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Synthesis And Properties Of Kafn-2024 Corrosion Inhibitor For The Oil And Gas Industry

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Abstract: The article presents the synthesis, physicochemical properties, and anticorrosion efficiency of the KAFN-2024 inhibitor, developed for protecting equipment in the oil and gas industry from hydrogen sulfide corrosion. The inhibitor is based on urea, formalin, sodium tripolyphosphate, and acrylic acid. Experimental studies include pH measurements at various temperatures, gelation time, density, and gravimetric tests on steels (36G2S, 17GS, St.3) at 120-250°C. Results show 93-98% inhibition efficiency at 100 mg/L concentration. Economic analysis compares KAFN-2024 (25.44 million UZS/ton) with analogs, demonstrating cost-effectiveness. Tables and graphs illustrate the data.

Keywords: Corrosion inhibitor, KAFN-2024, hydrogen sulfide corrosion, oil and gas industry, synthesis, gravimetric method, economic analysis.

INTRODUCTION:

In the oil and gas industry, corrosion caused by hydrogen sulfide (H_2S) poses a significant challenge to equipment such as separators and heat exchangers. Traditional inhibitors like NORUST PS 40 or DODIGEN 95 are effective but expensive. KAFN-2024, a locally developed inhibitor in Uzbekistan, offers a cost-effective alternative with comparable efficiency. This article describes its synthesis, properties, and performance based on laboratory tests.

METHODS

KAFN-2024 is synthesized from urea (carbamide), formalin (37% formaldehyde), sodium tripolyphosphate, and acrylic acid. The ratio is urea: 662 kg, formalin: 198.6 kg, sodium tripolyphosphate: 132.4 kg, acrylic acid: 132.4 kg per ton.

Synthesis process: Components are mixed in a reactor at 110°C for 30 minutes using an anchor stirrer. Hot water (90-100°C) is circulated through the jacket, with pressure increased to 1.1-1.2 atm to achieve 110°C. Formalin flow is controlled via a valve. The product is pumped to a second reactor (volume 0.6 m^3, 6 mm steel) for final mixing with acrylic acid.

Tests:

- pH at 80-200°C for 5% solution.
- Gelation time and density at 160°C.
- Gravimetric corrosion tests on steels (36G2S, 17GS, St.3) at 120-250°C, concentrations 0-100 mg/L, 360 hours, surface $S=10^{-4}$ m^2.
- Economic analysis for 1 ton production.

RESULTS AND DISCUSSION

Physicochemical Properties

Table 1: pH of 5% KAFN-2024 solution at various temperatures (estimated values).

Temperature (°C)	pH (estimated)
80	8.7
100	8.5
120	8.3
140	8.1
160	7.9
180	7.7
200	7.5

pH remains in 6.5-9.8 range, ensuring stability.

Table 2: Gelation time and density at 160°C (variants I-IV).

Indicator	I	II	III	IV
Gelation time at 160°C (min)	1.70	1.80	2.50	2.55
Density (g/cm³)	1.30	1.35	1.34	1.40

Gelation increases with variant, density stable.

Corrosion Inhibition Efficiency

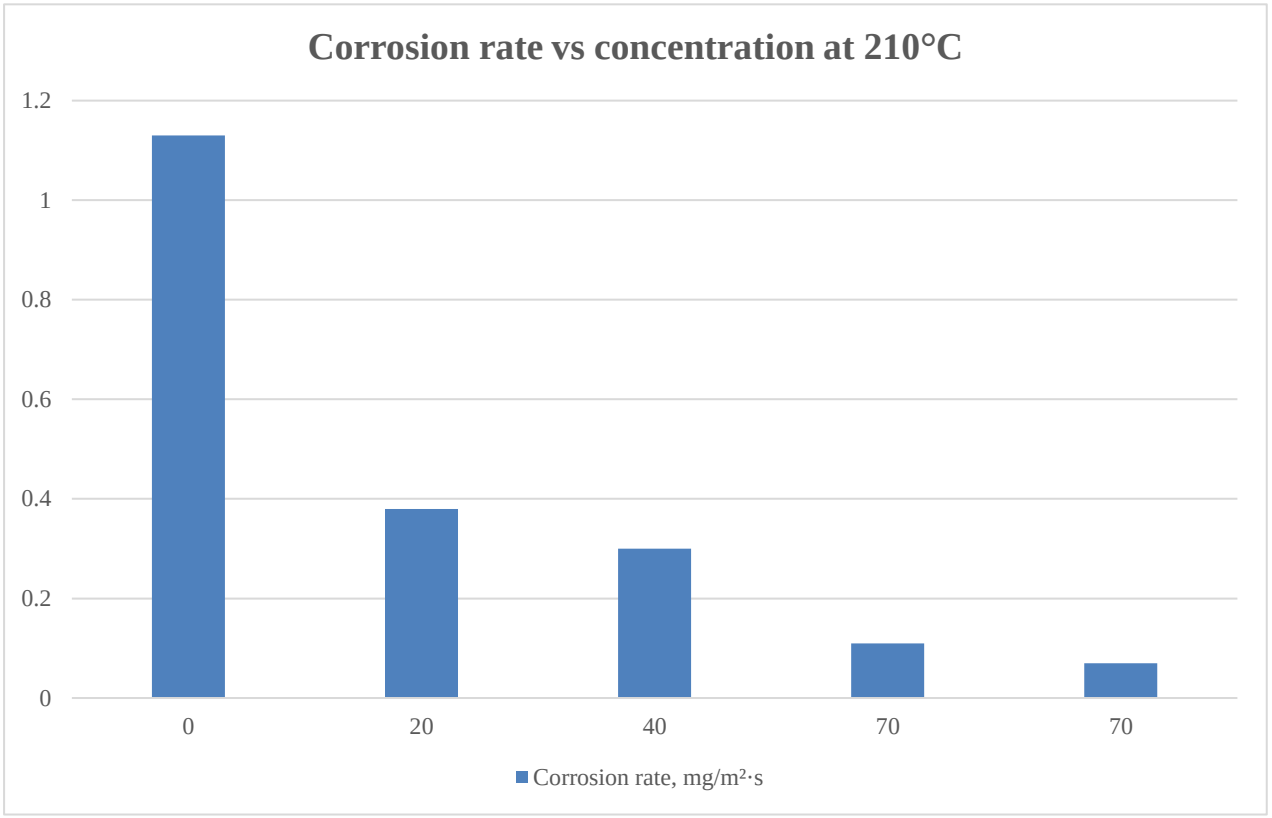
Gravimetric tests show high efficiency.

Table 3: Corrosion rate (mg/m²·s) for 36G2S steel at 120°C.

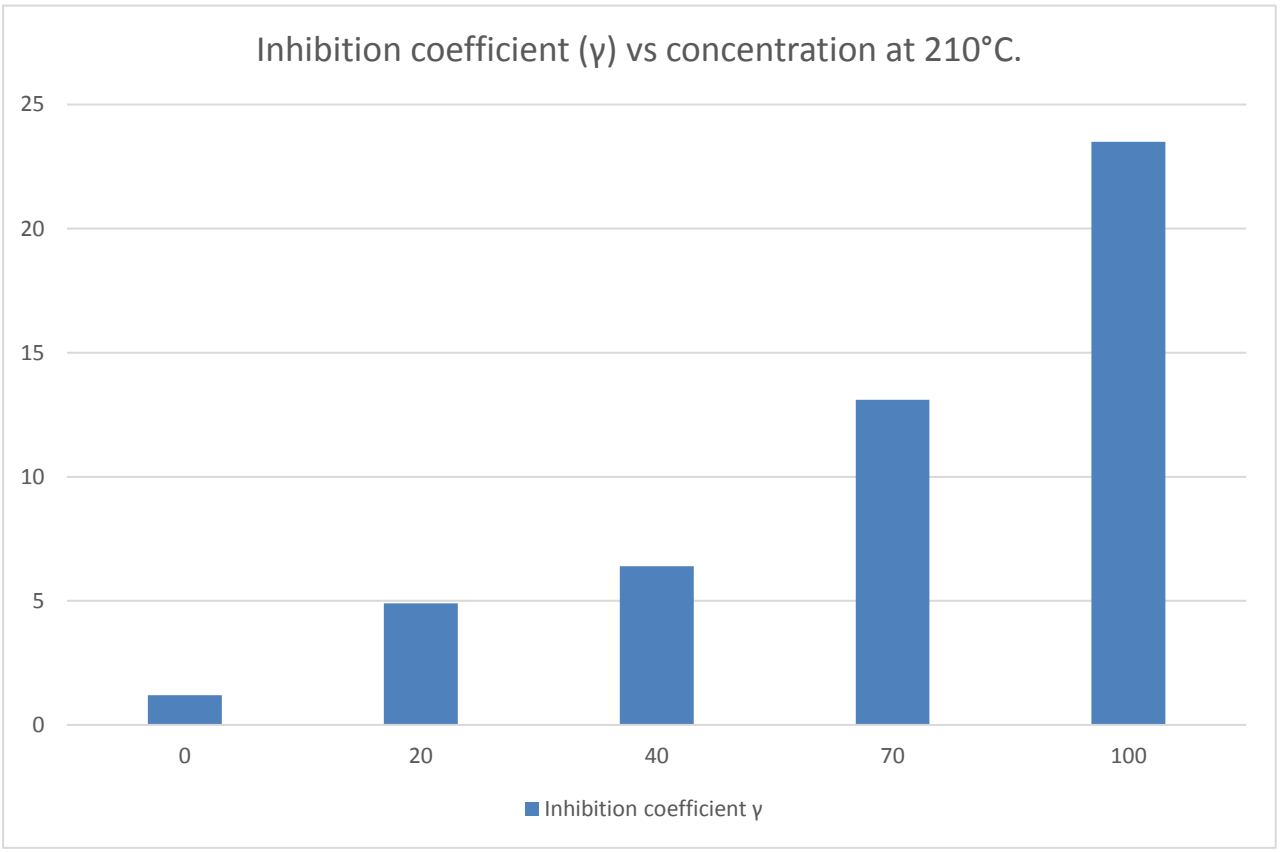
Concentration (mg/L)	Corrosion rate (mg/m²·s)
0	0.759
20	0.255
40	0.201
60	0.067
80	0.043
100	0.030

Efficiency (Z_e) at 100 mg/L: 96%.

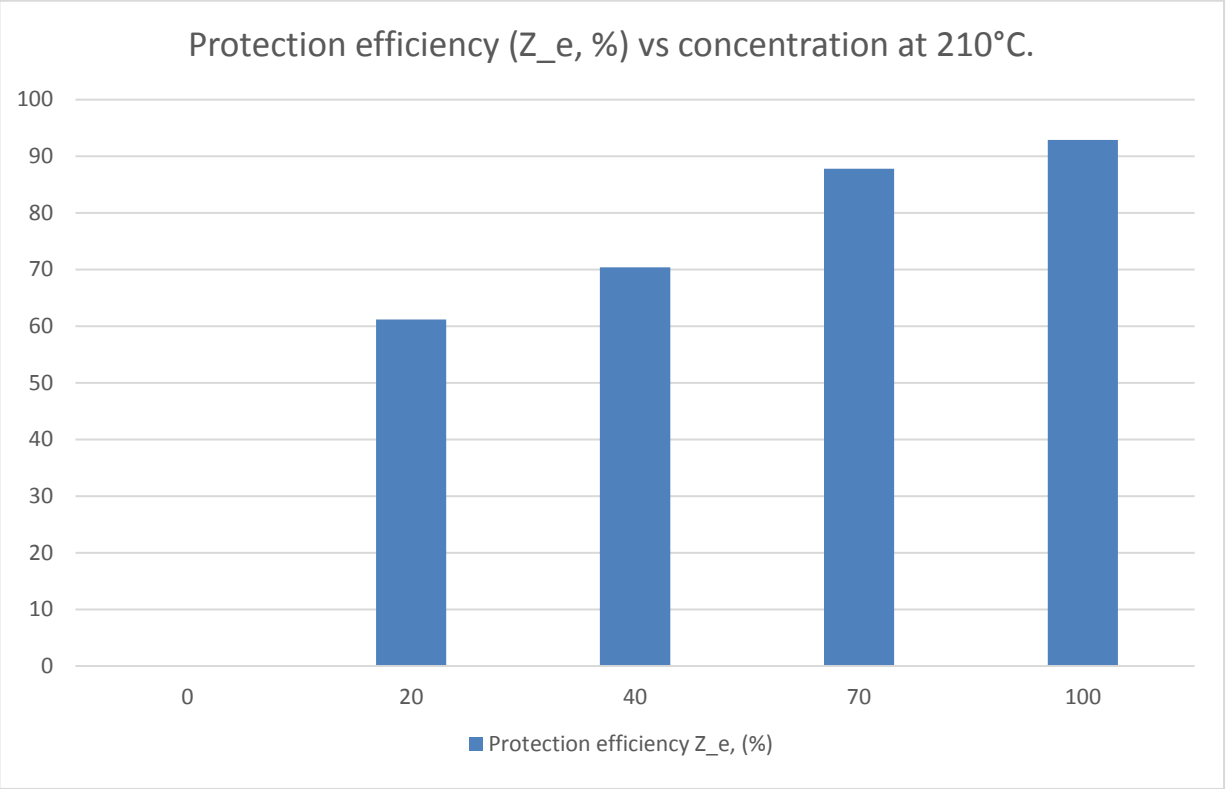
Graph 1:



Graph 2: Inhibition coefficient (γ) vs concentration at 210°C.



Graph 3:



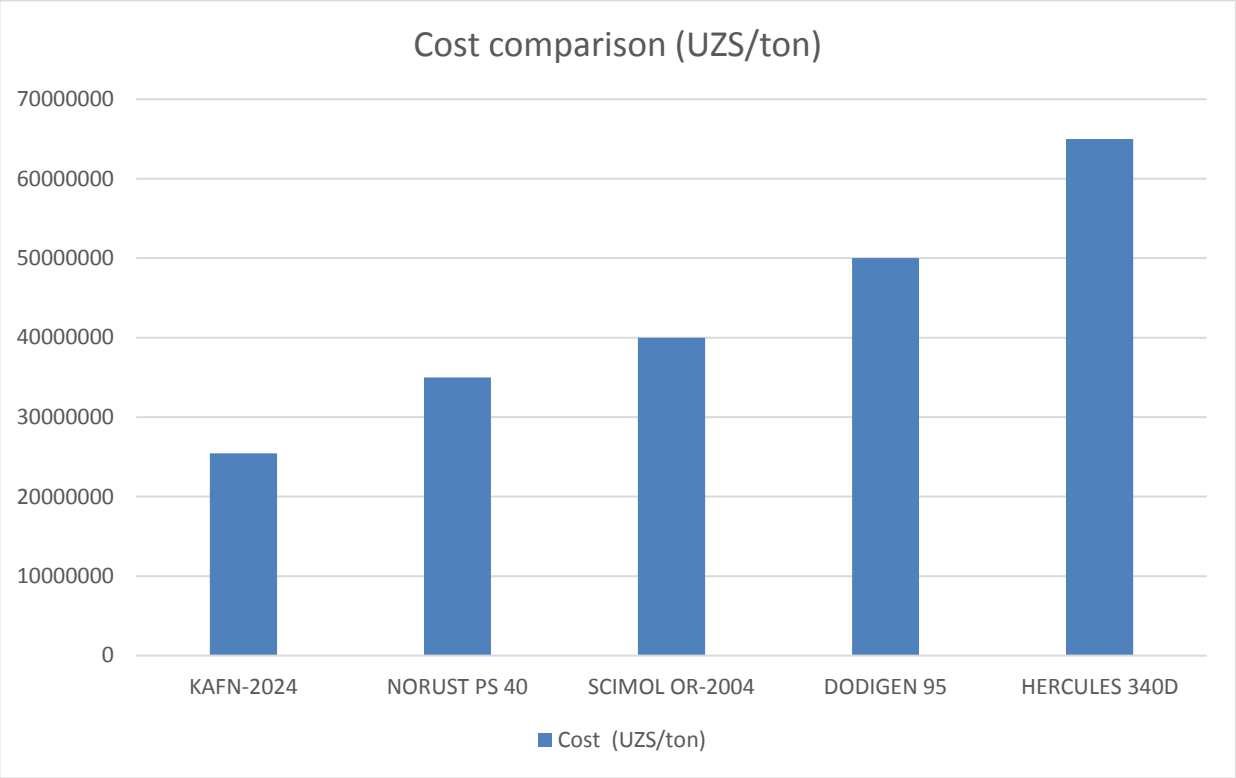
Economic Analysis

Table 4: Production cost for 1 ton KAFN-2024 (UZS).

Component	Amount (kg)	Cost (UZS)
Urea	662	2,537,446
Formalin	198.6	3,249,096
Sodium tripolyphosphate	132.4	662
Acrylic acid	132.4	5,783,232
Production costs	-	9,768,226
Tax (12%)	-	2,640,000
Transport & insurance	-	800
Total	-	25,440,000

Compared to analogs (NORUST PS 40: 35M, etc.), KAFN-2024 is 37-155% cheaper.

Graph 4:



CONCLUSION

KAFN-2024 shows 95% average efficiency, stable pH, and low cost (25.44M UZS/ton), making it suitable for Uzbekistan's oil industry.

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