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Electrochemical analysis of corrosion inhibitor synthesized using chlorine organomixture and ammonia

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Abstract

The article discusses the physicochemical properties of phosphorus-nitrogen-containing corrosion inhibitors for the oil and gas industry. As a result of the synthesis, corrosion inhibitors of metals were obtained and their level of protection was checked. CEM results were studied.

Introduction

Corrosion is the second leading cause of many industrial deaths. The causes of equipment failure in the oil and gas industry were evaluated from a 1993 survey (Ratnayake, 2012). Corrosion accounted for 60% of all maintenance costs for production platforms in North Sea oil and gas equipment (Steinsmo and Heggelung, 1993). One of the world's leading oil and gas companies announced in a 2003 survey that annual corrosion costs were $900 million (Thams and Al Zahrani, 2006). Another survey conducted in 2006 found that corrosion in the oil and gas industry in the United States cost up to $1.372 billion annually (Simmons, 2008). These data show that the economic consequences of corrosion in the oil and gas industry over the years are enormous. The global cost of corrosion in the oil and gas industry will increase further in the near future due to very high energy demand (Finsgar and Jackson, 2004) [1].

This review, based on our scientific and industrial experience, identified a clear gap in a comprehensive approach to consider wellbore corrosion processes throughout the life of oil and gas well tubing. In addition, with a new and comprehensive approach, we focused on the chemical effects of steel casing and tubing in a variety of environments, including completion fluid, acid and stimulation fluid, and production flow.

Phosphorus-nitrogen containing oil-soluble corrosion inhibitors are hydrophobic surfactants that fill the pores, increase inhibitor absorption by liquid hydrocarbons, and increase corrosion resistance [2].

Among the organic inhibitors, oil-soluble corrosion inhibitors of the acceptor type, which are amino acids and their derivatives, are widely used. These can be aliphatic, aromatic amines, amino acids, anilines, imidazolines, as well as five-membered, six-membered heterocycles containing nitrogen.

Corrosion of metals is one of the urgent technical and economic problems. The loss of metal equipment, products and structures due to corrosion is about 2-4% of the gross national product. In addition, in the petrochemical and chemical industry, as a result of the corrosion of equipment, toxic chemical products are released, and as a result, they pollute the atmosphere, water sources, and soil [3].

Material and Method

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. Properties

Properties	PF-1
1. Appearance	Transparent
2. Color	Pale yellow
3. Density at 20 0C, g/cm3	1...1,3
4. Nitrogen content, % by weight	7,0...9, 5
5. Ph environment at 20 0C	6,5-7
6. Corrosion protection level 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 0C	15

In order to study the inhibition efficiency of corrosion inhibitors, practical experiments were carried out in hermetically sealed containers with a capacity of 1000 ml. An electrochemical method was used to determine the inhibition efficiency, and the practical experiments were carried out for 2 hours.

The inhibition mechanism and effectiveness of corrosion inhibitors were also studied by measuring the polarization curve outputs in the CS-350 potentiostat. In this case, it is possible to determine the inhibition efficiency of the surface of the steel electrode from the difference between the potentials of the steel in the solution with and without the inhibitor. Current supplied to this process is also called corrosion current. We can see that the amount of corrosion current is significantly reduced as a result of the inhibition of the surface of the steel electrode in solutions containing a corrosion inhibitor.

According to it, the product formed by the interaction of chlorinated organic waste with ammonia was placed in a three-necked flask equipped with a reflux condenser, a thermometer and a stirrer, vegetable oil was added and a homogeneous mass was formed.

Results and Discussion

Electrochemical experiments were carried out on steel plate geometrical samples. A solution of Ag/AgCl was used as the standard electrode. In this the value of the corrosion current of the solution containing the corrosion inhibitor obtained on the basis of the treatment of organochlorine waste, which we investigated, was different depending on the type of inhibitor and the environment. This value decreased with increasing concentration of corrosion inhibitor.

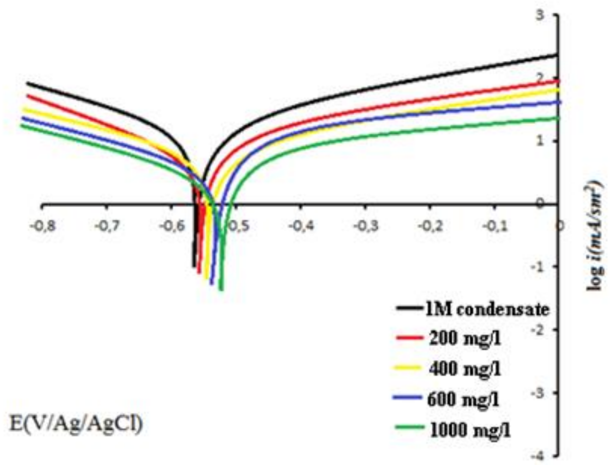


Figure 1. Polarization curves of PF-1 corrosion inhibitor at different concentrations in 1 M condensate medium for 2 hours at 298 ± 1 K for St3 grade steel.

As can be seen from Figure 2, the curves shifted towards the lower current density in the presence of inhibitors, which indicates that the inhibition efficiency of the corrosion inhibitor is higher in the condensate environment.

As the concentration of the inhibitor increases, the current density decreases on both the anode and cathode sides of the curves. However, the Tafel slopes and corrosion potential remained almost unchanged. Obviously, the PF-1 inhibitor works as a mixed type inhibitor, simultaneously reducing the dissolution of metal at the anode and the release of hydrogen at the cathode to the corrosion process. From this result, it can be seen that the inhibition efficiency is shown by blocking the metal surface of the adsorbed inhibitors.

As the concentration of PF-1 brand corrosion inhibitor in the solution increases, the electrical resistance of the solution also increases, as a result, the potential of the corrosion current value also decreases and the corrosion current value decreases to 0.095±0.01 i, (mA/cm2). When the concentration of PF-1 corrosion inhibitor was 1000 mg/l, its efficiency was 91.23% in a 1M condensate environment.

The electrochemical analysis of this PF-1 brand corrosion inhibitor in gasoline environment was studied and the potential curves were analyzed.

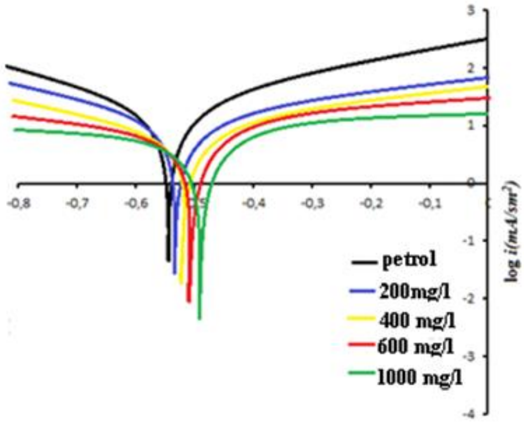
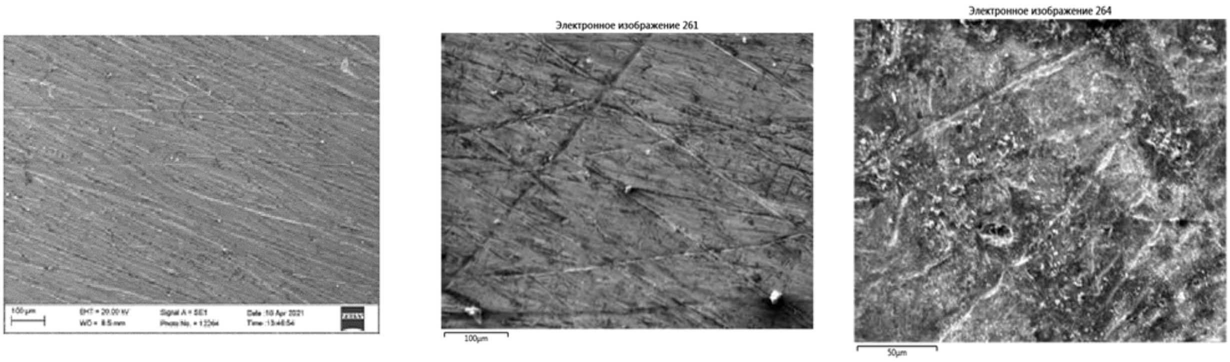


Figure 2. Polarization curves for steel grade St3 recorded for 2 hours at 298 ± 1 K at different concentrations of corrosion inhibitor PF-1.

In Figure 3, the corrosion current value of the solution with and without PF-1 corrosion inhibitor decreased from 0.98±0.11 i,(mA/cm2) to 0.08±0.001 i,(mA/cm2). PF-1 brand corrosion inhibitor showed 95.47% efficiency in gasoline environment.

This was investigated using SEM of the ST3 steel grade we used in the test.



(a) (b) (c)

Figure-3. SEM view of ST3 steel sample a) pure metal, b) inhibitory environment, c) non-inhibitory condensate environment.

In our research results obtained by scanning electron microscope, we can see that the PF-1 brand corrosion inhibitor we researched protects the metal surface from corrosion.

Conclusion

According to the electrochemical test results of this method, a series of tests from the low-concentration test program were conducted. The level of protection in the condensate environment at a concentration of 1000 mg/l was 91.23%, and the level of protection in the gasoline environment was 95.47%.

PF-1 brand corrosion inhibitors can be used in oil, gas, gas condensate wells, well drilling, oil and fatty acid production.

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