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INHIBITION OF THE ACCUMULATION OF INHIBITED ACIDS AND MINERAL SALTS BASED ON THEM

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ABSTRACT: In recent years, scientific publications have increasingly reported the use of inhibited hydrochloric acid as an effective inhibitor of mineral salt deposits [1, 2].

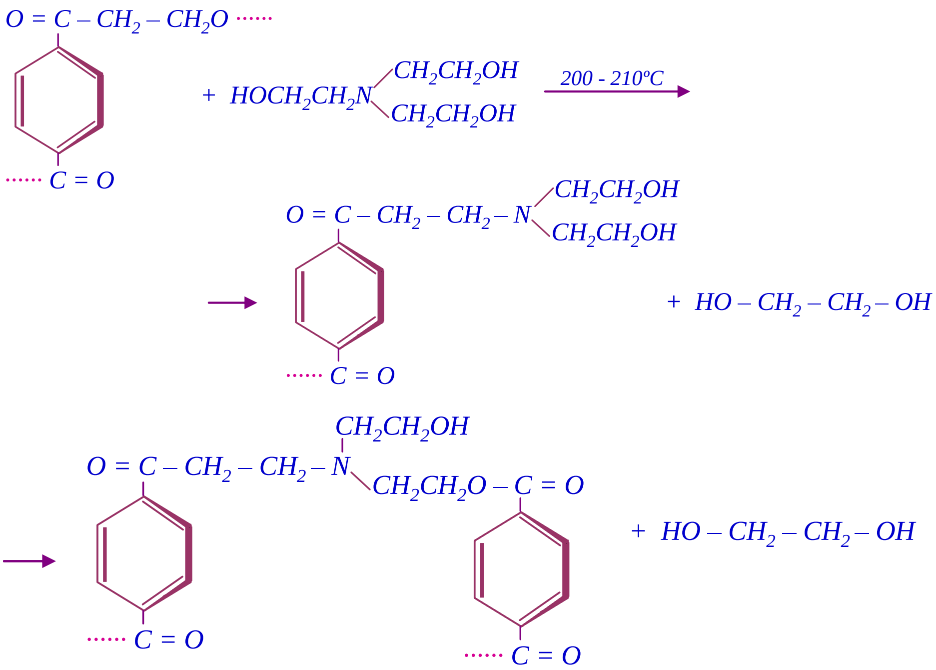
Inhibited acids are liquids with high antibacterial properties and a strong disintegrating effect. Technical inhibited hydrochloric acid is a mixture of hydrogen chloride and a corrosion inhibitor [3-5]. The main functions of this product are to dissolve deposits of inorganic origin and prevent the thickening of metal surfaces. It is very miscible with water, ethers, and benzene, which opens up new possibilities for their application.

The chemical and physical properties of inhibited hydrochloric acid make it similar to technical hydrochloric acid, but due to its high functionality, it can be used to solve a wider range of problems [6, 7].

INTRODUCTION

Inhibited acid has a neutralizing effect on the corrosive properties of metals and metal surfaces. The presence of special bactericides significantly slows down the process of acid corrosion. Thus, the inhibited hydrochloric acid, although aggressive, does not pose a catastrophic threat to metal surfaces, quickly and effectively dissolves carbonate deposits. Taking this into account, we also planned to synthesize synergistically effective protective inhibitors based on the aminolysis product PET: TEA synthesized during our research. The aminolysis-alcohololysis reactions of PET with TEA were carried out in the following sequence: the process was carried out in a three-necked flask equipped with a stirrer, reflux condenser and thermometer, with the addition of crushed, washed and dried IPET pieces and TEA. The temperature was raised to 100 °C for 60 minutes, then to 225 °C for another 60 minutes. After reaching a temperature of 225 °C, the synthesis was continued for 6 hours. The IPET particles gradually begin to bubble, and then after reaching a temperature of 225 °C, the reaction mass becomes homogeneous within an hour. The synthesis products are relatively solid at room temperature, and the consistency of the product becomes softer with increasing molar ratio of triethanolamine. Then, the acid number, hydroxyl number, saponification number, ether number, and Ubbelode viscosity point of the synthesis products are determined.

According to the aminolysis mechanism, the reaction of secondary PET with triethanolamine can be assumed as follows.



To obtain an inhibited acid containing 20-25% by mass of hydrochloric acid, 85 g is weighed, 15 g of distilled water is added for dilution, then, while stirring, 25 g of aminolysis product PET: TEA is added. The mixture is stirred intensively for 40 min, and the corrosion inhibition properties are determined according to TU 6-01-04-689381-85-91 (where the acid concentration is 22.0% by mass). To do this, 250 cm3 of inhibited acid are poured into 3 beakers, and pre-cleaned metal samples are lowered into the liquid until completely immersed, the beakers are placed in a thermostat at 30 ± 5 °C. After the specified time (24, 48, or 72 hours), the inhibited acid solution is removed, washed with copious amounts of water, and the corrosion marks on the plate are separated using a rubber scraper, washed with acetone, and dried for 1 hour.

Metal samples were made of steel of the St.3 brand, with a surface area of 11⍰10-2 cm2. An aggressive environment model was artificially prepared: A - sample 0.1 N sodium chloride: kerosene 16÷1 (pH = 3), Pco2=1 atm; B - sample mineralized water (NaCl-80, CaCl2-5.0, CaSO4-1.0, MgCl2-2.0, NaHCO3-0.1); G - sample 3% sodium chloride, Pco2=1 atm; V - sample 3% sodium chloride: kerosene 16÷1 (pH = 3), saturated with CO2 and H2S; D - sample mineralized water (NaCl-80, CaCl2-5.0, CaSO4-1.0, MgCl2-2.0, NaHCO3-0.1): oil 16÷1 (pH = 5), Pco2=1 atm.

Table 3.4

Effect of inhibitor on corrosion rate in single and two-phase environments. St.3 steel. Inhibitor concentration 10 g/l, inhibition duration 48 hours.

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Inhibitor	**Degree of protection against corrosion, % (35 °C)**				
	Composition A	Composition B	Composition G	Composition V	Composition D
Composition 1	99,7	99,3	99,9	97,6	98,9
Composition 2	99,9	98,9	99,9	96,9	99,9
Composition 3	97,9	96,3	97,8	95,8	97,3
Composition 4	99,4	98,6	99,3	98,7	99,8
Composition 5	98,1	96,2	96,7	97,8	97,4

To determine the composition that effectively inhibits the accumulation of mineral salts, compositions were prepared with the addition of inhibited acid (PET: TEA + HCl), urea, orthophosphoric acid, formaldehyde, and used DEA: inhibited hydrochloric acid (ICA) - 3-7%; X-reagent - 10-12%; urea - 18-22%; formaldehyde - 2 - 3%; orthophosphoric acid (OPC) - 8-12%; the rest was water.

The results of studies conducted to determine the protective effect of the inhibitors of the compositions against the accumulation of mineral salts are presented in Table 2.

The protective effect of synergistically effective compositions against the accumulation of mineral salts, temperature 80 °C

№	The composition of the inhibitor of the accumulation of mineral salts	Inhibitor concentration mg/l	Inhibitor effect,%		
			Water hardness, mg/l		
			4 - 5	8 - 10	11 - 13
1.	IXK - 7; X-reagent -10; karbamid - 21; formaldegid - 2; OFK - 8	4,0 8,0 10,0 12,0	80,72 81,38 82,70 82,70	79,40 80,06 81,38 81,38	78,74 79,40 79,40 79,40
2	IXK - 7; X-reagent - 10; karbamid - 22; formaldegid - 2; OFK - 8	4,0 8,0 10,0 12,0	80,06 80,72 80,72 81,38	79,40 80,06 80,16 80,06	78,08 79,40 79,40 79,40
3	IXK - 7; X-reagent - 10; karbamid - 22; formaldegid - 2; OFK - 9	4,0 8,0 10,0 12,0	90,82 91,48 92,14 92,80	90,16 90,82 92,14 91,48	88,84 89,50 90,16 91,16

4	IXK - 7; X-reagent - 10; karbamid - 22; formaldegid - 2; OFK - 10	4,0	91,48	79,50	78,18
		8,0	92,14	80,16	78,84
		10,0	92,80	81,48	79,50
		12,0	93,46	81,48	79,50
5	IXK - 7; X-reagent - 10; karbamid - 22; formaldegid - 3; OFK - 11	4,0	81,48	79,50	78,18
		8,0	82,14	80,82	79,50
		10,0	82,80	82,14	80,16
		12,0	83,46	82,80	79,50
6	IXK - 7; X-reagent - 12; karbamid - 22; formaldegid - 3; OFK - 12	4,0	84,78	82,80	81,48
		8,0	85,44	83,46	82,14
		10,0	85,64	84,12	82,80
		12,0	85,44	84,12	82,80

The table data shows that with an increase in the amount of active base, the effectiveness of protection against the accumulation of mineral salts also increases, and when the amount of inhibited acid and formaldehyde from synergistically effective additives is up to 10 g, and when the amount of I-DEA is 5 g, the inhibition efficiency is high, and when the inhibitor concentration is 10 g/l, it is 99.6 and 99.01%, respectively.

REFERENCES

1. Patent № 2096523 C1 Rossiyskaya Federatsiya, MPK C23F 11/04, C23F 11/14. sposob polucheniya ingibirovannoy solyanoy kislotы: № 95117415/02: zayavl. 11.10.1995: opubl. 20.11.1997 / F.V. Kaybыshev, N.I. Xisamutdinov, G.M. Kuzin [i dr.]; zayavitel Vnedrencheskiy nauchno-issledovatelskiy injenernыy центр "Neftegaztexnologiya", Ufimskoe gosudarstvennoe proizvodstvennoe predpriyatie "Ximprom".
2. Patent № 2732540 C1 Rossiyskaya Federatsiya, MPK C23F 11/04. sposob polucheniya ingibirovannoy solyanoy kislotы: № 2019133111: zayavl. 16.10.2019: opubl. 21.09.2020 / V.M. Filippov, N.A. Syadakova, O.B. Kapitonov [i dr.]; zayavitel Publichnoe akцionernoe obщestvo "Ximprom".
3. Ochistka trubok teploobmennika ot solevых otlojeniy / A.T. Tayekenova, A.K. Akurpekova, A.T. Tastemirova [i dr.] // Praktika protivokorrozionnoy zaщitы. – 2023. – T. 28, № 1. – S. 29-42. – DOI 10.31615/j.corros.prot. 1-4 s.
4. Patent № 2596547 C1 Rossiyskaya Federatsiya, MPK C23F 11/04. Sposob polucheniya ingibitora korrozii solyanoy kislotы (variantы): № 2015116992/02: zayavl. 05.05.2015: opubl. 10.09.2016 / V.M. Filippov, N.A. Syadakova, O.B. Kapitonov [i dr.]; zayavitel Publichnoe akцionernoe obщestvo "Ximprom".
5. Patent № 2176685 C2 Rossiyskaya Federatsiya, MPK C23F 11/04. Reagent dlya ingibirovaniya kislotnoy korrozii i sposob polucheniya ingibirovannых kislot (variantы): № 99119758/02: zayavl. 16.09.1999: opubl. 10.12.2001 / Yu.V. Baranov, T.L. Gogolashvili, M.M.

Xakimzyanova [i dr.]; zayavitel Otkrыtoe akцionernoe obщestvo "Nauchno-issledovatelskiy institut po neftepromыslovoy ximii"

6. Ochistka trubok teploobmennika ot solevых otlojeniy. A.T. Tayekenova, A.K. Akurpekova, A.T. Tastemirova [i dr.] // Praktika protivokorrozionnoy zaщitы. – 2023. – T. 28, № 1. – S. 29-42. – DOI 10.31615/j.corros.prot.2023.107.1-4.