

Conducting Ecological Analysis To Determine The Sources And Causes Of Generating Ecotoxics In Oil Industrial Enterprises

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Summary: Despite the modernization of the technological process and the prevention of harmful compounds released into the environment at oil production and refining facilities, compounds with ecotoxic properties are still released into the environment. In this regard, it is important to study the ecotoxics released into the environment from these industries, which have harmful effects on flora, fauna, as well as the human body. Therefore, modern technologies, as well as scientific research and the application of new approaches mean obtaining more effective results.

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As is known, one of the main sources of environmental pollution is the oil industry. Ecological toxic substances are formed during technological processes in the production and refining industries of the oil industry, which differ in composition and environmental characteristics.

In the oil industry, ecotoxic substances are mainly in the composition of gases, liquids and solid wastes obtained (formed) during technological processes. Therefore, depending on the amount of ecotoxics in industrial wastes, which are considered to be dangerous to human health and other living organisms, as well as the plant world, the environmental hazard of these wastes is generally determined.

In accordance with the purpose of our research, in order to determine the sources and causes of production of ecotoxics in industrial wastes formed in the oil industry, in the first case, environmental research and analysis were conducted, the following results were obtained:

1) in oil production enterprises

- each of the mixtures of CH₄, H₂S, SO₂, RSH, CO, NO_x gases, which are gaseous in the oil initially extracted from the ground and stored in tanks and released into the environment, are substances with ecotoxic properties;

- preparation of oil as a raw material (during the process of purification from water, mechanical impurities and natural evaporation of oil from oil storage tanks, ecotoxics C_xH_y, H₂S, SO₂, RSH, CO, NO_x are released into the atmosphere)

- during the purification of oil from water and mechanical mixtures in tanks, industrial wastewater containing hydrophobic, hydrophilic emissions salts of various composition, phenolic compounds, naphthenic acids and sulfide-containing metals and other chemical compounds with different properties - ecotoxicant mixture is formed (obtained). During the process of purification of these waters in accordance with environmental standards, H₂S, PH₃ and other harmful substances contained in them evaporate and are released into the atmosphere. At the same time, phenol-type compounds with good solubility in the water remaining in the treated industrial wastewater, salts of naphthenic acids, polycyclic aromatic hydrocarbons,

OPWM (oil product waste mixture) and other harmful substances are discharged into the water basins.

- during the technological process of preparation of oil as a raw material, III class environmentally hazardous oil sludge waste obtained in the form of solids and considered as industrial waste (containing 45-55% of oil, 3-5% of water, about 40-55% of sand-clay and other metal salts of various compositions, mechanical mixtures) is formed. Depending on the composition and origin of the oil, as a result of the presence of radioactive and other harmful heavy metals, during storage, neutralization and processing of oil sludge waste ecotoxic substances are released into the environment - atmosphere, hydrosphere, lithosphere.

2) in oil refineries:

- C_xH_y , H_2S , SO_2 , RSH, CO, phenol-type compounds and other ecotoxicant substances are released into the atmosphere during evaporation of oil from tanks for storage of crude oil prepared for processing;

- despite the ecological treatment of industrial wastewater containing naphthenic acids (mainly in Balakhani oil), phenol-type compounds, salts of various compositions, mechanical mixtures formed during the treatment of crude oil for processing in tanks, they are ecologically polluting the hydrosphere and the biosphere in general;

- ecotoxicants - phenol-type compounds, OPWM (oil product waste mixture) and other harmful substances accumulate in the mixture of wastewater from distillates-fractions as a result of oil leaks in technological equipment at industrial plants, together with industrial wastewater formed during the desalination process of oil in primary refineries. During the process of these wastewater treatment, ecotoxicant vapors - H_2S , OPWM - are released into the atmosphere. In general, from non-organized sources of "AT", "AVT", "ELOU AVT" primary oil refining facilities, technological equipment units and organized sources, technological furnaces ecotoxicants of various compositions and properties - C_xH_y , H_2S , SO_2 , RSH, CO, SO_3 , NO_x , Cl_2 , Me_xO_y , HCl and other substances are discarded into atmosphere;

- ecotoxicant-fraction C_xH_y , RSH, H_2S , phenol-type compounds evaporate into the atmosphere from the tanks of distillates obtained in the primary oil refineries.

In the process of obtaining and treatment commodity oil products:

- Na_2S (highly harmful salt) is obtained when cleaning the gasoline fraction with NaOH solution. This, in turn, is a production waste formed as a result of the presence of sodium salts of naphthenic (petroleum) acids ($ROONa$), free NaOH, phenol-type compounds, Na salts and their good solubility in water during the process of purification of kerosene and diesel fractions with alkaline solution. Due to the problem of deep water treatment, despite the fact that the water is treated in accordance with environmental standards, these ecotoxicant compounds evaporate and pollute the atmosphere, and at the same time have a deadly ecological impact on the flora, fauna and water basins.

- recently, during the process of catalytic purification of kerosene, diesel fractions and oil distillates in hydrogen, large volumes of ecotoxicant H_2S and RSH mixed gases are formed. Although H_2S is purified from the mixture of these gases with an absorbent (monoethanolamine), in the final stage the mixture of these gases and H_2S is purified at 800 °C by burning in in production torch towers.

However, in this case, other ecotoxicants (SO_2 , SO_3 , NO_x , CO, C_xH_y , etc.) are formed, and at the same time as a result of incomplete oxidation of H_2S gas, i.e. due to its reduction, S (sulfur) dust is released;

- ecotoxicants contained in the mixture of exhaust gases obtained in connection with the regeneration of catalysts during the technological process in the catalytic cracking unit are burned in the torch towers. Chemical transformations occur and other harmful substances - H_2S , SO_2 , SO_3 , NO_x , CO, coke and soot dusts of PAK compounds are also formed. The catalyst is filled into the reactor of this unit, and silica gel compounds containing aluminum and molybdenum (evaluated as ecotoxicants) processed in the electrofilter are released into the environment in the form of powder;

- during the technological process in the catalytic reforming installation the formation of H₂S gas occurs in the composition of the exhaust gases called dry gas. During the combustion of this mixture of gases, H₂S, C_xH_y, CO, SO₂, SO₃, S, NO_x, Cl₂, HCl are released into the environment;

- during the technological processes of processing of petroleum oils by contact with acid (H₂SO₄) and alkali (NaOH), "processed gumbrin" wastes are obtained in solid state (acid tar) with the release of H₂SO₄ acid, NaOH alkali vapors into the environment. Along with the release of hot H₂SO₄ vapors into the environment during the process of regeneration of "acid tar" from alkaline wastes from these solid wastes, the acidic waters obtained have a negative environmental impact on water bodies as a mixture of ecotoxicants, although they are treated in several stages. In the process of processing petroleum oils by contact bentonite clays, "processed gumbrine" containing up to 25% PAC with ecotoxicant properties is obtained;

- during the production of naphthenic acids, vapors of ecotoxic naphthenic acids, H₂SO₄ acid, NaOH alkali are released into the atmosphere. At the same time, hydrocarbons belonging to kerosene and diesel fractions, phenol-type compounds, a mixture of sodium salts of naphthenic acids because of well soluble in water have a negative environmental impact on the flora and fauna of water bodies due to the impossibility of deep sanitary treatment of industrial wastewater;

- as a result of technological processes in the gradual coking plant of heavy oil fractions, due to the high content of PAK and sulfur in these fractions, a mixture of gases containing PAK and H₂S is burned and neutralized in torch towers. SO₂, SO₃, S, NO_x, benzopyrene and other substances are discarded;

- a mixture of gases containing C_xH_y, PAK and H₂S, SO₂, which cannot be used, during the process of air oxidation of the tar fraction in the bitumen production plant is neutralized by incineration in the horizontal furnace of the plant at 800 °C.

During the research it was determined that taking into account the meteorological conditions, small amounts of C_xH_y, PAK, H₂S, SO₂, SO₃, NO_x benzopyrene, coke, soot are formed and released into the environment near the furnace.

Based on the results of our environmental research and analysis based on environmental normative and technical documents, statistical reports, technical literature and production practices in the oil industry, it can be noted that the ecotoxicants contained in the gas-liquid and solid waste mixtures obtained from these sources, qualitative and quantitative analyzes are programmed. Based on the results obtained, the actual assessment of the environmental impact of toxicants in the oil industry will be scientifically substantiated for the first time.

As can be seen from the above-mentioned environmental studies, depending on the volume, composition, causes of occurrence and ecotoxicological properties of gaseous, liquid and solid wastes generated in the oil industry, environmental pollution occurs during the neutralization, processing and storage of each of their mixtures. It should be noted that a mixture of gases that cannot be used, captured or separated at oil production facilities is neutralized by burning in torch towers. At the same time, a mixture of ecotoxicologically harmful substances as CH₄ and its homologues, large amounts of CO₂, H₂S, SO₂, S, SO₃, NO_x, etc. are released into the environment.

Recently, in some oil production enterprises is started capture, separate by special devices and use of these gases. This measure has great economic and environmental significance. A mixture of C_xH_y, H₂S, SO₂, CO and other ecotoxicant gases obtained from various technological processes of the oil refining industry, which cannot be used, is sent to the torch farm for neutralization and incineration in the torch towers. Petroleum hydrocarbons of various compositions make up 92-96% of the mixture of gases obtained from technological processes and released to the torch towers. Pollution of water basins occurs due to the presence of hydrophobic and hydrophilic emulsions in the treatment of industrial wastewater mixtures formed in the oil industry, which are difficult to separate by environmental standards during the mechanical and other methods of treatment of these enterprises.

The industrial wastewater (IWW) formed in the oil refining industry is very different from the IWW obtained in the oil production industry due to its composition, volume and various compounds and properties. That is why there are problems in the deep cleaning of various types of IWW formed in the oil refining industry and released into the treatment plants of the enterprise from various technological sources in accordance with environmental standards. During the treatment of IWW in mechanical, physicochemical and biological treatment plants, H₂S and other harmful substances contained in these waters evaporate into the atmosphere and cause environmental pollution. At the same time, despite the fact that IWW in the oil refining industry is treated in accordance with environmental standards, the ecotoxicants that remain in some of these waters have a lethal effect on the flora and fauna of water bodies, such as the Caspian Sea.

Thus, based on the results of research and preliminary environmental analysis the following explanations can be made:

Ecotoxicants H₂S, SO₂, NO_x, etc. emitted into the atmosphere from the organized sources of complex technological installations of oil refining enterprises, 120 meters of chimneys of technological furnaces, organized sources of torch towers, as well as from other production areas are not only in the sanitary protection zone. Due to metrological conditions (mainly depending on wind speed) they propagate at a long distance of 100 km and settles on the ground, polluting the environment.

Therefore, ecological monitoring-scientific research should be carried out in different directions to determine the compounds with ecotoxicological properties in all waste mixtures formed in oil production and refining enterprises, and the assessment of ecological analysis of environmental impact should be based on ecological-analytical experimental measurements.

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