AN EFFECTIVE WAY TO DISPOSE OF RAILWAY FUEL WASTE

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Abstract

The article discusses some issues related to the utilization of solid waste from railway transport.

Introduction

Modern reality dictates ever new and very difficult conditions for the oil and gas industry, which cannot but be canceled and ignored. Indeed, more and more oil and gas fields are being brought into development, the development of which was previously delayed due to their inaccessibility or other complicating factors. In addition, the requirements for the quality of oil, petroleum products, and gas condensates are increasing, which primarily applies to sulfur hydrocarbon raw materials, the production of which is carried out in traditional developed fields [1]. In addition to sulfur compounds (thiophenes, sulfides, free sulfur, etc.) contained in oils, the proportion of oils and condensates containing "active" sulfur compounds - mercaptans, dialkyl sulfides, hydrogen sulfide, is increasing, which creates the problem of environmental pollution [2]. The increased content of hydrogen sulfide in oil and the need to bring its quality to modern requirements is one of the difficult issues in the field preparation of commercial oil. Data on determining the content of hydrogen sulfide in oil, gas and water allow us to draw a conclusion about the manufacturability of the decisions made for the design and reconstruction of existing and under construction oil field facilities.

Thus, the presence of hydrogen sulfide, mercaptans and other aggressive sulfur-containing compounds in hydrocarbon raw materials, which create specific difficulties during production, transportation, storage and processing, makes the problem of desulfurization of oil and petroleum products especially relevant [3].In addition, the production volumes of sulfur and high-sulfur oils and gas condensates containing corrosive and highly toxic hydrogen sulfide and low molecular weight mercaptans are steadily growing in the world. The extraction, preparation, transportation, storage and processing of such oils creates a number of serious technological and environmental problems. These problems are associated primarily with the fact that the presence of these sulfur compounds in produced oil leads to premature corrosion destruction of oil field equipment, pipelines and tanks, reducing the time of their trouble-free operation and increasing the incidence of emergency oil spills into the environment. The consequence of this situation is the loss of oil and the emergence of dangerous environmental situations due to oil getting into the soil, water bodies and air pollution with toxic sulfur compounds. Strict requirements for the content of hydrogen sulfide and light mercaptans make the problem of introducing effective technologies for field purification of hydrocarbon raw materials more relevant and pressing for all enterprises producing hydrogen sulfide-containing oils and gas condensates[4].

One of the directions for solving the urgent problem of field purification of oils from hydrogen sulfide and light mercaptans is their absorption by chemical reagents directly in the oil. Despite the fact that a significant amount of research has been carried out in this area, the need to improve oil purification technology based on new reagents,making it possible to bring the quality of oil to the requirements of modern standards, and developing the technology for producing these reagents remains an urgent task. Environmental requirements dictate the need to use reagents that react irreversibly with hydrogen sulfide and mercaptans to form non-corrosive, non-volatile, easily recyclable and low-toxic sulfur compounds.

EXPERIMENTAL PART

Purpose of this workis to develop effective reagents for purifying oil from hydrogen sulfide and mercaptans based on waste and improving the technology of their production and use.

To achieve the set goalExperimental studies were carried out to assess the absorption capacity of ethanolamines, alkylamines, polyamines, oligomeric solutions based on bottom residues for hydrogen sulfide, and its relationship with the chemical structure of the initial amines and reaction conditions was revealed.

For the synthesis of new hydrogen sulfide absorbers, bottoms, technical and available ethanolamines, mono- and polyalkylamines (grades “pure” - pure and “reagent grade” - chemically pure) were used as starting materials:

- diethanolamine(CH3-CH2-O)2-NH, (h) according to TU 6-09-2652-91;
- methyldiethanolamine(CH3-CH2-O)2-N-CH3, (h) according to TU 301-02-66-90;
- monoethanolamine(CH3-CH2-O-NH2, (h) according to TU 6-09-2447-91;
- triethanolamine(CH3-CH2-O)3-N,(h) according to TU 6-09-2448-91;
- bottom amine residue, technical product;
- tertiary phosphates, technical product.

To increase the yield of new absorbents of hydrogen sulfide and mercaptans and increase their activity, activating additives - nitrogen and phosphorus-containing organic substances - were introduced into the reaction medium. The technical characteristics of the additive chosen as the most effective in the synthesis of the KF-1 reagent are given in Tables 1 and 2.

RESULTS OBTAINED AND THEIR DISCUSSION

The absorbers of hydrogen sulfide and mercaptans synthesized by us under the names “KF-1”, “KF-2” are a product of the interaction of the bottom residue from the distillation of a spent aqueous solution of amine with organic phosphate and amine, containing stabilizing additives of organic tertiary amines, phosphates (“KF-2”), and bottoms of amine production (“KF-1”).

Table 1 Technical characteristics and main properties of triethanolamine according to TU 2423-061-05807977-2002

No.	Name indicator	Grade A	Brand B	Brand B
1.	Appearance	Transparent liquid, colorless to dark brown. A greenish tint is allowed.		
2.	Density at 200C, g/cm³	1.120-1.135	1.090-1.130	1.090-1.130
3.	Mass fraction of triethanolamine, %, not less	95	85	
4.	Mass fraction of diethanolamine, %, no more	5	15	80
5.	Mass fraction of monoethanolamine, %, no more	0.5	2	20
5.	Mass fraction of water, %, no more	0.5	1	Not standardized
6.	Mass fraction of water, %, no more	0.5	1	Not standardized

Table 2 Technical characteristics and main properties of bottom amine residues C17-C20 according to TU 6-02-750-78

No. p/p	Name indicator	Bottom residues of amines C17-C20 (according to TU 6-02-750-78)
1.	Appearance	Waxy substance, yellow to light brown in color
2.	Density at 800°C, g/cm3	0.997
3.	Total mass fraction of primary and secondary amines, not less than %;	56
4.	Mass fraction of primary amines, %, not less	22-40
5.	Hydrocarbon content, %, no more	58
6.	Melting point, oC	60

These neutralizers, according to laboratory studies, have a bactericidal effect and corrosion inhibitor properties in hydrogen sulfide-containing environments, so they can be used as a bactericide to suppress the growth of sulfur-reducing bacteria (SRB) in oilfield environments, an inhibitor of hydrogen sulfide corrosion of oilfield equipment and pipelines, i.e. . are reagents with complex action. The physical and chemical characteristics of the reagents “KF-1” and “KF-2” are given in tables 3 and 4. The reagents are easily mixed with water, with most organic solvents and have limited solubility in oil and petroleum products. When in contact with water, air, oil and petroleum products, they do not burn and do not form specific toxic substances (specific toxic substances).

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Table 3 Physico-chemical parameters of the reagent "KF-1"

No.	Name indicators	Actually	Test method
1.	Appearance	Liquid from light yellow to red-brown color	
2.	Hydrogen index, pH, no less	8.5	Methodology PND F14.1:2:3: 4.121-97
3.	Density at 200C, g/cm3, within	1.050 - 1.150	GOST 3900
4.	Pour point, °C, not higher	- 25	GOST 20287
5.	Viscosity at 200C, mm2/s (cSt)	4.5 - 8.0	GOST 33

Table 4 Physico-chemical parameters of the reagent "KF-2"

No.	Name indicators	Actually	Method tests
1.	Appearance	The liquid is light yellow to red-brown in color.	
2.	Hydrogen index, pH, not less	8.5	PND F technique 14.1:2:3:4.121-97
3.	Density at 20°C, g/cm3, within	1.030 - 1.110	GOST 3900
4.	Pour point, °C, not higher	- thirty	GOST 20287
5.	Viscosity at 200 C, mm2/s (cSt)	3.5 - 5.0	GOST 33

They are classified as highly flammable substances, non-toxic, and according to the degree of impact on the human body they belong to hazard class III (LD50 = 2500 mg/kg), and have an irritating effect on the skin and mucous membranes of the eyes.

Thus, we were the first to study the comparative absorption capacity for hydrogen sulfide in the series of ethanolamines, primary alkylamines, polyamines and established its symbate dependence on the basicity of amines, pKa was used as a quantitative indicator. It has been established that electro-withdrawing substituent (-OH, -NH2, -P=OH) in amines reduce, and electron-donating (alkyl) substituents increase the basicity of amines. This is explained by the fact that the main properties of amine solutions are associated with the ability of trivalent nitrogen to form a bond through the donor-acceptor mechanism, adding a hydrogen proton.

The comparative absorption capacity for hydrogen sulfide of amino-formaldehyde solutions was experimentally determined, while a number of ethanolamines (CH3-CH2-O-NH2, (CH3-CH2-O)2-NH, (CH3-CH2-O)3-N, primary alkylamines (R-NH2), polyamines (R-(NH2)n. A higher absorption capacity of oligomeric solutions was established compared to the original amines.

CONCLUSION

As a conclusion, it should be noted that in recent years there has been a tendency towards an increase in the development of new effective reagents to suppress the growth of SRB. However, the range of bactericides needs to be further expanded, since bacteria are able to "get used" to living conditions and partially lose sensitivity to reagents introduced to suppress their growth. The use of bactericides is a powerful tool aimed at preventing the spread of hydrogen sulfide in oil field products, and can have a beneficial effect on reducing the cost of purifying oil and associated gas from hydrogen sulfide and mercaptans.

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