INVESTIGATION OF THE PHYSICO-CHEMICAL PROPERTIES OF INHIBITORS BASED ON ETHYLENE DIAMINE AND HYDROCHLORIC ACID

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Abstract. *During practical experiments, an EDF-1 brand corrosion inhibitor was obtain based on ethylene diamine and phosphorus. According to the IQ spectrum indicators of the corrosion inhibitor obtained in this research work, functional groups and chemical bonds were analyze. In addition, the application of the obtained corrosion inhibitor against salts formed in pipes was study.*

Keywords: *salt inhibitor, ethylene diamine, hydrochloric and phosphoric acid and nitrogenous medium protective effect.*

Introduction. The deposition of salts in heating systems through circulating water is consider a process of mass crystallization. In this process, under hydro and thermodynamic conditions, saturated solutions are form in the presence of water, components of oil, gas phase and mechanical impurities. One of the most effective ways to prevent the process of salt deposition in pipe systems is the use of inhibitors. Inhibitors designed to prevent the accumulation of mineral deposits of various compositions on the inner surface of circulating water heating equipment, maintain reservoir pressure and protect pipes and high-pressure equipment.

In the growing centers of the salt compound, adsorbed salt deposition inhibitors prevent the growth of the crystal and change its shape and size. It also prevents layers from sticking together and worsens the adhesion of the crystal to metal surfaces [1]. Currently, many inhibitors are being applied to salts. Sediment inhibitors of these salts significantly reduce salt deposition through sediment stabilization, combination, and crystal dispersion [2]. In the practical experiments of this study, an inhibitor against Salt deposition was obtained on the basis of ethylene diamine phosphates with hydrochloric acid, and its properties were studied.

Methods and materials. For the experiment, a tube equipped with a thermometer and a boiling refrigerator obtained. 10 ml of distilled water and 2.60 g/mole of ethylene diamine placed in the flask. The mixture was heated to a temperature of 60-70^{O}C and a weak solution of phosphatic acid in water with a mass of 8.1 g/mol was added. At the next stage of the reaction process, the temperature reached 110^{O}C, and for 24 hours 20 g /mole, formalin was add in a drip state. The mixture obtained as a result of the reaction was cooled to room temperature, neutralized in a 30% solution of sodium alkali and evaporated until a dry residue remained.

Compounds such as ethylene diamine phosphate, bicethylene diamine monohydrophosphate, and triethylene diamine phosphate are use to obtain their inhibitors against mineral salt deposition operating in mineralized environments. These chemical compounds are obtained in different proportions and their interaction is carried out at a temperature of 55-65ºC.

Results and discussion. In combination with ethylenediamine in the preparation of this inhibitor solution, phosphate and hydrochloric acids are obtained in different proportions. The preparation procedure is presented in the table below (table 1).

Table 1

Results of the preparation of mixed salt

o/n	Inhibitor	Molar ratio of substances that make up the inhibitor			
		Nitrogen-containing compound	Phosphate acid	Hydrochloric acid	Water
1	(Ethylene diamine + phosphate acid) + water	0,12	0,12	-	0,6
2	(Ethylene diamine dihydrogen phosphate + hydrochloric acid) + water	0,12	-	0,12	15,357
3	(Ethylene diamine + phosphate acid) + water	0,24	0,12	-	0,12
4	(Diethylenediamine monohydrophosphate + hydrochloric acid) + water	0,12		0,12	18,963
5	(Ethylene diamine + phosphate acid) + water	0,36	0,12	-	1,8
6	(Diethylenediamine phosphate + hydrochloric acid) + water	0,12	-	0,12	22,569

After that, the mixed composition of ethylene diamine with phosphate and hydrochloric acid cooled to normal conditions temperature and diluted with water until a 10% solution formed. To protect against this corrosion, an analysis of the IQ-spectrum indicators of the EDF-1 inhibitor, which is water-soluble and contains phosphorus and nitrogen, was carried out (fig. 1).

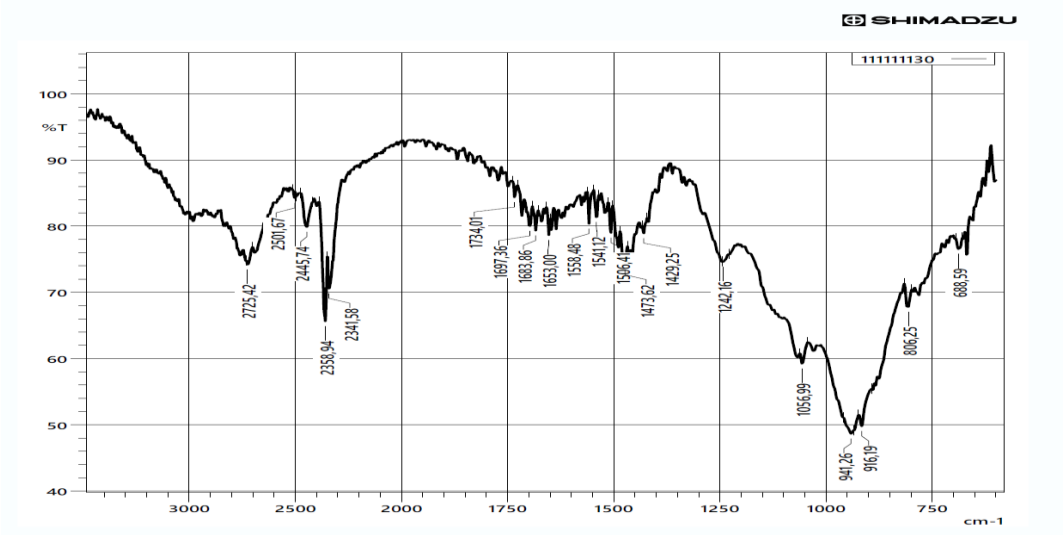

Figure 1. IR-spectrum indicators of the EDF-1 brand corrosion inhibitor.

In the course of experiments by IR spectroscopy (IRAffinity-1S (SHIMADZU)), chemical changes, functional groups and chemical bonds of the synthesized corrosion inhibitor. The IK spectroscopy of the synthesized inhibitor has analyzed. In the 941-916-cm^{-1} deformation

absorption lines of the IQ spectrum belongs to the $=CH_2$ functional group, 1056 cm^{-1} in intensive valence oscillations belonging to the -P-O-C - group, 1653-1558 cm^{-1} in medium intensity absorption lines-belonging to the NH_2 group as well as 2358-2341 cm^{-1} intermediate valence oscillation-found to have absorption lines belonging to group -C≡N (fig. 1).

In the reservoir model, a test-experiment carried out on the protective effectiveness of inhibitors prepared to prevent the accumulation of calcium carbonate and calcium sulfate salts. In the test-experiment conducted, structured water used according to the table below to model sediment formation (table 2).

Table 2

Calcium carbonate and calcium sulfate salts are available in water reserve

$CaCO_4$		$CaCO_3$	
$CaCl_2$	13,2 g/dm^3	$CaCl_2$	2,72 g/dm^3
$MgCl_2$-$6H_2O$	1,14 g/dm^3	$MgCl_2$-$6H_2O$	4,06 g/dm^3
NaCl	18,2 g/dm^3	NaCl	40,2 g/dm^3

In the test-experiment, "empty" samples with and without inhibitor after inhibitor transfer in a layer water model are stored in a thermostat at a temperature of 80°C for 5 hours. The sediment formed after cooling the samples was filtered. The residual content in the solution was determined by trilonometric titration of calcium cations. The effectiveness of the inhibitor was determined using the formula. Test-during experiments, indicators of the degree of protection of the inhibitor from Salt residues are presented in the table below (table 3).

According to this table, when comps are applied to sulfate and carbonate solutions with a flow rate of 25, 30, 35 mg/l, they show a high protective effect of more than 76%. The maximum level of protection was observed when 35 mg/l was introduced into the solution of sulfate and carbonate in the composition of the inhibitor. In such cases, according to the schedule, the indicator of the protective effect of the inhibitor exceeds 85%.

The process also obtained an EDF-1 corrosion inhibitor at a temperature of 55-65ºC, where the interaction of ethylenediamine and phosphates with 37% hydrochloric acid maintained an amine group in a nitrogenous environment and in the composition of reagents containing different molar ratios.

Table 3

Indicators of the level of protection of the inhibitor from salt residues

o/n	The composition of the inhibitor	Inhibitor	Inhibitor protection coefficient	
			$CaCO_4$-$2H_2O$	$CaCO_3$
1	Dihydrophosphate ethylene diamine ammoniochloride	25 30 35	76,4 78,1 83,7	78,2 79,3 84,4
2	Bisethylenediamine dichloride hydro phosphate	25 30 35	80,3 84,4 85,2	83,2 85,9 87,1

3	Phosphate ethylene diamine chloride	25 30 35	81,9 84,2 85,9	83,0 85,1 88,3

When the obtained inhibitors were applied with the introduction of 25, 30, 35 mg/l into sulfate and carbonate solutions, they were found to have a high effective effect of more than 81%. The maximum protective effect observed when a solution inhibitor of 35 mg/l applied (more than 85%).

Thus, the process of obtaining an inhibitor of the brand EDF-1, obtained during practical experiments, was research. Also, in the analysis of the IQ-spectrum indicators of this inhibitor, it founded that there are amine groups. In the tests carried out, the degree of corrosion protection of inhibitors that stored phosphorus and nitrogen was study. The experiment found scientific confirmation that the mineral salt inhibitor of the new composition obtained in the experiment has an effective protective quality.

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