Ecological Analysis Of The Treatment Of H2S Gas Contained İn Waste Process Gas InThe Refinery Industry

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Abstract. The ecological analysis (research) conducted by us is of great importance. Thus, it can be considered as one of the main directions of research work on the development of an ecologically friendly method of purification of ecologically hazardous H_2S gas, which is a mixture of gases formed during technological processes in the oil-refining industry, which can be used and not used.

That is, the above-mentioned research is scientifically justified. Therefore, the ecological research and analysis carried out in this direction belongs to the problematic, topical issues that are considered to be one of the main, broadest ecological requirements of the time.

Key words: oil, industry, ecology

As with all industrial plants in the world, air pollution from oil refineries occurs constantly and continuously. Therefore, in order not to change the natural composition of the atmosphere, which is one of the main sources of human life, it is economically and ecologically important for each country to fulfill state programs and special agreements on global obligations to prevent pollution by harmful substances, especially ecotoxicants.

In this regard during the implementation of special state programs to improve the environmental situation in the Republic of Azerbaijan as a result of the introduction of new technological installations, reconstruction work in the oil refining industry (ORI) of the State Oil Company of the Republic of Azerbaijan, a number of ecologically and economically important indicators are achieved.

In the oil and gas industry of the world, during the technological process in the oil refining industry, for an objective reason the atmosphere is polluted

due to the production of gas, liquid and solid waste and even in the processes of neutralization, processing, storage, disposal (intended use) of these waste.

One of the growing industrial sectors due to modern development is OPI. As noted elsewhere [1], as a result of an increase in the total volume of world industry for every 10-12 years, the amount of harmful substances emitted into the atmosphere and do not know borders, has increased several times.

Research carried out have shown that at the beginning of the twentieth century, 20 chemical elements were used in the world, in the middle - 50 chemical elements, and in the early 80s - all the chemical elements known in the Mendeleyev periodic table [1]. As a result of the organization and implementation of control systems of environmental monitoring to determine the composition of the atmosphere using stationary and mobile gas analyzers at sources of emissions of harmful substances into the atmosphere at industrial enterprises and their OPI, it was found that 200 different harmful substances are emitted and their list mainly includes SO_2, CO, NO_2, H_2S, H_2SO_4, HCl, Cl_2, phenolic compounds, formaldehyde, methyl mercaptan (CH_3SH), soot, dust, aerosol (salts, metal oxides), Mn, Cu, Ni, Pb, Fe, Zn and other metal compounds [1].

In connection with the purpose and requirements of our research work in the reference [2] explanations are given on the preliminary scientific research of the causes and sources of the formation of H_2S gas in the mixture of waste gases formed during technological processes in the OPI.

As noted in [2], despite the low sulfur content in Azerbaijani oils, a mixture of hydrogen sulphide-containing gases is formed at the initial and deep technological processes at the OPI. Therefore, at present, a new unit is being installed at the Heydar Aliyev Refinery to recover sulfur from H_2S, which is part of the waste gases.

According to our environmental analyzes (studies), until now it has not been possible to completely deeply remove the H_2S gas from the mixture of technological waste gases formed in modern OPI in the world.

Raw sulfur is extracted only from its part. In some cases, due to the small amount of H_2S gas in the process flue gas mixture, the waste gas is rendered harmless by burning this gas (H_2S) in the process burners. In some cases, neutralization is carried out by burning in technological furnaces as a source of thermal energy - fuel.

As is known from the technical and environmental literature, as well as from the conducted scientific research, H_2S gas is a very dangerous ecotoxicant substance. When the amount of this gas in waste gases is large, powerful explosions occur during neutralization, combustion. Therefore, waste gases containing H_2S are pre-purified in special devices to some extent with absorbents, and then burned in a flare. In addition to the above, during high-temperature combustion and neutralization, H_2S gas turns into harmful substances, such as SO_2, SO_3, CS_2.

$$2H_2S + 2O_2 \rightarrow 2SO_2 + 2H_2O$$
$$2SO_2 + O_2 \rightarrow 2SO_3$$

The resulting substances SO_2 and SO_3, when released into the atmosphere with a temperature of 600-800 °C, react with moisture in the air (H_2O vapors)

$$2SO_2 + H_2O \leftrightarrow 2H_2SO_3 \ , \ SO_3 + H_2O \rightarrow 2H_2SO_4$$

and cause the formation of a mixture of H_2SO_3 and H_2SO_4 acids and aerosol SO_2, SO_3 wastes.

As noted in the technical and ecological literature, SO_2 and SO_3 compounds are less toxic than H_2S. That is why waste gases containing H_2S are neutralized by incineration. During the neutralization of the H_2S-containing waste gases in this way, steel technological equipment around the production flare towers (depending on the height of the towers and meteorological conditions) are mainly subject to severe corrosion due to the influence of SO_2,

SO_3 aerosol waste, along with these, the environment is polluted and, finally a number of problems arise in the biosphere.

That is why taking into account the degree of danger of harmful substances obtained, generated and emitted into the atmosphere at each enterprise, the norms of sanitary protection zones (SPZ) for social facilities in the region where the enterprise is located, as well as the hazard category of the enterprise are determined [3].

Studies have shown that as in many industries, OPI uses mainly ethanolamines (mono-, di- and triethylamines), sodium phenolate, trialkyl phosphate and other sorbents to remove gaseous hydrogen sulfide from a mixture of waste gases. While there are some advantages to these methods, they also have other disadvantages.

It is known from the technical literature that when carrying out the absorption of gaseous H_2S formed during the purification of some petroleum distillates from sulfur with H_2 gas (hydrogen gas) and special catalysts in OPI, using monoethanolamine (MEA) as a sorbent, the periodic sorption process takes place under the following reaction conditions [4]:

$$2HOCH_2CH_2NH_2+H_2S \rightarrow (HOCH_2CH_2NH_3)_2S + H_2S \rightarrow 2(HOCH_2CH_2NH_3)HS$$

The absorption of H_2S by the MEA solution occurs at 25-40 °C. Desorption occurs at 106–130 °C and H_2S gas is produced. Occurrence of decomposition of H_2S during regeneration, and in the process of regeneration a part of compound $2(HOCH_2CH_2NH_3)HS$, which changes its composition, is discharged into the general sewage system with industrial wastewater. Consequently, as a result of subsequent transformations of these compounds, water-soluble H_2S gas or other sulfur compounds are formed. Thus, as can be seen from the above general explanations, the implementation of the technological process of obtaining raw sulfur by complete deep purification of H_2S formed in the OPI from the composition of waste gases is of great economic

and environmental importance. However, as in other industries, removing H_2S from a mixture of low H_2S waste gases is not considered effective.

Despite the small amount of H_2S in gas waste during technological processes at OPI, it is considered a substance that pollutes the atmosphere and is harmful to human health, flora and fauna, hydrospheric flora and fauna. Therefore, environmental research on the complete purification and targeted use of even small amounts of H_2S is considered the most urgent problem of our time.

As can be seen from the results of environmental scientific analyzes (studies), at present the extraction of raw sulfur from H_2S gas has also been developed along with the chemical (absorption) method of individual purification of gas formed in a small amount from a mixture of other gases, and during the purification of H_2S by the developed methods ecologically effective results not achieved. That is, each of the existing methods has its shortcomings.

Taking into account the results of our environmental scientific analyzes (studies), we have planned research work on conducting in laboratory conditions a complete deep purification of H_2S using cheap raw materials, solutions of substances with sorbent properties, as well as a parallel complex mixture of reagents for conducting research on purifying H_2S gas from a mixture of CH_4 gases with a content of 2% H_2S, and the use of the resulting new compound in several directions.

Therefore, at present it can be considered reasonable and advisable to conduct an in-depth preliminary environmental analysis of technological processes, as well as scientific research on the purification of H_2S gas from a mixture of waste gases in other industries and the oil and gas industry in the world. Therefore, based on the results of our special environmental scientific analyzes (studies), it can be considered scientifically justified to implement the development of a method for ecologically effective purification of H_2S gas in waste gases generated in the OPI.

References

1. Nikolayev Yu.N. Modern air pollution control devices. Ecology of production. Scientific and practical journal. M., ed. ZAO "Industry records", No. 10, 2005, p. 50-52 (in Russian).

2. Gadzhiyeva S.R., Abbaszadeh G.S., Bayramov G.I., Guseinov F.E., Rustamova U.N. Environmental analysis of the causes and sources of H_2S formation during technological processes in the oil refining industry. Monthly scientific journal. "Eurasian Union of Scientists" No. 2 (71), 2020, part 3, pp.44-46 (in Russian).

3. Vinokurova M.V. How to confirm the sufficiency of the boundaries of the sanitary protection zones. Research Institute "Ecotoxicology" Production ecology. Scientific and practical journal. No. 3, 2014, p. 58-64 (in Russian).

4. Sorkin Ya.G. Peculiarities of sulphurous oils processing and environmental protection. M.: "Khimiya" Publishing house, 1975, p. 131-137 (in Russian).