UDC: 622.24.062

WAYS AND POSSIBILITIES OF TAKING RUST CLEANING AND INHIBITING MEANS FOR THE CONSTRUCTIVE TYPE OF EQUIPMENT USED IN THE PRODUCTION PROCESS.

Jumaniyazov Maksud Jabbievich
Doctor of technical sciences, prof.,
Urgench State University
ximtex@rambler.ru

Sapaeva Surayyo Gofurjanovna
master's student,
Urgench State University
surayyo@urdu.uz

Annotasiya: mahalliy xomashyolar va sanoat chiqindilarlari asosida zangni tozalovchi vositalarning yangi avlodini olish bo‘yicha ilmiy-tadqiqot ishlari olib borildi. Eng yaxshi natijaga fosfat va limon kislotalari, $K_2Cr_2O_7$, $ZnSO_4$ tarkibga kiritish orqali erishildi. Yaratilgan optimal vositaning zangni tozalash samaradorligi yuqoriligi (97,7%) ilmiy asoslandi. Olingan tarkiblar IK-spektroskopik tahlillar qilindi.

Kalit so‘zlar: zanglash, ingibitor, metall, limon kislotasi, IK - spektroskopiya, himoya samaradorligi.

Аннотация. Проведены исследования по получению нового поколения средств для удаления ржавчины на основе местного сырья и промышленных отходов. Наилучший результат был достигнут при добавлении фосфатной и лимонной кислот, $K_2Cr_2O_7$, $ZnSO_4$. Научно обоснована высокая эффективность очистка ржавчины (97,7%) созданного оптимального состава. Полученные составы проанализированы методом ИК-спектроскопии.

Ключевые слова: Коррозия, ингибитор, металл, лимонная кислота, ИК-спектроскопия, эффективность защиты.

Annotation – Research has been conducted to obtain a new generation of rust cleaning products based on local raw materials and industrial waste. The best result was achieved with the addition of phosphate and citric acids, $K_2Cr_2O_7$, $ZnSO_4$. The high efficiency of rust removal of the created optimal content (97.7%) has been scientifically substantiated. The resulting compositions were analyzed by IR spectroscopy.

Keywords: corrosion**,** inhibitor, metal, citric acid, IR spectroscopy, protection efficiency.

Introduction. Improving the efficiency of reliable and long-term maintenance of all objects of metallurgical systems, enhancing their resistance to aggressive environmental effects has always been important tasks. It is known from world experience that metals often deteriorate before the service life, specified in the project. Moreover, the reliability and durability of these structures are determined only by the effectiveness of the applied protective equipment.

Even though today there is a lot of research on the prevention of metal corrosion in various sectors of the economy of industrialized countries, this issue remains one of the unsolved problems.

Numerous scientific studies have been carried out to create cleaning compositions from corrosion residues formed on the surface of steel samples. Most of them were synthesized based on phosphoric acid furfuryl alcohol, hydrolyzed lignin, and urotrapine [1-2]. The second side of the matter is that the concentration of phosphoric acid in the solution must be optimal for the formation of phosphate shells. In cases of high concentrations of phosphoric acid, in addition to rust removal, metal melting is also observed [3-4].

The effectiveness of cleaning a metal surface with phosphoric acid from atmospheric corrosion has been studied in many scientific studies. Protective layers of water-insoluble phosphates form mainly on metal surfaces. The protective characteristics of samples of carbon steel with a phosphate coating have been measured. The tests were carried out in the temperature range 20–75 ° C, the ratio of the sample area to the solution volume was 0.5–3.0 dm2 / dm3, and optimal compositions of phosphating solutions were developed, in which it was impossible to completely carry out the tests to immediately clean the rusted surfaces [5-7].

This article presents the results of research on taking a new generation of rust cleaners that quickly clean a rusty surface in various aggressive environments and are devoid of the listed disadvantages. Phosphate and citric acids, salts $K_2Cr_2O_7$, $ZnSO_4$ served as raw materials in this scientific work [8-10].

Initially, the effectiveness of rust removal was studied at various ratios of phosphate and citric acid. In initial studies, 2.0-5.0% citric acid was added to the composition and tested at 25 ° C for 24 hours on 50x50x5 mm stainless steel plates of various grades. The results of the study are presented in table 1 below.

The table shows that 96.09% efficiency was achieved by adding 2% citric acid to 20% phosphatic acid concentration and cleaning the surface in 25˚C however when phosphoric acid concentration increased to 25% by adding 5% citric acid the efficiency rose to 97.7%.

1-table

RESULTS OF STUDIES OF POSTPHATIC AND LITARIC ACIDS IN DIFFERENT RATIOS

№	H_3PO_4, %	$C_6H_8O_7$, %	Temperature, ˚C	Weight of metal under corrosion	Processing time, hours.	Metal surface mass after processing	Purification efficiency,%
1	20	2	25	3,00	24	2,59	96,09
		4	25	3,19	24	2,63	97,05
		5	25	2,91	24	1,98	97,2
2	25	2	25	2,98	24	2,39	96,5
		4	25	2,75	24	2,43	97,3
		5	25	2,61	24	1,75	97,7

To ensure that the resulting composition forms anti-corrosion coatings on the cleaned surface at the same time as washing rust, we have carried out tests by adding

potassium dichromate and zinc sulfate to this composition. The studies were carried out at room temperature (25 °C) for 24 h in a 3% NaCl solution. The results are shown in Table 2.

2-table

RESULTS OF DETERMINING THE MECHANISM OF INHIBITION BY THE INFLUENCE OF ZINC SULFATE IN THE CONTENT

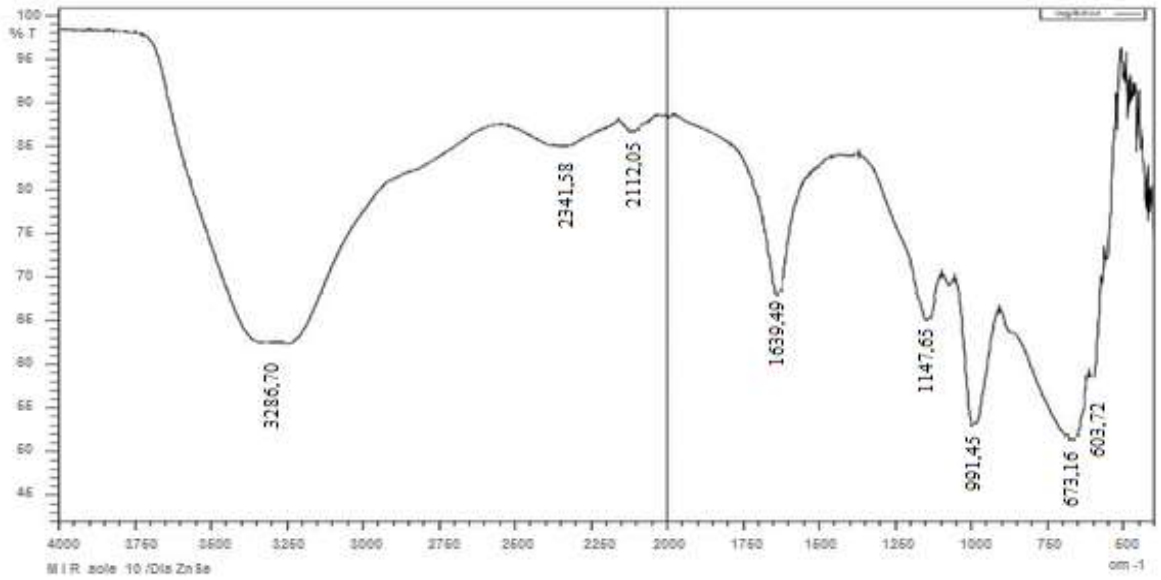
№	H_3PO_4, %	$C_6H_8O_7$, %	$K_2Cr_2O_7$, %	$ZnSO_4$, %	Weight of metal under corrosion, г	Metal mass after processing	Protection efficiency, %
1	20	2	1,0	-	3,46	3,49	93,32
		4	1,5	-	3,06	3,04	94,5
		5	2,0	-	3,17	3,16	95,0
2	20	2	-	1,0	3,25	3,28	90,4
		4	-	1,5	3,19	3,17	90,5
		5	-	2,0	3,39	3,35	91,3
3	20	2	1,0	1,0	2,14	2,11	96,3
		4	1,5	1,5	2,02	2,00	96,6
		5	2,0	2,0	2,37	2,33	96,8
4	25	2	1,0	-	2,19	2,17	94,03
		4	1,5	-	2,56	2,51	94,07
		5	2,0	-	2,63	2,59	95,06
5	25	2	-	1,0	2,29	2,13	91,2
		4	-	1,5	2,23	2,20	91,8
		5	-	2,0	2,42	2,37	92,6
6	25	2	1,0	1,0	2,81	2,54	95,8
		4	1,5	1,5	2,34	2,21	96,08
		5	2,0	2,0	2,20	2,09	96,3

According to the results of the above table, the greatest protective efficiency was observed in the composition of 20.0% phosphoric acid, 2.0% citric acid, 2.0% potassium dichromate, 2.0% zinc sulfate, that is, 96.8% of the achieved protective effect. Basing on the results of this study, it was determined that the optimal composition is a mixture of 20.0% phosphoric acid, 2.0% citric acid, 2.0% potassium dichromate, 2.0% zinc sulfate.

It is seen from studies that potassium bichromate and zinc sulfates, which are used in cleaning the surfaces with rust, enhance the anti-corrosion effect of washed surfaces. It should be noted that efficiency indicator was higher than when using each separately, there was synergy.

1- picture

IR analysis of inhibitor substance



The IR spectroscopic analysis of the obtained optimal content was carried out. The structure of their atomic electron shells, the structure of spectral lines, absorption bands, stretching and bending vibrations of atomic groups in the vibration spectrum have been determined. The results are shown in Picture 1.

3-table

IR SPECTROSCOPY RESULTS

Atomic groups	**Absorption in the vibrational spectrum of atomic groups arrangement of stripes *V, см-1***		**Composite formula**
	Valence of vibration	**Deformational viberations**	
SO_4^{2-}	603,72	599,86	$ZnSO_4$
PO_4^{3-}	1147,65	991,41	H_3PO_4
$Cr_2O_7^{2-}$	1111,51	-	$K_2Cr_2O_7$
C=O	673,16	-	$C_6H_8O_7$citric acid
-C-OH	3286,70	1639,49	$C_6H_8O_7$citric acid

According to the results of IR spectroscopic analysis, stretching vibrations of the SO_4^{2-} ion in the region of 603.72 cm^{-1} were observed, which is associated with the added substance $ZnSO_4$ to the inhibitor. The ionic group PO_4^{-3}, belonging to orthophosphate acid, is in the region of 1147.65 cm^{-1} and 991.41 cm^{-1}, the $Cr_2O_7^{2-}$ ion belonging to potassium dichromate is in the region of 1111.51 cm^{-1}, and the Atoms group is C = O, belonging to citric acid are 673.16 cm in the region of cm^{-1}, while the group of atoms -C-OH shows stretching and deformation vibrations in the regions of 3286.70 and 1639.49 cm^{-1}, respectively.

In conclusion, the main intensity peaks observed in the IR spectrum of the modifier material are in the region of 991.41 cm^{-1} in the PO_4^{-3} bond of the N3RO4 substance, in the region of 673.16 cm^{-1} in the C = O atomic group of citric acid and 3286 in the group -C-OH atoms. 70 and 1639.49 cm^{-1} correspond to stretching and deformation vibrations in the regions. This, in turn, indicates that phosphate and citric acid are the main constituents of the inhibitory substance and its predominance in the context of chemical action.

The physical and mechanical parameters of the instant rust and inhibitor removal were determined, the results are presented in the table below.

4-table

Physical and mechanical peculiarities of rust cleaners

Name of indicators	**Standart**
1.Appearence	A homogeneous fluid
2. Color	From light green to brown
3. Smell	No
4. Mass fraction of phosphoric acid, (at the expense of P_2O_5), %	20,0-22,0
5. Mass fraction of water, %	61,5-72,5
6. Mass fraction of citric acid, %	2-5
7. Mass fraction of potassium bichromate, %	1,0 – 2,0
8. Mass fraction of zinc sulfate, %	1,0 – 2,0
9. Concentration indicator of hydrogen ions (pH)	2,3-2,5
10. Crystallization temperature, not low, °C	-20,0
11. Solidity, kg/m^3	1180,00 – 1190,00
12.Emission, g/m^2, max	85,0
13. Strength of adhesion to metal in shear (adhesion), MPa, minimum	4,0
14. Impact resistance, n·m, min	1,9
15. Flexibility, mm, max	7,0
16. Electrolytic conductivity., Ω·cm^2, min	1 . 1010
17. Protective efficiency,%, min - from general corrosion - from sulfide corrosion under influence	 99,6 95,0
18. Complete duration, hours, max	12
19. Applicable climate range	Not limited
20. Resistence to atmospheric conditions	Durable
21. Resistance to variable temperatures	Durable
22. Expected lifespan, 6 mm thick, days, at least	1000,0
23. The duration of the full formation of the protective layer, hours, no more	12

Created means for cleaning from rust are intended for chemical cleaning and protection from corrosion residues of surfaces of various corrosion products and corroded metals. Under the action of this tool, an anti-corrosion coating of the metal surface is formed, which is resistant to prolonged exposure to hydrogen sulfide, acidic, alkaline, water-salt and other abrasive environments.

Conclusion

1.The optimal composition of a new type of anti-rust detergent based on phosphate and citric acid has been found. According to it, the purification efficiency of the composition of 20.0% phosphoric acid and 2.0% citric acid was 97.2%.

2.Studies have shown that when the components of the composition are used together, namely potassium dichromate and zinc sulfates, in comparison with the use of separate anticorrosive agents, their inhibitory power is several times higher, that is, the phenomenon of synergy is observed. It was found that the optimal composition is 20.0% phosphoric acid, 2.0% citric acid, 2.0% potassium dichromate, 2.0% zinc sulfate.

3. The rust-washing properties of this composition were tested in sulfuric acid, hydrochloric acid, salt water and ordinary water at a temperature of 10˚C for 24 hours on a 50x50x5 mm stainless steel plate and found to fully meet the requirements of GOST.

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