STUDY OF THE INFLUENCE OF INHIBITORS ON THE CORROSION OF STEEL IN ECOLOGICALLY HARMFUL COOLING SOLUTIONS BASED ON LOCAL RAW MATERIALS

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ABSTRACT

The article provides information on sodium hexametaphosphate as an effective inhibitor of corrosion of carbon steel. The efficacy of sodium hexametaphosphate under various conditions and against other inhibitors has been determined experimentally.

Key words: solution, corrosion inhibitors, corrosion of carbon steel, calcium nitrate, Cylindrical specimens, concentration, filtration and evaporation, gravimetric method, alkali and alkaline earth metals, carbamide, sodium hexametaphosphate, calcium saccharate.

In our Republic with a hot climate, to preserve agricultural products, solutions of refrigerants are used in cooling systems. The most commonly used refrigerants are aqueous solutions of chlorides of alkali and alkaline earth metals. They are highly corrosive, and carbon steel refrigeration equipment undergoes intense corrosion to reduce the corrosion of steel in refrigeration solutions, corrosion inhibitors are widely used.

In salt solution systems with various anions, corrosion of carbon steel is most difficult to inhibit in solutions containing chloride ions than nitrate ions [1]. Moreover, the disposal of used chloride-containing solutions creates certain difficulties and the environment.

The paper presents the results of research on the search for corrosion inhibitors based on local raw materials and secondary resources, as well as their influence on the corrosion of carbon steel in solutions of calcium nitrate. The protective properties of inhibitors against corrosion were studied in 10, 15, 20, and 30% solutions of calcium nitrate. Cylindrical specimens made of steel “steel 20” were used as the test metal. The sample areas were 26.9 cm^2. The corrosion rate was determined by the gravimetric method.

We have studied the properties of a cooling solution based on calcium nitrate, methods for producing calcium nitrate, inhibition of a solution of calcium nitrate. Calcium nitrate can be obtained in several ways, for which there are huge reserves of raw materials in our country.

A solution of calcium nitrate was obtained by the action of marble, limestone or chalk powder on an aqueous solution of nitric acid until neutral, followed by filtration and evaporation of the resulting solution to a certain concentration.

As in most saline solutions with a neural medium, the corrosion of steel 20 in calcium nitrate solutions decreases with increasing concentration, which is explained by a decrease in the concentration of dissolved oxygen (Table 1). Moreover, the corrosion rate of steel 20 in calcium nitrate solutions is much lower than in chloride solutions [2].

Table 1. Influence of the concentration of calcium nitrate on the corrosion of steel 20 (t-room, test time 7 days).

№	Solution concentration	Corrosion rate, g / m^2 day
1	$Ca(NO_3)_2$ 40% the masses	0.250
2	$Ca(NO_3)_2$ 30% the masses	0.436
3	$Ca(NO_3)_2$ 20% the masses	0.985
4	$Ca(NO_3)_2$ 10% the masses	1.124

In the presence of sodium hexametaphosphate (SHMP) and calcium saccharate to a concentration of 0.7% of the mass. The corrosion process depends on the presence of chlorine ions (0.001 mol / l) in a solution of calcium nitrate. A small content of chlorine ions practically does not slow down corrosion within the concentration of additives 0.01-0.5% of the mass. At these concentrations and calcium saccharate, the pH of the solution increases from neutral to 8-10, and in the presence of SHMP decreases to 4.

In the absence of chloride ions, protection with the addition of SHMP is achieved even at a concentration of 0.05 wt%. At a concentration of SHMP and calcium saccharate of 0.5% by weight and higher, a high protection effect is achieved; corrosion of steel 20 is insignificant even in a 30% solution of calcium nitrate and during long-term testing (Table 2).

Table 2. The effect of additives on the corrosion of steel 20 in a 30% solution of calcium nitrate (t-room, test time-60 days).

№	Additives	pH solution	Corrosion rate, g / m^2	Protective action,%
1	No additive	7,0	0,360	-
2	Na_2SiO_3 0,5% the masses	10	0,167	53,6
3	$NaNO_2$ 0,5% the masses	7,0	0,084	76,6
4	Carbamide 1% + $NaNO_2$ 0,5% the masses	7,0	0,042	88,3
5	Carbamide 1% + Na_2SiO_3 0,5% the masses	9,0	0,251	30,5
6	SHMP 0,7% the masses	5,0	0,036	90,0
7	calcium saccharate 0,7% the masses	10,5	0,036	90,0

As can be seen from Table 2, for neutral media in solutions of calcium nitrate, other inhibitors are not very effective than SHMP.

In a 30% solution with the addition of 0.7-1.0% by weight of calcium saccharate, the solution becomes cloudy and over time a small amount of white precipitate falls out. Solutions with the addition of varying amounts of SHMP are transparent.

Thus, corrosion of steel 20 in a solution of calcium nitrate is easily inhibited and this solution can be successfully used as a cooling solution down to minus 290C [3]. In this case, the used solution, if necessary, can be consumed as fertilizer.

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