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Obtaining and testing results of PF-1 brand corrosion inhibitor obtained based on the processing of chlorinated organic waste used in the oil and gas industry

Khalilov Jamshid Akmal Ugli*[*1], Nurkulov Fayzulla Nurmuminovich [1], Djalilov Abdulahat Turapovich [1]

[1]Tashkent Research Institute of Chemical Technology, Department of Technology, Uzbekistan, jamshidxalilov885@gmail.com; fnurkulov82@gmail.com

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Keywords
Corrosion inhibitors
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Fatty acids
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Abstract

The article examines the physical and chemical properties of corrosion inhibitors obtained on the basis of the processing of organochlorine waste for the oil and gas industry. Corrosion inhibitors of metals were obtained as a result of the synthesis and their level of protection was checked. The results of IR and NMR spectra were studied.

Introduction

In the global production of corrosion inhibitors composed of organic compounds, hydrocarbon-soluble inhibitors account for about 30% of the volume, the largest part of which (~70%) is used in oil refining Corrosion of these metal-based materials has a large economic impact. According to a recent study by NACE, the total economic loss to the environment due to corrosion is USD 2.5 trillion, which is equivalent to 3.4% of world GDP. [1].

In most cases, the recommended inhibitors are organic compounds of various classes containing heteroatoms: nitrogen, sulfur, oxygen, and phosphorus. The effectiveness of the inhibitory effect of substances increases in the series of heteroatoms: O ^ N ^ S ^ P. However, since the toxicity of products also increases in this series, nitrogen-containing compounds are usually chosen for industrial use. Although it is less effective than compounds containing sulfur or phosphorus, they are a less toxic compound [2].

Corrosion inhibitors are chemicals that are injected into the well in various ways to protect the casing from internal corrosion caused by the produced fluid. It should be noted that some operators further protect parts of upstream structures after the wellhead by choosing the appropriate type and dosage of inhibitors injected into the wells.

The main metal rusting properties are:

$$2Fe + 2H_2O + O_2 \rightarrow 2Fe^{2+} + 4e + H_2O \rightarrow 2Fe(OH)_2 \quad (1)$$

$$2Fe(OH)_2 + H_2O + 1/2O_2 \rightarrow 2Fe(OH)_3 \quad (2)$$

$$Fe_2O_3 + 3H_2O \rightarrow 2Fe(OH)_3 \quad (3)$$

Material and Method

Our researched PF-1 brand corrosion inhibitor was tested by gravimetric method. This method is used to determine the corrosion rate for corrosion control purposes and to evaluate the protective ability of corrosion inhibitors. The gravimetric method is based on measuring the difference in the mass of control metal samples

before and after exposure to a corrosive environment. A limitation of the use of this method is that it characterizes the average corrosion rate without taking into account the unevenness of the corrosion.

In general, when working, it is necessary to follow the current standard GOST 9.506-87 "Methods for determining the protective ability of metal corrosion inhibitors in water-oil environment".

According to it, the product based on amino compounds and fatty acids obtained from the treatment of organochlorine waste is first put into a three-necked flask equipped with a reflux condenser, a thermometer and a stirrer for interaction, and a homogeneous mass is formed. mix until Stirring was continued at a certain temperature for several hours. The obtained corrosion inhibitor was dissolved in gasoline, condensate, and motor oil media at concentrations of 1%, 3%, and 5%. Many studies have been conducted on the resulting solutions.

The physico-chemical properties and analysis results of our PF-1 brand corrosion inhibitor with this synthesized new composition were studied.

Physico-chemical characteristics of PF-1 brand corrosion inhibitor obtained on the basis of chlorinated organic waste processing:

Table 1. Physico-chemical properties of PF-1 corrosion inhibitors obtained from chlorinated organic waste processing.

Indexes	PF-1
1. Appearance	Transparent
2. Color	Pale yellow.
3. Density at 20 ^{0}C, g/cm3	1...1,3
4. Nitrogen content, % by weight	7,0...9, 5
5.Ph environment at 20 ^{0}C	6,5-7
6. Level of protection against corrosion at a concentration of 150 mg/l	98,5
7. Solubility:	
- In gasoline	Complete
- In the condensate	Complete
- In the water	30% of weight gain
-In the case of I-20	Complete
8. Fluidity cCt at 20 ^{0}C	15

Results and Discussion

IR spectrum and analysis of PF-1 brand corrosion inhibitor. The IR-spectrum was presented to study the composition and structure of the PF-1 corrosion protection inhibitor that we synthesized and used in the test (Figure 3).

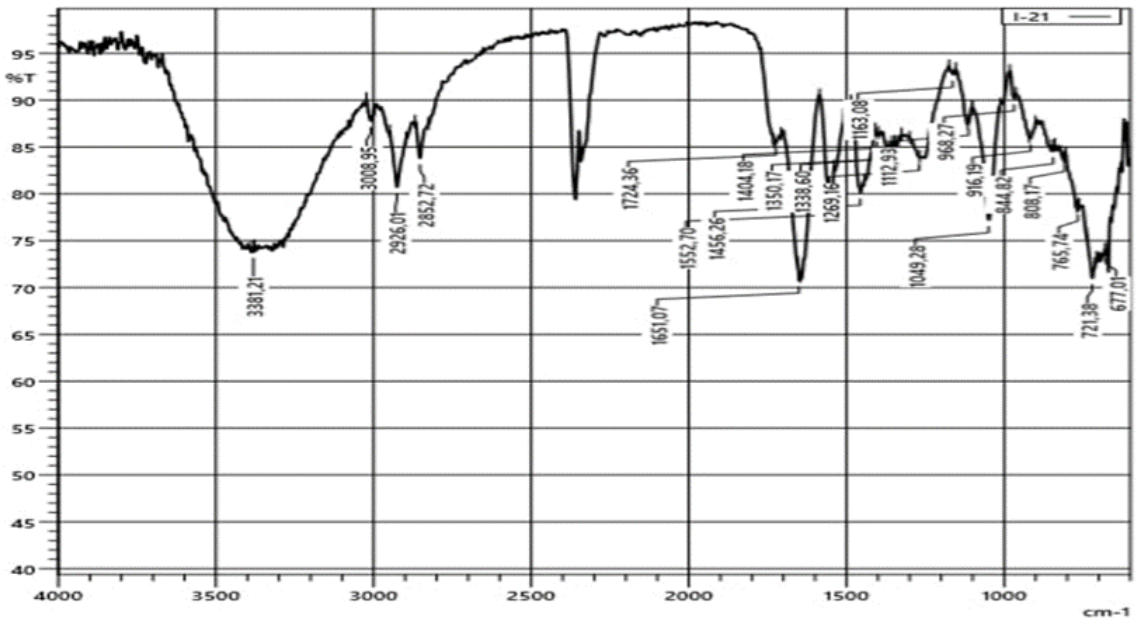

Figure 3. IR spectrum of PF-1 brand corrosion inhibitor.

The composition and structure of PF-1 corrosion inhibitor was studied using IR-spectrometer technology (IK-Fure, SHIMADZU, Japan) in the range up to 4000 cm-1. The spectrum of the –N=C< groups produces valence vibrations in the region of 1651.07 cm-1 and in addition 1552.7 cm-1 –NH2 in the structure. >N-CH2 in 1350.17 cm-1 and valence fields 844.82 – 808.17 cm-1 contain absorption lines corresponding to -CH2-CH2- groups in the aromatic ring.

According to the results of this analysis, our researched corrosion inhibitor contains nitrogen, which shows that it has anti-corrosion properties.

From this table, we can see that the highest level of corrosion protection of the metal surface was applied at a concentration of 6%.

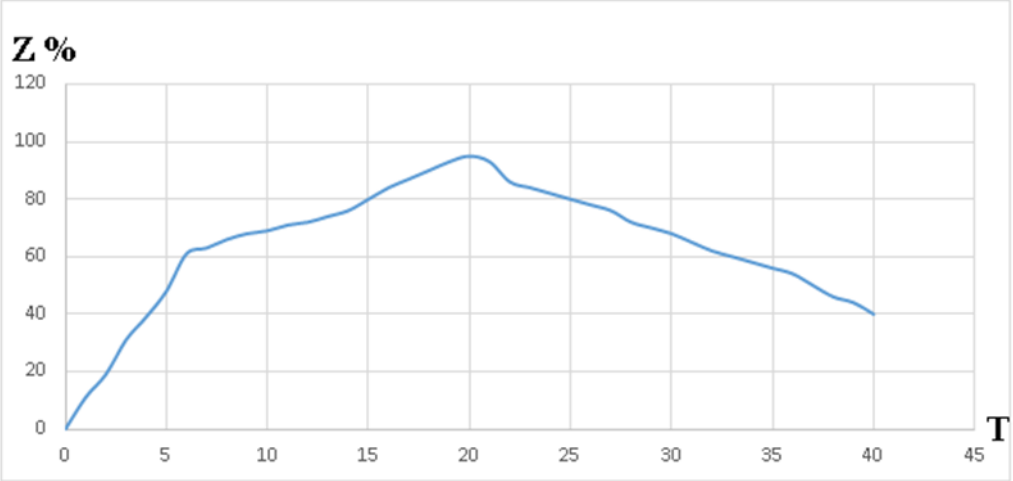

Figure 1. Protection level as a function of temperature.

Figure 1 shows the protection level of protection against corrosion at different temperatures. From this graph, we can see that the optimum temperature for our synthesized PF-1 corrosion inhibitor is 20 ^{0}C.

Table 2. Corrosion rates, protection levels and surface coverage coefficient values at different mass ratios of PF-1 brand corrosion inhibitor.

Mass ratios P:F	Corrosion rate	Protection level	θ
1:1	0,065	72,31	0,7231
1:2	0,08	89	0,89
1:3	0,071	78,98	0,7898
2:1	0,058	64,5	0,645
3:1	0,051	56,7	0,567

As a result of the test research, we can see with the help of table 1 that the best mass ratio of amine compounds and fatty acid is 1:2, and the level of protection in it is 89%.

Conclusion

The physicochemical properties of the PF-1 brand corrosion inhibitor synthesized by us and the analysis of the IR and NMR spectrum of the synthesized product were obtained. As a result of the analysis, it was found that this inhibitor contains nitrogen. These compounds have been found to be the most effective against corrosion.

Also, the obtained inhibitor was tested in different environments, at different mass ratios and temperatures. The PF-1 brand corrosion inhibitor, obtained as a result of the processing of organochlorine waste, containing nitrogen, was carried out in a condensate medium with a concentration of 1%, 3%, and 6%. As a result of the tests, the level of protection was 83.3, 90.6, 98.6 percent, respectively.

Our researched and tested PF-1 corrosion inhibitor can be used in various pipelines in the oil and gas industry in various aggressive environments.

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