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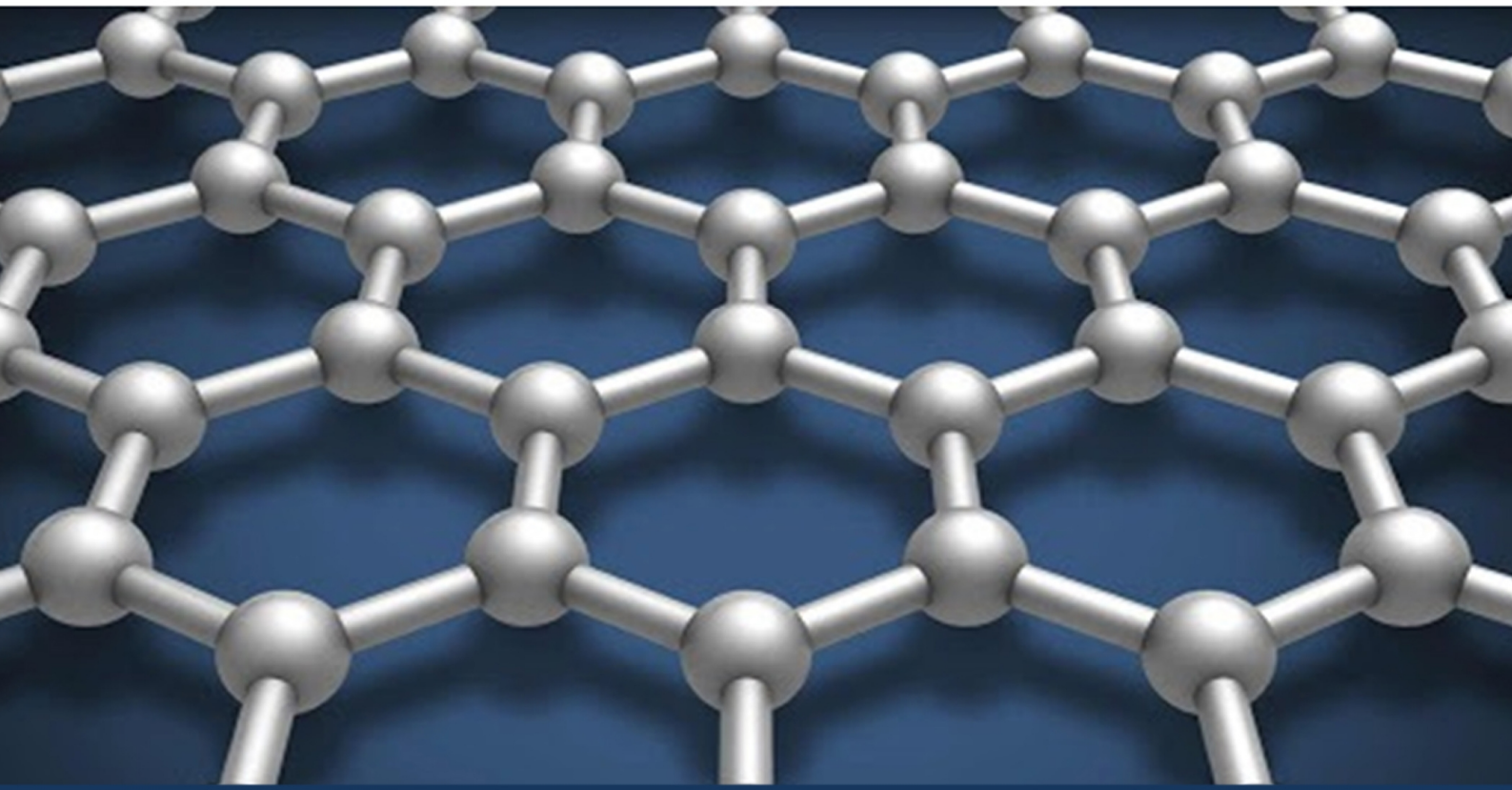

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SYNTHESIS AND INVESTIGATION OF CHARACTERISTICS OF CORROSION INHIBITOR IKMM-1 ST20 STEEL IN 1 M HCl SOLUTION

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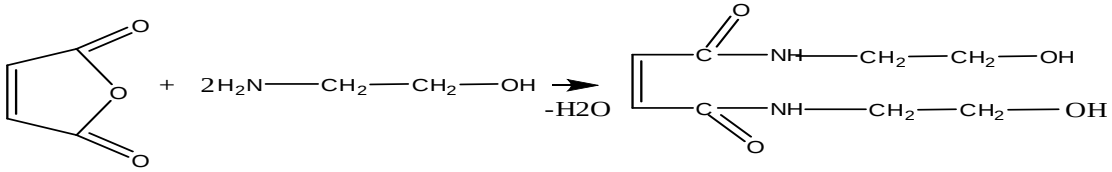
Introduction. Today, corrosion of metals is one of the processes that prevent from maintaining the metal and devices based on it in stable conditions[1]. As a result, there is not only a moral, but also a sense of loss. As an example of an economic solution, the following figures can be cited: for example, an international study conducted by NACE (IMPACT 2016) showed that the annual economic damage from the occurrence in the world is 2.5 trillion dollars. If this figure is by country, then it is about 3.4% of the average gross domestic product (GDP) of each country[2]. Iso N, N, N', N'', N''-pentamethyldiethylamine-N,N''-di-[tetraethylammonium bromide] 14-2-N(CH3)-2-14 from oligomeric steel materials against environmental corrosion used to protect [3], research on the synthesis of a monomer based on dodecanediamine (DDA), N,N-diallyl-N-propargyl-(12-N'-formylamino)-1-dodecylammonium chloride, homo- and copolymers, and the use of the synthesized chemical compound as a corrosion inhibitor. One of the allyl groups copolymerizes with propargyl or another allyl group in a 4:1 ratio in higher yield than the other ratios. The inhibitory effect of the obtained copolymer on steel was determined by gravimetric and electrochemical methods in acidic and saline media at a temperature of 60°C.

The inhibitor concentration was obtained at the level of 200 mg/l at various concentrations of hydrochloric acid; 81-99% in 1M HCl, 97-98% in 4M HCl, 87-93% in 7.7M HCl, 68% and 91% in 0.5M H2SO4, 84% in 3.5% NaCl - inhibition efficiency 92%[4]. The inhibitory properties of N,N-dipropynoxymethylamine trimethylphosphonate were studied using potentiometric polarization curves and electrochemical methods. At the same time, the temperature was studied in the concentration range from 298 K, 40 mg/l to 320 mg/l, which was attributed to mixed-type inhibitors. It has a mixed inhibitory mechanism and obeys the Frumkin adsorption isotherm[5,6,7].

Objects and methods of research

1. Synthesis of corrosion inhibitor grade IKMM-1

The yield and structure of the reaction between monoethanolamine and maleic anhydride also depend on temperature, a process which is an exothermic reaction at high temperatures below room temperature (8 and 10 ^{0}C). The reaction mechanism of the interaction of monoethanolamine and maleic anhydride can be described as follows**:**



The relationship between the temperature of the reaction product and the molar ratio of the starting material between monoethanolamine and maleic anhydride is shown in detail in Table 1

Table 1

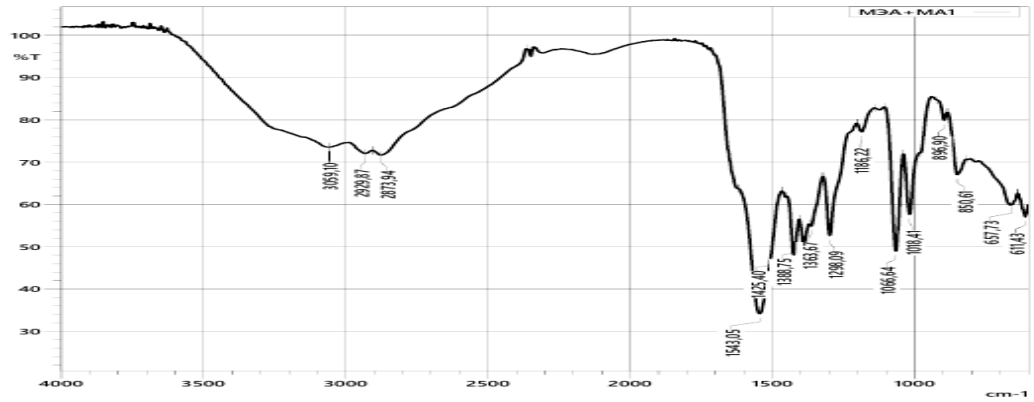
Molecular ratio of the initial substance of the reaction product and temperature dependence

Molar ratio of monoethanolamine and maleic anhydride	Temperature ^{0}C	Yield %	Temperature ^{0}C	Yield%
1:1	5÷10	69,67	15≤t	45,35
1:2		90,36		82,36
2:1		70,15		61,26
1:3		55,62		32,56
3:1		69,43		42,25

The resulting product has the following physical and chemical properties:

Light red, non-volatile, dark polymer-like, slowly soluble in water at room temperature, accelerates dissolution and quickly melts when heated, soluble in acetone, toluene, ethanol and methanol.

Results and its discussion. IR Spectroscopic Analysis of Corrosion Inhibitor IKMM-1.



Pic 1. IR spectrum of corrosion inhibitor IKMM-1

The composition and structure of the corrosion inhibitor synthesized on the basis of monoethanolamine and maleic anhydride were studied in the range of 4000 cm^{-1} using IR spectrometric (IK-Fure, SHIMADZU, Japan) technology. In the IR spectrum of the corrosion inhibitor synthesized on the basis of monoethanolamine and maleic anhydride, in a wide and intense absorption region, stretching vibrations of OH groups (due to the formation of H-bonds) 3059.10 cm^{-1} are observed. Also, in the region of 2929.87 cm^{-1}, elongated vibrations of OH groups with a wide range of assimilation are observed. Asymmetric stretching vibrations of -C-N- groups correspond to an area of 1545.05 cm^{-1}.

Weight loss measurement method and Inhibitor Efficiency. A steel sample (1.5x2.5x1.2) was used for a practical experiment based on mass loss.

Practical experiments were carried out in a solution of Salsola oppositifolia extract at various concentrations with the addition of 0.5 M sulfuric acid solution and at different temperatures. Corrosion rate (1) and efficiency (2) were determined by the following equations.

$$C_R = \frac{W_b - W_a}{At} \qquad (1)$$

$$\eta(\%) = \frac{C_{R(blank)} - C_{R(inhibitor)}}{C_{R(blank)}} \qquad (2)$$

Where: $C_{R(blank)}$- corrosion rate, W_b- weight of the metal sample, before the experiment, W_a- weight of the metal sample after the experiment, A - sample surface area, t- time spent on practical experiment, hour.

$C_{R(blank)}$- corrosion rate without inhibitor, $C_{R(inhibitor)}$- corrosion rate with inhibitor.

Table 2

The values of the braking coefficient of the corrosion inhibitor IKMM-1 (γ), the degree of complete surface coverage (θ), the degree of protection (η), determined by the gravimetric method in 1 M HCl at different temperatures

Inhibitor	**T,** (K)	**C,** (mg/l)	**W,** mass/(sm^2 hour)	**γ**	**η,** (%)	**θ**
ИКММ-1	**298**		**1.32**	-	-	-
		100	0.3013	6,56	80,09	0,8009
		200	0.2851	7,26	87.56	0,8756
		300	0.2151	9,49	90.87	0,9087
		400	0.2041	11,21	92.62	0,9262
	313	-	**1,63**	-		-
		100	0,4124	6,95	78,85	0,7885
		200	0,3025	8,76	81,25	0,8125
		300	0,2271	10,44	86,95	0,8695
		400	0,2015	10,96	90.32	0,9032
	323	-	**1,75**	-		-
		100	0,561	7,25	75,61	0,7561
		200	0,356	11,56	80,51	0,8051
		300	0,250	14,81	85,96	0,8596
		400	0,223	14,96	89.23	0,8923

An increase in inhibitor concentration and an increase in temperature are inversely proportional to each other, i.e., an increase in concentration increases the inhibition efficiency, but with an increase in temperature, the inhibition efficiency also decreases.

Conclusion.When synthesizing corrosion inhibitors of the IKMM-1 brand, it is necessary to maintain the temperature at a much lower level, and this temperature determines the efficiency of the reaction product. The resulting corrosion inhibitor had an inhibitory efficiency of 92.62 % at 298 K when its inhibitory effectiveness was determined gravimetrically**.**

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Kalit so’zalar: IKMM-1, korroziya ingibitor, IQ spektroskopiya, massa yo’qotish metodi HCl

Ushbu tadqiqot ishida malein angidirid va monoetanolamin asosida IKMM-1 markali korroziya ingibitorini sintez qilish tadqiqoti o’rganilgan.

Korroziya ingibitorining ingibirlash samaradorligini turli konsentratsiyalarda massa yo’qotish, tormozlanish koffesienti(γ), yuzaning qoplanganligi(θ) va himoyalsh darajasi(η) asosida aniqlandi.

Ключевые слова: ИКММ-1, ингибитор коррозии, ИК-спектры, измерение потери массы, метод, HCl.

В данной работе изучен синтез ингибитора коррозии ИКММ-1 на основе малеинового ангидрида и моноэтаноламина. Ингибитор коррозии получен путем измерения потери массы с различными концентрациями (от 100 мг/л до 400 мг/л) и эффективностью ингибирования при различных температурах (298, 313 и 323 К) и коэффициенте торможения (γ), оверхности (θ) , определяли значения степени защиты (η).

Key words: IKMM-1, corrosion inhibitor, IR spectra, weight loss measurement, method, HCl

In this work, we studied the synthesis of the corrosion inhibitor IKMM-1 based on maleic anhydride and monoethanolamine. Corrosion inhibitor was obtained by a weight loss measurement with different concentrations (from 100 mg/l to 400 mg/l) and inhibition efficiency at different temperatures (298, 313 and 323 K) and braking coefficient (γ), surface (θ), determined the values of the degree protection (η).

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