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Investigation Results of Properties of Stripe Coatings in Oil and Gas Pipelines

Amir Samimi
Young Researchers club, Central Tehran Branch, Islamic Azad University, Tehran, Iran
(amirsamimi1161@gmail.com)

Abstract- The studies have been done on the navy tube lines, land and the metal workforces that are related to the oil and gas industries, shows that in most cases, weld lines and edge of a sharp regions has been influencing on location of corrosion and eroding of effective thickness of coating film. So by initializing of coating separation is from the surface of tube and the other metal workforces, from the location of weld line and the edge of the other regions. Nowadays, experts of corrosion science and coating industries are trying to solve this problem by stripe coating. In this essay physical and mechanical properties of coating and tube surface as adherence on steel, traction strength, permeability, resistance on strike and etc is measured and compared for presence and absence of stripe coating according to valid standards. In addition, it being paid to scrutinize of his kind of coating, usage causes, how to apply and an offer in order to perform it in an oil and gas industries.

Keywords- *Oil and Gas Industries, Mechanical Properties of Coating, Corrosion*

I. INTRODUCTION

Stripe coat is a coating film of color which is applied before and after a full coating on the edge or weld lines of metal skeleton. This kind of coating is applied in order to create an appropriate structure and enough resistance against corrosion in these regions. Therefore SC has more protection for the edge of the coverage or weld line. It is applied before preparation of surface or before a full coating. Technical knowledge is relevant to community of protective coatings that has the following recommendations about SC {color usage, the shape of painted area and keeping of color of steels.

1. If SC has been determined for a project, it would have been before Primer or a complete coating in order to use for all corners, gaps, nails, screws, welds and sharp edges.
2. It should involve around the edges at least 2cm.
3. To prevent from peeling of Primer during the actions, it should reach to touch dry {it should be dry enough and non-sticky} and then use Primer {so this time should not be too long because it cause to regions without Primer become corrode.}
4. Maybe SC use once after Primer action, especially if much time is needed to dry.
5. SC is more effective on surfaces that are reduced of sharpness by grinding.

Most SC is used for all edges, vertebrates and the weld because liquid colors move and flow in these parts; this phenomenon is the result of tension of surface and contraction of color film during drying. If this event happens, the color film will become thinner at location or close of edges. When color destroys in the regions of vertebrates, screws and welds can lead to crisis. Because these factors cause the continuity of skeleton become destroy. Overall SC has 2important advantages: the first one cause to cover small defects and differences of surface such as: porosity of welds, the second one: If enough time gave to SC for drying, it would have prevented from flowing of last coating on the edges and causes more problem for them. Colors with high percentage of solid toward colors with low percentage of solid are less apt to be thin in the edge of the regions because overall, colors with high solid have more curing time and against Viscosity are higher and have less tension on the surface.

Frequently corrosion of environment clarifies that whether SC is necessary or not? Often SC is affordable in environments with high corrosion such as: inside the tanks, water storage tanks and chemical materials. In environments with low corrosion, by choosing suitable materials and also by strict quality of control without using SC, maybe it reaches to appropriate protection against corrosion. SC is not necessary for very weak corrosive environments which the moisture is very low in it. Wholly low solid colors with low viscidity, have more advantages toward SC because fast self-stabilizing colors do not remove of the edges like non natural base of Zinks with high solid degree and high Viscosity such as{epoxy adhesives }.

However SC is used for sharp regions and the edges which maybe have not suitable thickness for coating. We should remember that the first advantage of SC is reducing the thickness of coating. We can use SC for all the coating layers. Excess colors increase the residual tension of film of coating that leads to gap or become membranous. Operator of color and expert at first maybe choose the best method by quality of control. Overall quality requirement of SC is consisted of:

1. Filling defects and ups and downs regions on surface.
2. Make a suitable sticky surface for a complete coating.

3. Thickness should not make more than acceptable for the complete coating.

These two methods have quality cases like below:

1. coating with brush
2. coating with air spray

Coating with brush is used for little spaces that are consisting of weld edges, screws and vertebrates and spray for large areas. The methods of using should be prevented from high thickness that destroys the film.

Overall, from desirable characteristics of stripe coating we can hint to below cases:

In view of capability, high percentage of sticky on the various length of proliferation) this coating can tolerate each strike and dimensional changes. Very good resistance toward heat shocks to 110®C.It has resistance at immersed conditions at temperatures between 30®Cand 80®C.

In cases which coating has sudden injury, it can be easily flexible. Pollutions are not stick on this coating and can be easily clean. Very low permeability (stream 0/0018perm/cm) Existing this coating is increased on the surface of resistance against of transmission of electricity.(2mm thickness can be at dc flow with 15000 voltage)

Time of half-life of coating is 30years so that after this period mechanical and chemical properties reduce to half but it can service too. It possesses high chemical resistance toward corrosive chemical materials with (PH=1-13)

II. Corrosion Mechanism

Gases such as carbon dioxide or acetic acid and other short-chain aliphatic acids may be low or high production. The presence of these gases and acid corrosion control is making the complex problems for wells. Corrosion in oil and gas wells has electrochemical mechanism. When the system reaches a temperature below the dew point, moisture is converted to liquid and large droplets on the tube wall may occur. Water plays the role of electrolyte in the electrochemical reaction. The water itself is not corrosive, when acidic gases such as H2S and CO2 are dissolved in water, an acidic environment in the vicinity of the sets that severe corrosion of the steel. The corrosive gases other than oxygen, sometimes in oil wells to gas wells, but the problem are there is no oxygen. H_2S gas source can be found in the layers of sediment, oil and gas products of the reaction process or activity is bacteria. Further deterioration in gas wells due to localized corrosion occurs, the local corrosion under the insulation, the deposits or to be caused by bacteria and 10 to 100 times faster than the corrosion damage is uniform. Another type of corrosion is localized corrosion resulting from defects or FILC. The apparent deterioration in the situation is different. Presence of CO_2 as a needle shaped defects FILC or rupture occurs. CO_2 corrosion in gas wells can be divided into three temperature regions:

A) Temperature below 140 degrees Fahrenheit (C_{60}) does not protect the product and the level of corrosion caused by severe corrosion exists.

B) Above 300 degrees F (C 150), Mgntayt is formed and the environment unless the presence of large amounts of salt water, is slightly corrosive. Between 300-140 degrees Fahrenheit (C150 -60) has the ability to protect the metal carbonate product layer does not even need a deterrent. But in the presence of ions such as chloride or hydrogen sulfide, or the destructive effect of high velocity fluid layer may be destroyed. Circumstances of high-speed m / s 10 and turbulent fluid flow, creating a protective layer, it is unstable. Aykada Believes that the growth of iron carbonates ($FeCO_3$) crystals incomplete causes a small anodic area and the wounded are yellow corrosion, At temperatures above C_{100} product of pyrite (FeS_2) was created on the metal surface is quite stable in terms of thermodynamic, at lower temperatures the formation of this layer decreases and the corrosion rate increases. General corrosion in sour wells (includes gas H_2S) in the concentration of this gas, ppm 2000 and in the range pH 5 to 5 / 6 occurs.

III. Factors in the Corrosion of Gas Wells

Temperature: Effect of fluid temperature corrosion in oil and gas industry in similar chemical environments, Corrosion rate is increased at higher reaction temperature corrosion so often that every 20 degrees Fahrenheit
(C_{11}) increasing temperature, the corrosion rate is doubled.
Corrosion of steel in corrosive CO_2 gas in the vicinity there are three temperature diets:

A) Low temperature and non-protective iron carbonate C 60 and the corrosion rate is a function of CO_2 partial pressure.

B) Between temperature and C_{150}-C_{60} almost protective iron carbonate layer is formed and the corrosion rate reaches an acceptable value.

C) C_{150} is top layer is formed which completely cover and It is also resistant to high velocities and extreme turbulence and is only sensitive to chloride ions.

Pressure: High pressure gas wells in the gas solubility in liquid corrosive effects. Gas pressure can reach psi 12000. Partial pressure of corrosive gases is an important point. The amounts of corrosion of a well produced by CO_2 are as follows:

- Partial pressure of CO_2 is Less than 7 psi → non-corrosive environment.
- Partial pressure of CO_2 between 7-30 psi → corrosive environments.
- Partial pressure of CO_2 is 30 psi → highly corrosive environments.

IV. The Role of Fluid in the Corrosion

Experience shows that the wells have corrosion problems when Water cut in the total amount of fluid in them is more than 85 percent. Of course It has plenty of exceptions. Fluid emulsion of water in the fluid conductivity and efficiency as a conductor affects. Mode of the large amount of water wells (without emulsion) produce more corrosive than water wells with Less water cut and more emulsions . Many studies have been conducted to determine the corrosive fluid within the

well. Brad Bern 20 different wells of the contract and amounts of water and acidic gas CO_2 produced as the variables considered. He found that the amount of water is more productive; the amount of CO_2 is more soluble in the vicinity of the wall and creates more corrosion.

V. Fluid Velocity

Fluid velocity in the fluid regime and the regime's fundamental role in determining the type of fluid are corrosive and performance inhibitors. Experiments have shown that a diet supplemented fluid and field tests are equal, Mechanism and the corrosion rate was similar in both conditions. Regardless of diet, fluids, in order to evaluate the effect of corrosion rate in the temperature range considered three, The corrosion of CO_2 at low temperature has a range of corrosion depends on the hydrolysis rate of CO_2 And is independent of the speed . Range 20 to 60 ° C. The rate of corrosion is very little because the phase of the reaction is CO_2.

VI. The Experiments Have Been Done

All experiments have been done about quality of control in company of industries. Different physical and chemical experiments on Poly urethane coating have been done at presence and absence of SC. These experiments are consisted of measurement of electricity, permeability and separation of beam. Also resistance of coatings was in various environments. These experiments have been done according to international standards and the results of experiments are interpreted with these standards.

VII. Results and Discussion

In this part, the results are obtained from experiments.chart1 shows physical and mechanical results. The results are obtained in comparison with available standards shows that Poly urethane coating has favorable properties.

VIII. Conclusion

SC usage increases longevity of coating

This coating applies for prevention from color motion at the edge, and also reduces the thickness of dry film. Accuracy of preparation of surface and selection of suitable system of coating is very affordable.

SC should limit to 1 layer in order to prevent from excess thickness.

Suitable usage of SC is needed in order to prevent from defection on color film which itself causes other defects like premature corrosion.

In oil and gas industries, corrosion monitoring was carrying out with different methods. In our country, corrosion coupons are typically used. While the growth of technology, suggests use of the probe. Probes, especially the electrochemical probes have the faster and more accurately results. Also EIS probes can help to extract the details of local corrosion. It is not possible with other monitoring methods. In this paper, only the monitoring methods and electrochemical techniques were introduced. Details of each of the techniques, described in used sources.

Study of Reference list of the companies such as Socothern (Italy) and Corinth pipe work (Greece) and Jotun powder coating (UK), which is include pipe diameter, type of coverage and other data, indicate that mainly pipes are covered under 24 inches 3 layer polyethylene coating. In panel that recently was formed by experts of corrosion in Britain and America, and resulting is published in an article titled US & UK Industry discusses key challenges: in the Journal of Pipeline & gas journal monthly. John T Oshea former chairman of the British Institute of corrosion, after pose of status of gas network in Britain and its coverage in the high pressure line (164000 km) says: These lines are constantly developed for responsibility to the increased demand and new lines of high diameter are protected against corrosion by use of coatings with high integrity coating. Oshea in answer to the question of what kind of high integrity coating is this coating? Says:

Examples of these are fusion bonded epoxy and multi component liquid coating (polyurethane) and don't pointing to use of coating 3 layers polyethylene for coating of pipe diameter. Also in response to the question of what percentage of the 164,000 km of country's pipelines are 3 layer polyethylene coating? Says: very little amount of these lines have this coverage and currently used of cover in the middle pressure pipes with a diameter of 36 inches. He is noted about separated the 3 layer polyethylene coating in Britain lines: they have little experience about 3 layers cover in their country.

Tables 1: The results of physical and mechanical experiments

Column	experiment	Coating with absence of SC	Coating with presence of SC
1	Transmission of electricity ohm/m^2	$4*10^2$ To $4*10^{10}$	$4*10^{12}$ >
	Result	Good	Excellent
2	Permeability Gms. 24hr/$m10^2$	7/6-8$*10^2$	./262 ./0025
	U.S.Perms Result	Very Good	Excellent
3	(mm) tear of beam -1.5V,20-25®C	-	6
	3% NaCl 30 days -6.0V,20-25®C	13-21	-
	3%NaCl 30 days result	Weak	Very Good

A table 2 is shows the resistance of corrosion of using coatings in different corrosive environments. Also this chat states how to applying mentioned coatings that this kind of coating is whether suitable or not? As can be seen chart 2, Polyurethane has good resistance with 100% solid in most corrosive environments and use of this coating is recommended.

Tables 2: resistance to corrosion and how to apply in different environments

Column	experiment	Coating with absence of SC	Coating with presence of SC
1	Resistance to corrosion in temperature of room	Weak	Very good
2	50% average 10% weak	R	R
	acid	NR	R
	50%<dense	NR	R
3	10% weak base	R	R
	50%average	NR	R
	50%<dense	NR	R
4	salts	R	R
5	Solvents		
	1 alcohol	NR	NR
	Variety of Ketones	NR	NR
	Use as protective coating R-recommended NR-not recommended I-R – limited recommended	NO	YES

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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