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On The Possibility Of Corrosion-Resistant Materials Based Resin Gossypol And Phosphoric Acid

Dr. Sci. , Prof, **Jumaniyazov Maqsood Jabbievich**
dept. Chemical Engineering
Urgench State University
Urgench, Uzbekistan
e-mail: ximtex@rambler.ru
cand. tehn. sciences, **Kurambaev Sherzod Raimberganovich**
dept. Chemical Engineering
Urgench State University
Urgench, Uzbekistan
e-mail: texnologiya2011@rambler.ru
cand. tehn. sciences, **Radjabov Mansur Farhodovich**
dept. Chemical Engineering
Urgench State University, Urgench, Uzbekistan
e-mail: r-misha38@rambler.ru
lecturer, **Holmuratov Khalilla Sarievich**
dept. Chemical Engineering
Urgench State University, Urgench, Uzbekistan
e-mail: k_xalil@mail.ru
lecturer, **Ibragimov Nasiba Muminovna**
dept. Chemical Engineering
Urgench State University
Urgench, Uzbekistan
e-mail: bitum_2012@mail.ru

***Abstract*—The paper presents the results of research synthesis anticorrosion coatings based on gossypol resin and phosphoric acid. The data obtained confirmed by X-ray and IR spectroscopic analysis methods.**

Keywords—gossypol resin anticorrosive material, phosphoric acid, iron absorption bands corrosion products anticorrosive effect.

INTRODUCTION

Based on literature data [1,2] can be argued that the alleged reaction that will corrode the metal and its protection, are as follows:

I. Iron in an aqueous medium:

$Fe + nH_2O \rightleftarrows Fe(OH)$ dac (donor acceptor compounds) $+ H^+ + e^-$

$(FeOH)$ adc $\rightleftarrows FeOH^+ + e^-$

$FeOH + H^+ \rightleftarrows Fe^{2+} + H_2O$

$(FeOH)$ adc $+ H_2O \rightarrow [Fe(OH)_3]$ adc $+ H^+ + e^-$

$[Fe(OH)_2]$ adc $+ H^+ \rightleftarrows FeOH^+ + H_3O$

$Fe^{2+}\text{-}e \rightleftarrows Fe^{3+}$

Formed iron ions FeOH + and exchanging sodium ions of the sodium salts of fatty acids and resin composition gossypol soap stock can form salts of iron (Td - acceptor donor compound):

II. The formation of salts of fattu acids:

$R\text{-}COONa + FeOH^+ \rightarrow R\text{-}COOFeOH + Na^+$

$2R\text{-}COONa + Fe^{2+} \rightarrow (R\text{-}COO)_2Fe + 2Na^+$

$3R\text{-}COONa + Fe^{3+} \rightarrow (R\text{-}COO)_3Fe + 3Na^+$

Such compounds are water insoluble and have long radicals oleic, stearic and other acids. This enhances the barrier-type corrosion protection with simultaneous water repellent surface of the metal and prevents the infiltration of aggressive ions.

From the experimental data can be distinguished on the basis of compositions structure gossypol resin and phosphoric acid, give the shyest anticorrosive effect in different environments.

The process of forming a phosphate film of iron ions can be represented by the following reactions [3]:

III. The formation of salts of phosphoric acid:

$Fe^{2+} + 2H_2PO_4^- \rightarrow Fe(H_2PO_4)_2$

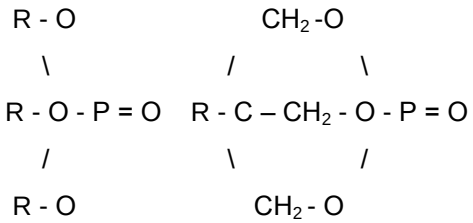
$Fe^{2+} + HPO_4^{2-} \rightarrow FeHPO_4$

$3Fe^{2+} + 2PO_4^{3-} \rightarrow Fe_3(PO_4)_2$

As the consumption of phosphoric acid increases pH, which leads to increased hydrolysis and dihydrogen phosphate in elevated content of di- and tri-substituted salts, while nonproliferation-soluble metal phosphate is formed on the film.

Organic derivatives of phosphoric acid, due to the presence of phosphorus donor atoms and oxygen are good complexing with metal ions. Suggested that the anion of an acid or salt will be guided around the phosphorus atom, thereby sposob-contributing stvuya greater polarization of the phosphoryl group and therefore up¬rochnyaya oxygen-hydrogen bond (metal). In turn, the strengthening of the bond of oxygen-hydrogen (metal) leads to a strong interaction with the anion fosforoila positive field [4].

Perhaps as a result of heat treatment gossipolovoy resin with phosphoric acid esters are formed, and various kinds of salts. Among them more stable and better complexing trisubstituted phosphoric acid esters and trialkyl phosphates:



It is known that carboxylic acid compounds having general-OH groups present in the resin composition gossipolovoy come into re-esterification between the stock and a phosphoric acid. The result is a material with a higher molecular weight than the original and which apparently contribute to the formation of the protective film.

Esters in the presence of alkali and acid hydrolysis (according to the transesterification reaction) to the starting components. We can assume that in saline and acidic environments by hydrolysis of esters of carboxylic acid gossipolovoy resin decreases the effectiveness of corrosion protection coatings investigated.

In order to establish features of conversion of rust, as well as the mechanism of action of coatings on the process we have studied the composition of corrosion products and its interaction with the coating on the basis of sexual Goss-resin sustained throughout the year in the US-urban atmospheric conditions [5].

It can be assumed that the processing rusty surface coated suspend corrosion and rust is modified in soluble compounds.

This conclusion is confirmed by the results of IR spectroscopic studies. The IR spectrum of rust (Fig. 1), the bands stretching and deformation vibrations of the hydroxyl groups at 3000-3100 cm^{-1} and 1010 cm^{-1}. Absorption band around 450 cm^{-1} can be attributed to vibrations of Fe-O.

In the IR spectrum of the sample treated coated Gossip-based resin lovoy absorption bands above are present. Along with these new bands appear at frequencies: 2900-2820; 1690; 1500; 1380 cm^{-1}. High-frequency band on a background of broad band (ν) ot-nositsya to the vibrations of C-H hydrocarbon radicals comprising the gossipolovoy resin.

Absorption bands in the 1690-1380 cm^{-1} are due to the absorption of carbonyl and carboxyl groups. Probably, carboxylic acids react with the corrosion products to form sparingly carboxylates of Fe (III), and other stable compounds.

Appears on its face was not observed peeling and blistering of the coating. It was only with black discoloration characteristic gossipolovoy resin to light brown Coated individual partial areas, which indicates the passage of a chemical process.

Thus, the data of X-ray and IR spectroscopic methods of analysis confirms the results of other physico-chemical studies and suggest that treatment with rusty surface coatings obtained modification promotes corrosion products sparingly stable compounds significantly inhibited the process of destruction of metal, as well as forms protective layer firmly bonded to the metal surface. With this anticorrosive coating based resins have properties gossipolovoy modifiers rust.

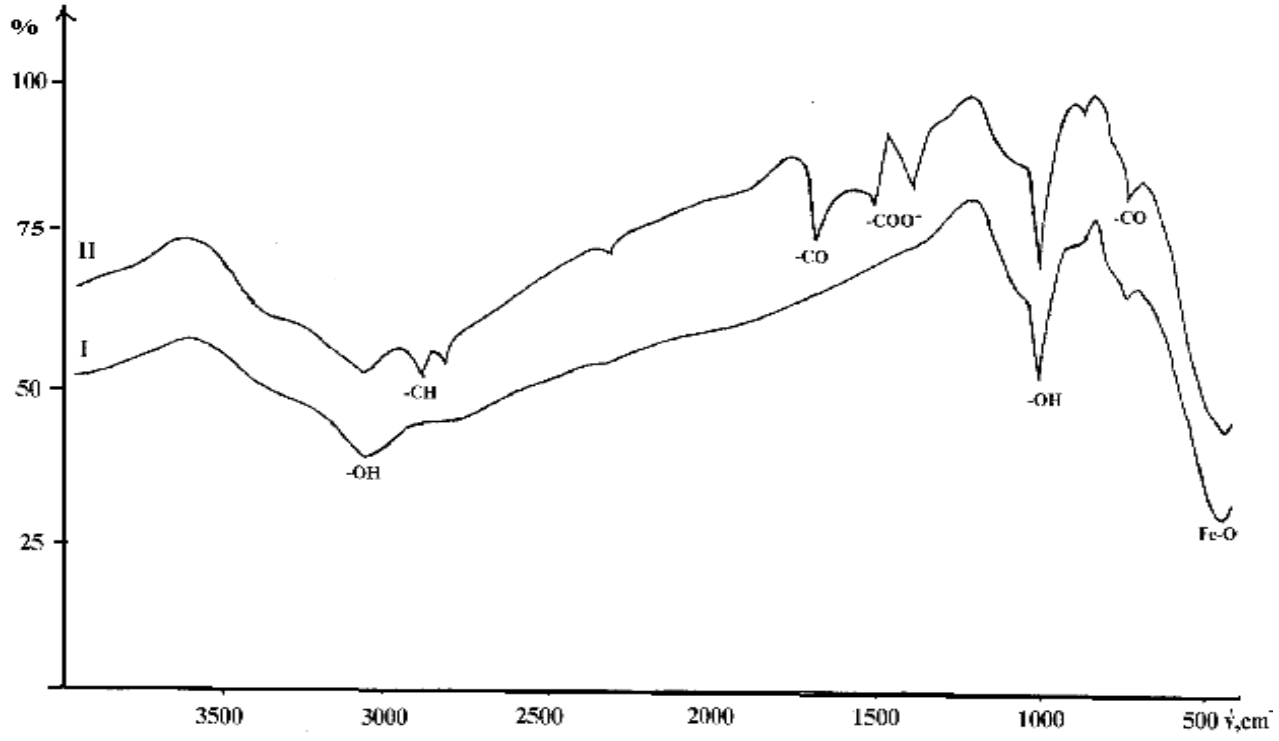


Fig. 1. The IR spectra of rust

Considering the results of the physical and mechanical properties (Table. 1) it can be argued that the resulting coating on the main indicators meet the requirements for corrosion-resistant coatings. For example, rapid drying time, impact resistance, elasticity at flexural, excellent adhesion, and also the possibility of applying these coatings by any paint material [6].

Table 1 Physical and mechanical properties of the coatings

№	indicator	coatings				
		1	2	3	4	5
1	Relative viscosity at 20,5 ± 0,5 (° C) of the viscometer VZ-4, sec	30-40	30-40	30-40	50-60	180-200
2	Mass fraction of solids,%	35-40	35-40	35-40	55-60	70-80
3	Drying time to degree 3, max at 20 ± 2 (° C) per hour at 100 ± 2 (° C) min.	24	24	24	24	24
		20	20	20	30	30
4	elasticity at bending the film, mm	1	1	1	1	1
5	film strength impact on unit U-1A, J.	5,0	5,0	5,0	5,2	5,0
6	Adhesion of the film, points, not exceeding	1	1	1	1	1

Evaluation of the protective properties of the coatings were determined by time-visa tially according vosmibalnoy scale GOST 6992 [7]. Coatings A-applied not rustu and b - the rusty metal surfaces general tol-ness of about 1.0 mm was determined and resistance to bath of distilled water and 3% sodium NaC1 (Table. 2). Weather resistance was measured in the atmosphere, which is considered moderately aggressive environment within two years.

Thus, all the coatings obtained have an average of 4-5 in water resistance up to 7 days, the resistance to NaC1 3% solution to 5 days prior to weathering and two years. In all cases, studies are less resistant coating on rusty surface. At the same time, it should be noted that the samples is tested in atmospheric conditions on rusty surface, eventually observed blyudalos partial enlightenment rust to bright metal and rust color change from red-burogo to light brown. Probably here is modified rust, that is formed metal salts of carboxylic acids, and other soluble compounds. Due to this the rusty surface pretreated with such coatings may be applied in any painting material. This is one of the basic properties modifiers rusty positive in comparison with other protective coatings.

Table 2 The stability of the protective properties of coatings time in points

№	indicator	timeday	coatings									
			1		2		3		4		5	
			а	б	а	б	а	б	а	б	а	б
1	durability coatings to static action water at T = 20 ± 2 ° C	3	8	7	8	7	8	7	8	8	8	8
		5	6	5	6	6	7	5	7	6	7	7
		7	5	4	5	5	5	4	5	5	7	6
		10	3	2	2	2	3	2	4	3	5	5
		14	1	1	1	1	1	1	2	1	4	3
2	Resistance to static action v / v solution at NaCl T 20 ± 2 ° C	1	8	8	8	7	8	8	8	8	8	8
		3	6	5	6	6	6	5	7	6	7	6
		5	4	3	3	3	3	3	5	4	6	5
		7	2	2	2	1	2	1	3	2	4	4
		10	1	1	1	1	1	1	2	1	3	3
3	Resistance to weathering in	182	7	5	7	6	7	7	7	7	8	7
		365	5	4	5	5	6	5	6	6	7	6
		547	3	2	3	3	4	3	5	4	6	5
		730	2	1	2	2	3	2	4	4	4	4

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