

ENVIRONMENTAL ANALYSIS OF CAUSES AND SOURCES OF H₂S FORMATION DURING TECHNOLOGICAL PROCESSES

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Abstract. *This article studied the environmental analysis of the causes, sources of hydrogen sulfide formation and methods of its neutralization at OGRP, which, as indicated in the technical literature, during the neutralization of gas mixtures containing H₂S, as well as during their combustion in order to obtain a thermal effect together with environmentally hazardous SO₂ substances, SO₃ also free S powder (sulfur) is obtained.*

Keywords: *adsorption, absorption, seravadarod, carbon monoxide, atmosphere, sulfur.*

It is known that hydrogen sulfide gas generated during volcanic eruptions and in many technological processes in various industrial spheres is an environmentally hazardous substance in the occurrence of environmental problems. Investigation of the causes of H₂S formation in petroleum processing processes. That is why, as well as in other industrial areas, the study of the cause of the formation of H₂S and research work on environmentally effective neutralization of this gas are one of the most pressing topics of our time. Despite lengthy research work on H₂S decontamination, it has not yet been possible to carry out deep environmental decontamination of H₂S in the composition of a mixture of harmful gases formed in the processes of OGRP. Therefore, on our part, a scientific study was conducted for the primary substantiated environmental analysis and for experimental studies of the sources and causes of H₂S formation.

The following results were obtained during the studies. The amount of H₂S in OGRP, as well as other harmful gaseous substances, depends on the causes and sources. - Depending on the composition of oil in primary oil processing plants (AP, AWSP), gases, including gaseous H₂S, are formed during the decomposition of RSH mercaptans and other sulfur organic compounds. During catalytic cracking to produce high-octane gasoline, as well as its purification from sulfur by the process of cleaning diesel fuel from sulfur using H₂, H₂S is formed in the composition of the OGRP. During the catalytic reforming process, high-octane gasoline is produced by the formation of H₂S.

In the process of production hydrotreatment of oils and other petroleum products in the presence of a catalyst, hydrogen sulfide is formed in the composition of OGRP. During the tar oxidation process during bitumen production, the resulting waste gases are burned for decontamination (they contain H₂S) and as a result, the final harmful gases enter the environment. A huge amount of gaseous H₂S is formed in the composition of the OGRP during the process of coking heavy oil products, which contain many sulfur compounds. H₂S obtained from the above

sources during commercial oil processing is neutralized along with other harmful waste gases by combustion at production flares (CPF). But, flaring off gases on CPF is not an environmentally efficient method. Thus, despite the combustion of OGRP on CPF, C_xH_y , CO, CO₂, H₂S (in a small amount), CO₂, SO₃, NO_x, H₂O (steam), Me_xO_y, Cl₂, HCl and other harmful substances are still present in the composition of the hot gas mixture emitted into the atmosphere. Due to the fact that H₂S is released in a large amount in the processes of catalytic cracking of hydrotreating of OGRP, purification from the H₂S gas mixture is carried out using monoethanolamine in a special process apparatus [3-4].

In the catalytic cracking process, there is a lot of H₂S in the mixtures of ethane-ethylene, propane-propylene, butane butylene, and therefore a chemical absorption method with monoethanolamine is used to purify this gas. Next, the regeneration of hydrogen sulfide monoethanolamine is carried out. The H₂S produced by this process, together with other waste gases, is decontaminated by combustion. CO₂ and SO₃ generated by H₂S combustion are released into the atmosphere. They, in turn, react quickly when hot with water vapors in the air. It is for this reason that the burning of H₂S together with other waste gases in the OGEP creates environmental problems for personnel and the population living in sanitary protection zones [5-6].

During the environmental analysis of the causes, sources of hydrogen sulfide formation and methods of its neutralization at the OGRP, it was revealed that, as indicated in the technical literature, when neutralizing gas mixtures containing H₂S, as well as when they are burned in order to obtain a thermal effect, together with environmentally hazardous substances SO₂, SO₃ is obtained and free S (sulphur) powder. Thus, even during the neutralization of H₂S by combustion, substances with less toxic properties are obtained, which create environmental problems for the environment. In other process units, gasoline and gas fractions are purified from H₂S in special process units by passing through a NaOH solution. Together with the causes and sources of H₂S formation, the following data can be indicated in the NPP that is harmful to the environment. - In the process furnaces of all production units of NPP, depending on the burning fuel, substances such as C_xH_y , CO, CO₂, H₂S, SO₂, SO₃, NO_x, H₂O (steam) are emitted into the atmosphere [7-8]. In process furnaces, a mixture of 96% C_xH_y and 4% harmful compounds is burned in order to obtain a thermal effect and to neutralize harmful exhaust gases, resulting in CO, CO₂, H₂S, SO₂, SO₃, NO_x and other harmful products into the atmosphere. In recent years, industrial oil and gas process furnaces have used ecologically more efficient combustible natural gas instead of liquid combustible fuel (fuel oil, diesel fuel). Despite the environmental efficiency of natural gas compared to liquid fuel during its combustion, H₂S, SO₂, SO₃ are formed in process furnaces due to the presence of C₂H₅SH (ethyl mercaptan), which is introduced into the composition of natural gas for odoring [9-10].

In the developed countries of the world, H₂S, obtained as a result of the processes of OGRP, the complete purification of which is impossible to remove, is used as a raw material for the production of H₂SO₄. Despite the fact that Azerbaijani oil belongs to the groups of oil that do not contain sulfur in the composition of the NGV, from the primary to the final, at each stage of processing, a release of poisonous gases is formed, in which H₂S is emitted. Research is underway on the use of special absorbent reagents for scientific work in order to fully effectively purify the isolated H₂S from an environmental point of view of solving the problem. According to technical

literature, H₂S gas is often found in the oil and gas industry as part of oil and gas produced from the subsoil.

In this regard, when raw materials are obtained from oil and gas, a huge amount of H₂S gas is emitted into the environment, which, along with a serious impact on human health, has a destructive effect on all spheres (atmosphere, lithosphere, hydrosphere) and creates long-term environmental problems. In addition, during the production of oil and gas from underground, during its storage, the transportation contained in their composition H₂S gradually leads to corrosion of steel equipment, as a result of which fires, explosions and other incidents often occur. As can be seen, from the above facts - the presence of free H₂S in oil and the formation of sulfur organic compounds (RSH, RSSR, sulfur-containing hetero-compounds) in catalytic processes, the formation of H₂S at different stages of oil processing in OGRP occurs in different quantities. H₂S gas is known to be an ecotoxicant. That is why for the purification of this gas, a program in several areas was chosen in new chemical, environmental and cost-effective ways. Work was carried out on the development of a procedure for the purification of H₂S from samples containing NGV, as well as from a gas mixture composed in special vessels in laboratory conditions.

According to our studies, any of the methods for purifying H₂S from the composition of exhaust gases emitted during extraction and processing in the technological processes of the oil and gas industry has its drawbacks. Therefore, it was not possible to achieve 100% purification and environmentally effective neutralization of H₂S from the composition of the gas mixture, that is, the targeted environmental use of this gas was not achieved. Thus, as can be seen from our previously mentioned explanations, the development of a method for the environmentally efficient purification of H₂S from the composition of exhaust harmful gases as a result of technological processes of OGRP is one of the most pressing issues. In preparing the above environmental explanations, the main technical literature on the oil refining industry and the regulations of the main processing units were used. At the same time, as noted in the literature used, as a result of the use of new catalytic, electrical, and especially absorption methods for purification, neutralization, and utilization of exhaust gases from many enterprises, the amount of harmful gases emitted into the atmosphere has decreased in recent years.

Purification of effluent OGRP by absorption is evaluated as environmentally effective. But, in the final stage, in the process of desorption of the absorbed substances, that is, in the purification or disposal of the absorbent, other environmental problems are again created.

So, according to our environmental research, it was revealed that conducting environmental scientific work on the development of a new chemical method for environmentally effective purification, neutralization, disposal of the main ecotoxicant (environmentally hazardous substances of the 2nd and 1st class) of poisonous, explosive gas H₂S, which is formed in industrial enterprises and, especially, in the technological processes of the oil refining industry is scientifically justified.

REFERENCES

1. Fenouil L.A., Towler G.P., Linn S. Removal of H₂S from coal gas using limestone: kinetic considerations / *Ind. Eng. Chem. Res.* 1994 Vol. 33, №2, p. 265–272.
2. Hartman V.L. Dynamics of sulfur chemisorption by a solid absorber and its application for optimization of industrial desulphurization / *Diss. on sois. uch. degree cand. tech. Sciences.* M.:2000. p. 111.

3. Lazarev V.I. Methods of purification of natural gas from hydrogen sulfide by solid sorbents / *Obz. inf. Scientific and tech. aspects of environmental protection. environment / VINITI.* 1999. №4. p. 84–113.
4. Kipnis M.A., Kalinevich A.Yu., Goncharuk S.N., Dvlganyuk V.F., Danilova L.G. Catalysts for desulphurization and steam reforming of hydrogen production plants / *Oil refining and petrochemistry.* 1994. №5. p. 12–15.
5. Furmer Yu.V., Beskov V.S., Brui O.I., Yudina V.V., Danzig M.L. Kinetics of hydrogen sulfide chemisorption by zinc oxide absorbers / *Chemical industry.* 1982. №12. p. 37-40.
6. Akhmetov S.A. Physical and chemical technology of deep oil and gas processing: Textbook. 4.2. Ufa; Publishing house of UGNTU, 1997. p. 304. ISBN 5-7831-0077-3.
7. Danzig G.A., Grechenko A.N., Grigoriev V.V., Serova L.P., Yagodkina G.N. Influence of the method of introducing copper oxide on the chemisorption properties of zinc-containing sulfur-refining masses / *Zh. prikl. chemistry.* 1988. №6. p. 1240–1246.
8. *Catalyst Handbook.* 2nd ed./Ed. By M.V. Twigg. Wolfe Publishing Ltd, 1989, p. 209.
9. Zelvensky Ya.D., Gerchikova S.Yu., Tr. GIAP, vol. 2. GNTIHL. M.-L. (1953) p. 132–159.
10. Yumura M., Furimsky E. Comparison of CaO, ZnO and Fe₂O₃ as H₂S adsorbent at high temperatures / *Ind. and Eng. Chem. Process Des. and Dev.* 1985. Vol.24, №4. p. 1165–1168.