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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

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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 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.

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.

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 1).
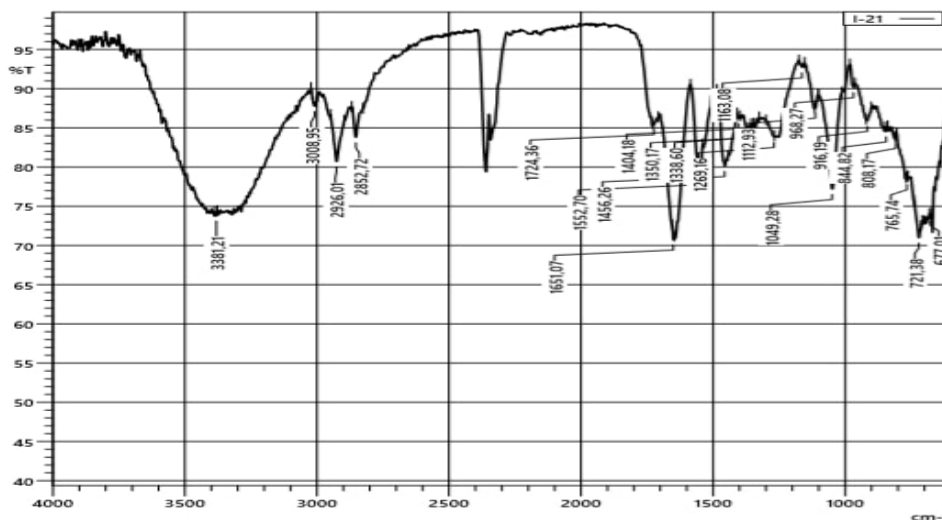

Figure 1. IR spectrum of PF-1 brand corrosion inhibitor

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.

Results and Discussion

Properties of nitrogen-containing oil-soluble corrosion inhibitors were studied by the test method according to GOST 9.506-87. The molecules of these corrosion inhibitors consist of one or more functional groups that are organic substances containing a hydrocarbon radical. Tests have been conducted

3 different concentrations for 72 hours in a test rig at atmospheric pressure. The test time is calculated from the moment the samples are placed in the environment. The duration of the tests was determined according to GOST 9.905 82. Tests were conducted in gasoline and condensate environments.

The concentration of PF-1 brand corrosion inhibitor containing nitrogen and phosphorus is 1% 3% 6%; ; It was carried out in a condensate environment. As a result of the tests, the level of protection was 81.1, 89, 98.5 percent, respectively. With the help of the graph below, the levels of protection of our corrosion inhibitor at different temperatures are presented.

The Table 1 shows corrosion rates and protection levels in inhibited and uninhibited environments.

Table 1. Test results of PF-1 brand corrosion inhibitor

Model number	Sample Surface S, m^2	Mass of the sample before the test M, g	Mass of the sample after the test M, g	Sample mass loss, M_1-M_2, g	Vn.i Corrosion rate in medium without inhibitor,g/ m^2*s	Vi Corrosion rate in an inhibitory medium, g/ m^2*s	Protection level (Z)%
1	2	3	4	5	6	7	8
Without an inhibitor	0,005	0,41243	0,38412	0,02831	0,07863	-	-
1%	0,005	0,40389	0,39853	0,00536	-	0,0148	81,1
3%	0,005	0,43408	0,4312	0,00288	-	0,08	89
6%	0,005	0,41933	0,4181	0,00123	-	0,00341	98,5

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 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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