴۸/۶
80	۳۷	۲۵۰/۲	-۸۴۶/۵

Corrosive test on simple carbon steel in α -MDEA conduct on collision and quiet situation in 10, 15, 20, 27 & 30% concentration and 80 ± 2 ℃, 65 ± 2, 50 ± 2 temperature. Samples preparing way before test is that at first they cut sheets about 1cm2 area and sheets become manet after attach to wire. Then sample surface prepare with emery 600 and clean with alcohol & after that during. This test conducted on corrosion standard sell with calomel reference electrode and under CO_2

gas for fuelling of solvent of CO_2. Solvent temperature control don by benmarry. Collusion in sell is by entering gas large bubbles to solvent by plastic tubes with 5cm diameter and 5 lit/min flows and produce CO_2 gas. This solvent is under CO_2 gas after reach to thermal balance and sample enter to solvents.

This sample maintained in solvent about 20 min for reach to balance. Toffel polarization tests conducted by 263 A model of EG&G potassium stat plant from 250 mV lower than open Axis amount to ½ V above open axis potentiall wit lmv/s scan Rate. After drawing E-log I curves referred to toffel graphs, these curves are evaluated by sof-core III software of document of Toffel Extrapolation technics. Until we abstain necessary information for evaluating corrosion Rate. All of alternative Empdanse drawing is in 260 mV direct potentiall and in -10 MHZ and 1200 MHZ Range and 5 mV voltages. Galvanic flow density between carbonic simple steel and dustproof steels in temperature & density different situation that measure flow density and drawing according to time.

REFERENCES

[1] Rice, W., "Hydrogen Production from Methane Hydrate with Sequestering of Carbon Dioxide", International Journal of Hydrogen Energy, 2006

[2] Samimi, Amir, Zarinabadi, Soroush, An Analysis of Polyethylene Coating Corrosion in Oil and Gas Pipelines, Journal of American science,U.S.A.,2011

[3] Zarinabadi, Soroush, Samimi, Amir, Scrutiny Water Penetration in Three-layer Polyethylene Coverage, Journal of American science, U.S.A., 2011

[4] Samimi, Amir, Zarinabadi, Soroush, "Reduction of greenhouse gases emission and effect on environment.", Australian journal of basic and applied science, 752-756, 2011

[5] Zarinabadi, Soroush, Samimi, Amir," Problems of hydrate formation in oil and gas pipes deal," Australian journal of basic and applied science, 2011

[6] Zarinabadi, Soroush, Samimi, Amir, Erfan Ziarifar, Mohammad Sadegh Marouf, Modeling and Simulation for Olefin Production in Amir Kabir Petrochemical, Proceedings of the World Congress on Engineering and Computer Science 2010 Vol II WCECS ,San Francisco, USA,2010

[7] Samimi, Amir, Zarinabadi, Soroush, Application Polyurethane as Coating in Oil and Gas Pipelines, International Journal of science and investigations, France, pp.43-45, 2012

[8] Samimi, Amir, Zarinabadi, Soroush, Samimi, Marzieh, Solar Energy Application on Environmental Protection, International Journal of science and investigations, France, pp.21-24, 2012

[9] Setoudeh, Mehrdad, Samimi, Amir, Zarinabadi, Soroush, Almasinia, Babak, Nazem, Esmaeil, Rezaei, Rohollah, hedayati, Abbas, Experimental Study of Factors Affecting Corrosion in Gas Wells Using Potantio Acetate and Galvan Acetate Tests, International Journal of science and investigations,pp.13-16,2012

[10] Samimi, Amir, Preventing Hydrate Formation in Gas Transporting Pipe Lines with Synthetic Inhibitors, International Journal of science and investigations, France, pp.48-50, 2012

[11] Samimi, Amir, Zarinabadi, Soroush, Setoudeh, Mehrdad, Safavian, Amir, Review Applications to Prevent Corrosion Reducing Gas Pipe Line, International Journal of Basic and Applied science, Indonesia, pp.423-428, 2012

[12] Samimi, Amir, Zarinabadi, Soroush, Setoudeh, Mehrdad, Safety and Inspection for Preventing Fouling in Oil Exchangers, International Journal of Basic and Applied science, Indonesia, pp.429-434, 2012

[13] Samimi, Amir, Zarinabadi, Soroush, The Comparison of Increasing Method for Petroleum Pits Output (Fluids Dynamic), International Journal of Basic and Applied science, Indonesia, pp.435-439, 2012

AMIR SAMIMI (*CORRESPONDING AUTHOR)*

(16/05/1983, Isfahan City, Isfahan Province, Iran)

Studied M.SC Chemical Engineering, Master at Islamic Azad University, The Member of IAENG, Have 2 Years Experience in Oil Refinery Company, Member of Young Research, and Have 14 Articles in the International Journal, Conference (U.S.A, France, Italy, Indonesia, India, Australia, Europe Chemical Engineering Conference) and More than 45 Articles in the National Journal, Conference in Iran