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## The effect of fluorine-containing inhibitors of corrosion of copper in atmospheric conditions

The effect of fluorine-containing inhibitors of corrosion of copper in atmospheric conditions was studied by method of removing anodic polarization curves and corrosion of full-scale tests. The introduction of the inhibiting compositions as corrosion inhibitor of copper polyfluorinated amines leads to a decrease of the peak current of active dissolution of copper, which increases the corrosion resistance of copper wire rod during transportation in various climate conditions.

**Key words:** polarization curves, polyfluorinated amines, copper wire rods, corrosion inhibitor.

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### Introduction

The various amines are the effective corrosion inhibitors of copper in aggressive media. The inhibitory effect of some derivatives of triazole is caused by their adsorption and formation of the in-

soluble complex of copper on the copper surface [1, 2]. Therefore, the use of amines in the composition of the inhibiting composition can provide the protection from corrosion of copper rod for transportation.

### Experimental part

The paper studies the anodic behavior of copper deposited on its surface preservative coating the inhibitory composition, containing polyfluorinated amine – amine polyferrocenylsilane:  $\text{HCF}_2\text{-CF}_2\text{-CF}_2\text{-CF}_2\text{-O-CH}_2\text{-CH}_2\text{-NH}_2$ , which was synthesized at the Department of technology of organic synthesis, Chemical technology Institute, Urals Federal University.

For accelerated evaluation of the protective action of inhibiting compositions and optimization of the composition of the preservative coating was used the method of removing anodic polarization curves. The polarization curves were recorded on a potentiostat-galvanostat IPC-PRO in potentiometric mode at a linear scan rate of potential of 2 mV/s in a three-electrode glass cell with sepa-

rated anode and cathode spaces in 0.5 M NaCl solution at 25 °C. The silver chloride electrode was served as the reference electrode in a saturated solution of potassium chloride. The potentials were calculated on present n.v.sh. The platinum sheet was served as the auxiliary electrode.

As object of study was used copper brand M00k (99.99 % pure) for the manufacture of copper wire rod. To remove the polarization curves were used cylindrical rods of copper by diameter 8 mm with a

## Results and discussion

The studies have shown that in the absence of inhibiting on the metal surface films anodic polarization curve for copper has the form characteristic of soluble active metal, followed by passivation. When potentials are of about 0.18-0.19 changing to the passive state starts in copper electrode starts.

The polarization curves for copper, pre-treated in solutions of isopropanol with different content of polyfluorinated amine (PFA) are presented in the below figure.

As can be seen from Fig. when applied to a metal surface of the copper protective film from solutions containing the PFA, there was a significant decrease of peak current of active dissolution of copper on the polarization curve, indicating a slowing of the rate of anodic dissolution of copper and the inhibition of anodic reaction. From these data it follows that the magnitude of the limiting current of anodic dissolution of copper depends on the concentration of the PFA. The maximum anodic current density observed on polarization curves decreases with increasing concentrations of PFA and reaches a minimum value of 3.32 % solution of inhibit-

total working area of 4 cm<sup>2</sup>. The field corrosion tests were conducted on samples of copper rod of length 150 mm and diameter 8 mm in the salt spray chamber Ascott 120 Plus.

The protective constitutions of inhibiting compositions were applied on a degreased with acetone, the working surface of the copper electrodes by dipping them in the solutions of inhibiting compositions for 15 seconds.

ing compositions on the basis of the PFA, which may indicate the increased corrosion resistance of copper is inhibited.

However, only the character of the polarization curves does not allow us to judge the influence of inhibitor on the corrosion resistance of copper in atmospheric conditions. So in addition to the electrochemical measurements were conducted in situ corrosion testing of samples of copper wire rod in the salt spray chamber Ascott 120 Plus.

The results of electrochemical measurements are consistent with the data

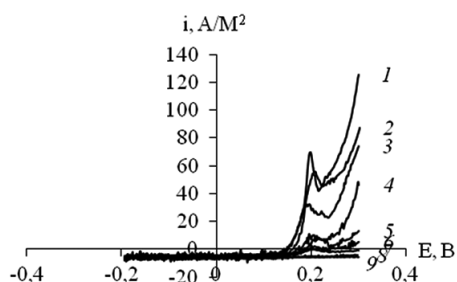


Fig. The polarization curves for copper, inhibiting composition treated with different concentration of PFA in isopropanol, 0.5 M sodium chloride solution: 1 – pure copper; 2 – 0% the PFA; 3 – 0,25 % PFA; 4 – 0,5% and the PFA; 5 – 0,75 % PFA; 6 – 1 % PFA; 7 – 1,25% of the PFA; 8 – 1,66 % PFA; 9 – 3,32 % PFA

of corrosion tests. The corrosion tests showed that pockets of corrosion on the copper samples without inhibiting compositions and treated with clean isopropanol appear already in the first days of exposure of samples in the chamber. At the same time on the samples treated in an anhydrous solution of inhibiting compositions on the basis of the PFA, corrosion lesions appear in 2-4 days depending on the concentration of the PFA. Of in-

vestigated compounds inhibiting compositions the best results (up to 4 days) were achieved for 3,32 % solution of inhibiting compositions on the basis of the PFA.

Thus, when used in inhibiting compositions as corrosion inhibitor of copper polyfluorinated amines can increase the corrosion resistance of copper wire rod during transportation in extreme conditions.

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