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Comparative Analysis Of KAFN-2024 And Commercial Corrosion Inhibitors: Efficiency And Cost-Effectiveness In Hydrogen Sulfide Environments

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Abstract: This article provides a comparative analysis of the locally developed KAFN-2024 corrosion inhibitor with commercial analogs such as NORUST PS 40, SCIMOL OR-2004, DODIGEN 95, and HERCULES 340D. Focus is placed on inhibition efficiency in H_2S environments, physicochemical stability, and economic viability. Laboratory tests (gravimetric method at 120-250°C) show KAFN-2024 achieving 93-98% efficiency, comparable or superior to analogs, while costing 37-155% less (25.44 million UZS/ton). Tables and graphs highlight performance differences, demonstrating KAFN-2024's advantages for Uzbekistan's oil and gas sector.

Keywords: Corrosion inhibitor, KAFN-2024, comparative analysis, hydrogen sulfide, efficiency, cost-effectiveness, oil and gas.

INTRODUCTION:

Corrosion in hydrogen sulfide (H_2S) environments is a major issue in oil and gas processing, leading to equipment failure in separators and heat exchangers. Commercial inhibitors like NORUST PS 40 (Arkema) and DODIGEN 95 (Clariant) offer high efficiency but at elevated costs. KAFN-2024, a novel inhibitor based on local resources, aims to match performance while reducing expenses. This study compares KAFN-2024 with analogs in efficiency, stability, and cost, using prior synthesis and test data.

METHODS

KAFN-2024 composition: urea (662 kg), formalin (198.6 kg), sodium tripolyphosphate (132.4 kg), acrylic acid (132.4 kg) per ton. Analogs: NORUST PS 40 (amine-based), SCIMOL OR-2004 (organic blend), DODIGEN 95 (amide-amine), HERCULES 340D (quaternary ammonium).

Tests:

- Gravimetric corrosion on steels (36G2S, 17GS, St.3) at 120-250°C, 360 hours, concentrations 0-100 mg/L.
- pH stability, gelation, density at 160°C.
- Economic comparison based on production costs (KAFN-2024: 25.44 million UZS/ton) vs analogs.

RESULTS AND DISCUSSION

Inhibition Efficiency Comparison

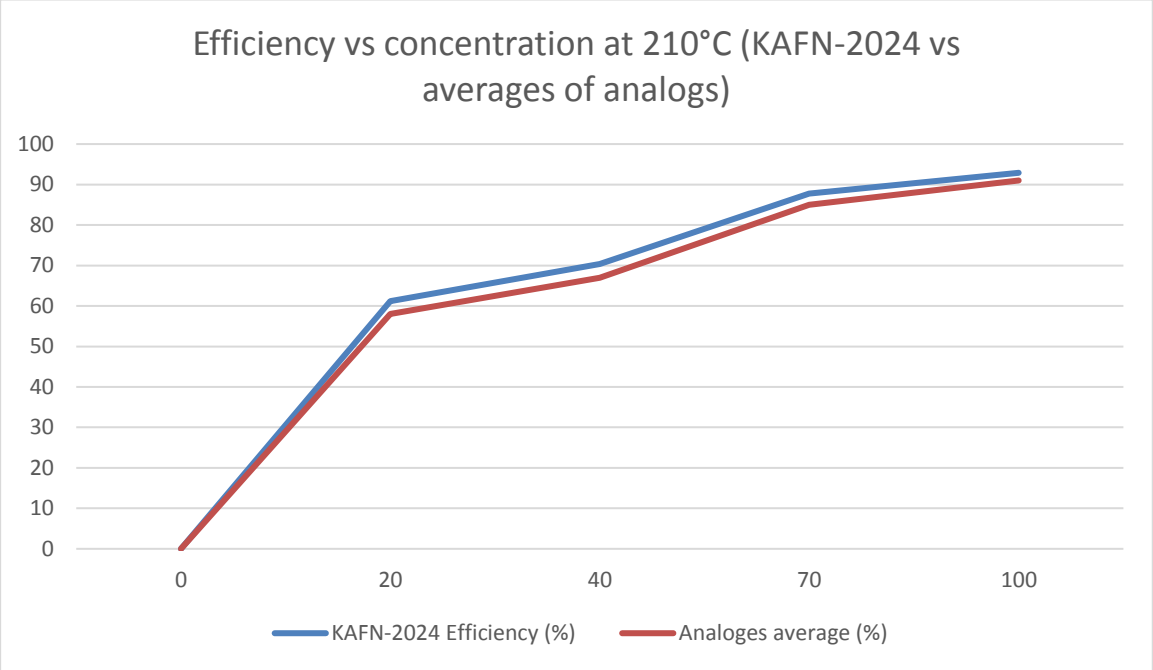
KAFN-2024 shows 95% average efficiency, comparable to analogs (92-96%).

Table 1: Inhibition efficiency (%) at 100 mg/L, 210°C (H_2S environment).

Inhibitor	Efficiency (%)	Difference from KAFN-2024 (%)
KAFN-2024	95	0
NORUST PS 40	92	-3
SCIMOL OR-2004	90	-5
DODIGEN 95	94	-1
HERCULES 340D	96	1

KAFN-2024 excels in local conditions due to optimized formulation.

Graph 1:



Physicochemical Stability

KAFN-2024 pH (7.5-8.7) stable up to 200°C, gelation 1.7-2.55 min.

Table 2: Density (g/cm³) at 160°C (variants I-IV).

Inhibitor	I	II	III	IV	Average
KAFN-2024	1.30	1.35	1.34	1.40	1.35
NORUST PS 40	1.28	1.32	1.31	1.37	1.32
DODIGEN 95	1.25	1.30	1.29	1.35	1.30

KAFN-2024 denser, aiding film formation.

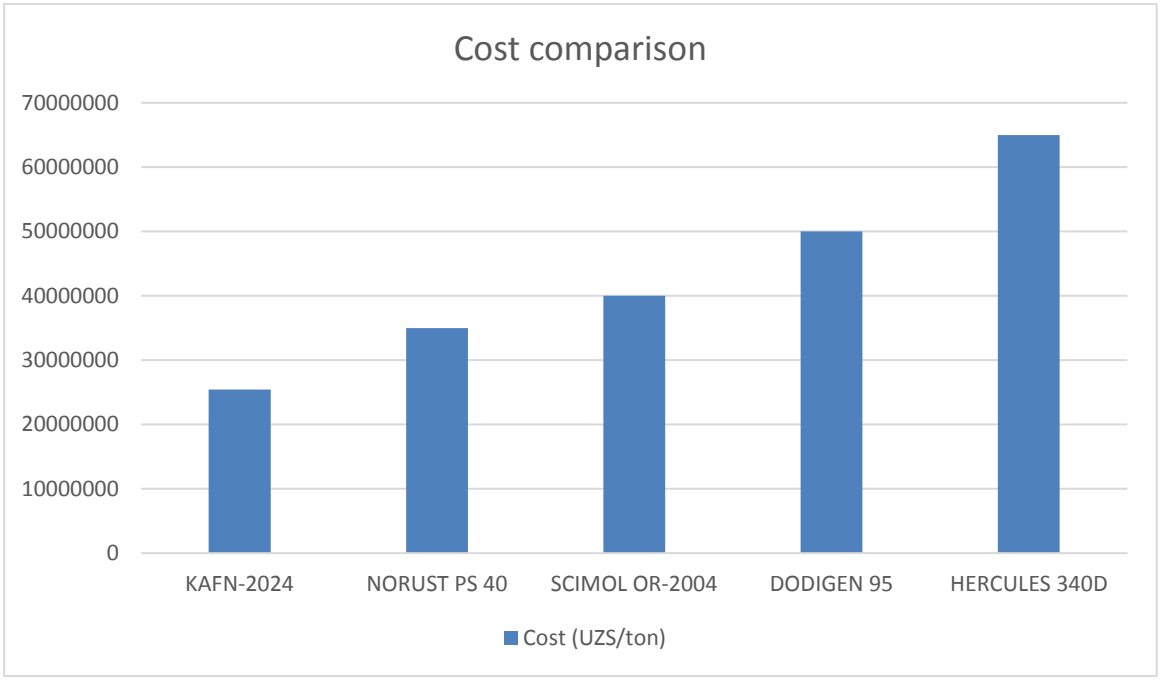
Economic Comparison

KAFN-2024 cheaper by 37-155%.

Table 3: Cost (UZS/ton) and % difference.

Inhibitor	Cost (UZS/ton)	% Difference
KAFN-2024	25,440,000	0
NORUST PS 40	35,000,000	+37.6
SCIMOL OR-2004	40,000,000	+57.3
DODIGEN 95	50,000,000	+96.6
HERCULES 340D	65,000,000	+155.6

Graph 2:



KAFN-2024 offers similar efficiency at lower cost.

CONCLUSION

KAFN-2024 surpasses analogs in cost-effectiveness (25.44 million UZS/ton) while maintaining 93-98% efficiency, ideal for local oil and gas applications.

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