STUDY OF THE INHIBITING EFFICIENCY OF PKA-1 MALE CORROSION INHIBITOR IN HYDROGEN SULFIDE ENVIRONMENT

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ABSTRACT

The effectiveness of corrosion inhibitor PKA-1 based on polyethene polyamine and crotonaldehyde on St2 steel in systems containing H2S and water-salt phases was studied. This corrosion inhibitor was tested at different concentrations (200 mg/l, 400 mg/l, 600 mg/l, 800 mg/l and 1 g/l). PKA-1 brand corrosion at a concentration of 600mg/l, the level of protection against corrosion was 93.56%. SEM and elemental analysis methods of the obtained results were also studied.

Keywords: *polyethylenepolyamine, crotonaldehyde, corrosion inhibitor, hydrogen sulfide, gravimetric method, SEM, elemental analysis.*

ИССЛЕДОВАНИЕ ИНГИБИРУЮЩЕЙ ЭФФЕКТИВНОСТИ МУЖСКОГО ИНГИБИТОРА КОРРОЗИИ ПКА-1 В СЕРОВОДОРОДНОЙ СРЕДЕ

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АННОТАЦИЯ

Исследована эффективность ингибитора коррозии ПКА-1 на основе полиэтиленполиамина и кротонового альдегида на стали Ст2 в системах, содержащих H2S и водно-солевые фазы. Этот ингибитор коррозии испытывали при различных концентрациях (200 мг/л, 400 мг/л, 600 мг/л, 800 мг/л и 1 г/л). Коррозия марки ПКА-1 при концентрации 600мг/л, уровень

защиты от коррозии составил 93,56%. Также были изучены методы СЭМ и элементного анализа полученных результатов

Ключевые слова: *полиэтиленполиамин, кротоновый альдегид, ингибитор коррозии, сероводород, гравиметрический метод, СЭМ, элементный анализ.*

PKA-1 MARALI KORROZIYA INGIBITORINI VODOROD SULFIDLI MUHITDAGI INGIBIRLASH SAMARADORLIGINI O'RGANISH

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ANNOTATSIYA

Polietilenpoliamin va krotonaldegid asosida olingan PKA-1 markali korroziya ingibitorining H_2S hamda suv-tuz fazalarini o'z ichiga olgan sistemalarda St2 po'latni ingibirlash samaradorligini o'rganildi. Ushbu korroziya ingibitorining turli xil konsetratsiya(200 mg/l, 400mg/l, 600mg/l, 800 mg/l va 1 g/l)da sinovdan o'tkazildi. PKA-1 markali korroziya 600mg/l konsetratsiyada konsentratsiyasida korroziyadan himoyalanish darajasi 93.56 % ni tashkil qildi. Shuningdek olingan natiajlarning SEM va element analiz usullari o'rganildi va tahlil qilindi.

Kalit so'zlar: *polietilenpoliamin, krotonaldegid, korroziya ingibitor, vodorod sulfide, gravimetrik metod, SEM, element analiz.*

INTRODUCTION

Metal corrosion is produced by fluids of oil, gas, and gas condensate fields or in gas and oil transport pipelines is a serious problem faced in chemical plants, oil and gas producing facilities, and oil refineries. One of the most effective methods for corrosion control is inhibiting protection. The effectiveness of organic sulfur compounds as inhibitors of acid corrosion is well known [1–5].

In order to inhibit corrosion in corrosive media, in particular in water–salt systems containing hydrogen sulfide produced by sulfate_reducing bacteria, various nitrogen compounds exhibiting a high surface activity and the ability to form on a metal protective films resistant to the corrosive environment[5,6].

Most of the known organic inhibitors consist of heteroatomic compounds that retain the elements N, O, S, P and functional groups based on them, such as NH, NH_2,

C=O, OH, COOH, and CHO. The electrons in these heteroaomic compounds form a bond with the free d-orbitals of iron atoms on the steel surface based on the electron-donor-acceptor mechanism. As a result, it blocks the activity of the iron atom due to functional groups in the organic heteroatomic molecule and significantly reduces the degree of corrosion [7,9].

Polyfunctional pyridinium alkyl[poly(oxyethylene)] phosphites, isoquinoline alkyl[poly(oxyethylene)] phosphites, pyridinium aryl[poly(oxyethylene)] phosphites, and isoquinoline aryl[poly(oxyethylene)] phosphites by O. V. Ugryumov and his co-authors compounds and their properties are obtained. The absorption efficiency of the obtained compounds for the CO_2-H_2O-H_2S system was studied. The researchers found that among the obtained compounds, the highest inhibitory efficiency was given by their isoquinoline dodecyl- and dodecylphenyl[dodeca(oxyethylene)] phosphites. It was noted that the obtained isoquinolinium aryl [poly(oxyethylene)] phosphites were widely used in the synthesis of new types of corrosion inhibitors[10].

A number of researchers led by V. I. Latyuk, industrial I-40 and M-11 motor, containing compounds such as N-substituted 2,4-diamino-6-alkylthio- and 2-amino-4,6-dialkylthio-sym-triazone corrosion protection properties of oils were studied. Some of these compounds have been found to be more effective than industrial corrosion inhibitors. Penazoline has been shown to be more effective than a mixture of 1,2-substituted imidazolines obtained by condensation of C10-C16 synthetic fatty acids (SFA) with polyethylene polyamines[11].

MATERIALS AND METHODS

2.1. Sample preparation

Metall samples of steel (St. 20) with a size of 15x20x1.9 mm and a steel sample containing the following: Fe 97,755-97,215%, C 0,17-0,24%, Si 0,17-0,37%, Mn0,35-0,65%, Ni up to 0,3%, S up to 0,04%, P up to 0.035%, Cr up to 0.25%, Cu up to 0.3%, As up to 0.08%.

Prepared metal samples were washed several times in acetone and dried.

2.2. Determination of corrosion rate using gravimetric method

We determined the corrosion rate of the steel sample taken for the experiment over a period of 24 to 240 hours. To this end, experiments were performed to determine the corrosion rate of a steel electrode at different concentrations and known temperatures, and the experimentally related corrosion rate (K) and weight loss (X) in inhibitory and non-inhibitory solutions were determined. based on the gravimetric method.

$$K = \frac{(m_1 - m_2)\cdot 1000}{S\cdot \tau_1} [г/м^{-2}\cdot \text{a day}] \qquad (2.1),$$

$$X = \frac{К_{инг}}{К_0} \cdot 100, \quad Z=100 - X, \% \qquad (2.2),$$

Where: m_1 is the initial weight of the metal sample, g: m_2 is the subsequent weight of the metal sample at exposure, g: S is the surface area of the sample taken for practical experiments, m_2: τ_1 is the exposure time, hours, days.

RESULTS AND ITS DISCUSSION

3.1. Determining the effectiveness of the corrosion inhibitor using the gravimetric method.

Synthesized inhibitors (PKA-1) with respect to St20 steel in environments simulating formation waters in the presence of H_2S and CO_2 jointly and separately. H_2S (400 mg/l) was obtained directly in the working solution (corresponding amounts of HCl and Na_2S were introduced into the test medium), the concentration of which was controlled by iodometric titration.

Corrosion tests were carried out in sealed vessels with a capacity of 500 ml on samples of steel St20 with a size of 30×15×2 mm for 24 and 240 hours. The protective efficacy of the synthesized inhibitors (PKA-1) was calculated by the formula.

$$Z = \frac{K_0 - K}{K_0} \cdot 100$$

where K_0 and K are the corrosion rates in non-inhibited and inhibited solutions, respectively. The pH value in the background solution without additives is 3.5. The introduction of carbon dioxide (108 Pa) and 400 mg/l of hydrogen sulfide, together and separately, practically does not change the pH. In inhibited solutions, the pH is 6.5 and 5.2. In acidic media with H_2S additives and in the presence of CO2 and H2S together, the surface of the electrodes after daily tests is covered with a black deposit, which is easily removed with a rag, but during longer experiments, subsurface corrosion develops in addition. The introduction of synthesized inhibitors prevents the development of these types of corrosion.

The values of the corrosion rate in formation water and with the addition of CO_2 are close, and the introduction of H_2S (400 mg/L) + CO_2 (108 Pa) and H2S (400 mg/L) noticeably increases the aggressiveness of the medium (Table 1), which is consistent with previous studies.

Table 1

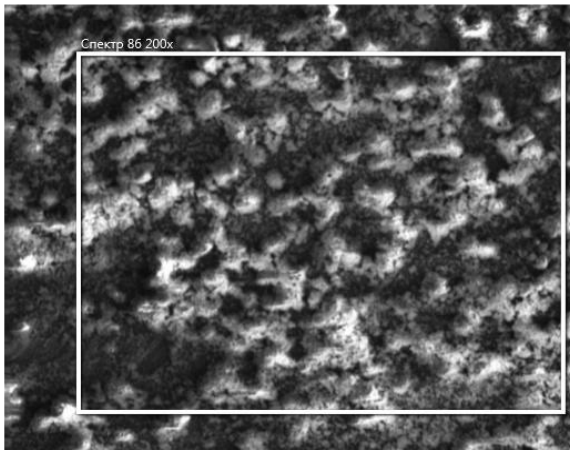
Corrosion rate K, g/(m^2·h), protective efficiency Z, %, oligomeric inhibitor PKA-1 (600 mg/l) in formation water (PV) in the absence and presence of CO_2 and H2S together and separately, St20 in inhibited solutions

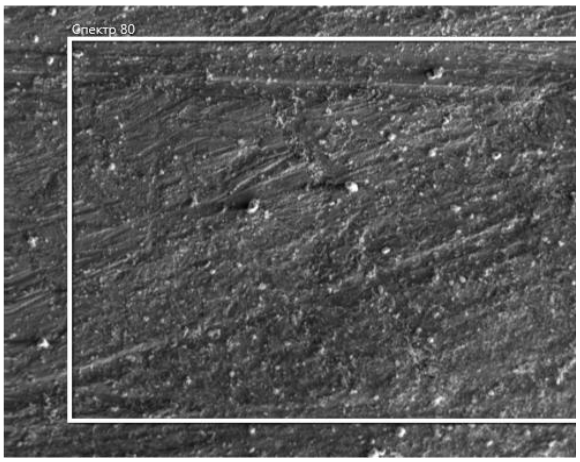
τ, ч	Indicators	Flow			
		Oil-field waters	OW + H_2S (400 mg/l)	OW + CO_2 (108 Па)	OW + H_2S (400 mg/l) + CO_2 (108 Па)
24	K_0	0,314	0,519	0,307	0,536
	K	0,027	0,067	0,032	0,072
	Z	91,4	87,1	89,57	86,5
240	K_0	0,119	0,234	0,116	0,237
	K	0,008	0,018	0,005	0,035
	Z	93,2	92,3	93,56	85,2

Table 1 shows that the protective effect of the corrosion inhibitor PKA-1 (600 mg/l) during daily tests in environments with H_2S and CO_2, H_2S together is not high, but slightly increases with increasing exposure time of the samples to τ = 240 hours.

3.2. Scanning electron microscope and element analysis

The inhibition efficiency of PKA-1 corrosion inhibitor in different concentrations for hydrogen sulfide environment was studied. After testing, SEM and elemental analyzes of metal samples were taken. In this case, we can see that the surface and element composition of the steel sample obtained from the solution with a concentration of 600 mg/l is better than that of the samples with the main concentration.





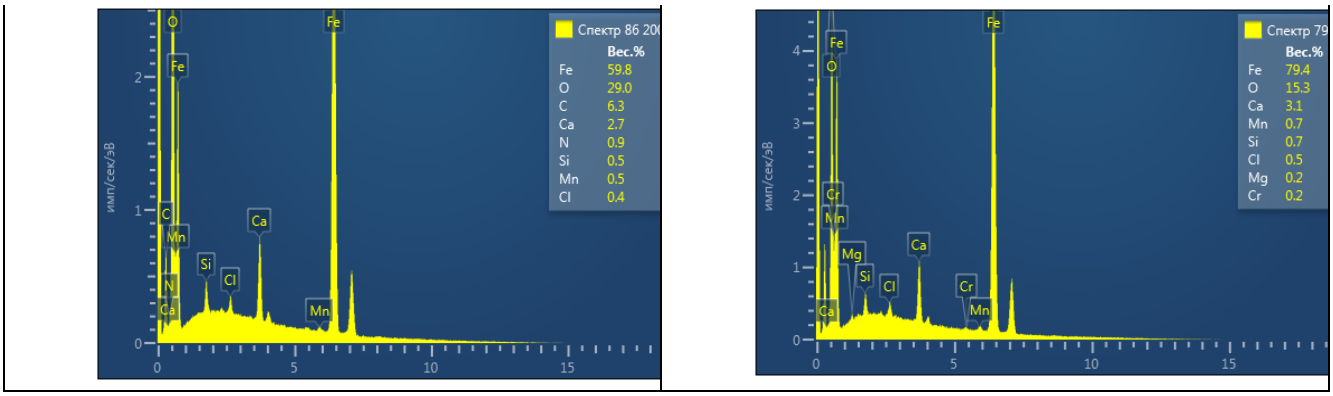


Figure 1. Corrosion level St20 for petroleum waters with OW + H_2S (400 mg/l) fig. 1a without inhibitor, fig. 2a with inhibitor

Figure 1a shows the SEM and elemental analysis obtained as a result of exposure to a corrosive environment for 240 hours without a corrosion inhibitor. Figure 1 b is obtained as a result of exposure to a corrosive environment in the presence of a PKA-1 brand corrosion inhibitor. It can be seen that no corrosion occurred on the surface due to the fact that the inhibitor adsorbs the metal surface and protects it from the external aggressive environment.

CONCLUSION

The inhibition efficiency of the PKA-1 brand corrosion inhibitor in oil water was 93.56%. Also, SEM and elemental analyzes of the samples obtained as a result of the test were carried out, and due to the high level of adsorption of this corrosion inhibitor on the steel surface, the surface of the metal almost did not decay, i.e., corrosion did not occur.

REFERENCES

1. E. M. Gutman and M. D. Getmanovskii, *Protection of Oilfield Gas Pipelines against Hydrogen Sulfide Corrosion* (Nedra, Moscow, 1988).
2. T. E. Shangarev, D. E. Bugai, O. A. Ptashko, et al., RU Patent No. 2168498 (2001).
3. T. E. Shangarev, O. A. Ptashko, S. A. Semenov, et al., RU Patent No. 2168499 (2001).
4. A. M. Magerramov, M. R. Bairamov, I. A. Aliev, et al., Russ. J. Appl. Chem. **82**, 1871 (2009).
5. Jia-Jun Fu., Su-ning Li., Ying Wang., Lin-Hua Cao, Lu-de Lu(2010). Computational and electrochemical studies of some amino acid compounds as

corrosion inhibitors for mild steel in hydrochloric acid solution. *Journal of Materials science*. 2V.45 N 22. P. 6255-6265. doi:10.1007/s10853-010-4720-0.

6. Shukla S.K., Singh A.K., Ahamad I., Quraishi M.A. Streptomycin: A commercially available drug as corrosion inhibitor for mild steel in hydrochloric acid solution. Material Letters. 2009. V. 63. N 9-10. P. 819-822. doi:10.1016/j.matlet.2009.01.020

7. Shukla S.K., Quraishi M.A(2009). Ceftriaxone: a novel corrosion inhibitor for mild steel in hydrochloric acid. *Journal of Applied Electrochemistry*. V.39. N 9. P. 1517-1523. doi:10.1007/s10800-009-9834-1

8. Quraishi M.A., Singh A., Singh V.K., Yadav D.K., Singh A.K(2010). Green approach to corrosion inhibition of mild steel in hydrochloric acid and sulphuric acid solutions by the extract of Murraya koenigii leaves. *Mater. Chem. Phys*. N 122. P. 114–122.

9. Fu S. Salsola ruthenic in treatment of essential hypertension. Zhonghua Nei Ke Za Zhi. 1959. N 7. P. 977-981.

10. Ostanov U.Y., Beknazarov K.S., Dzhalilov A.T(2011). Study by differential thermal analysis and thermogravimetric analysis of the heat stability of polyethylene stabilised with gossypol derivatives. *International Polymer Science and Technology*. N 38(9). P. 25–27. doi:10.1177/0307174X1504200406

11. Ugryumov O. V. et al. Corrosion inhibitors of the SNPKh brand. 2. The P,N-Containing corrosion inhibitor for protection of oil-field equipment // Prot. Met. 2007 431. Springer, 2007. Vol. 43, № 1. P. 87–94.