



Air pollution in oil industry of Azerbaijan

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Abstract

The emissions of air pollutants (SO₂, CO_x, NO_x, RH, dust and other) by industrial objects for last 13 years in Azerbaijan are adduced. The main sources of emissions and the distribution of emissions on the stationary and non-stationary sources have been established. The problems of air pollution by oil industry objects were investigated in detail. Specific emissions of harmful substances from energy-supply systems of oil-industry objects (extraction, preparation, transportation and refining) to the atmosphere have been determined. The contribution of oil industry objects in pollution of the air atmosphere of Baku and the dynamics of their changes for 8 years have been adduced. The brief results of scientific researches on the prevention of air pollution are evaluated.

1 Introduction

Azerbaijan has developed the oil-industry and energy-production branches of its economy. In the country about 9-10 million tons of oil, 6-7 billion cubic meters of natural gas and 15-16 billion kWh of electrical power on the basis of fossil fuels per year are produced. The industrial objects of these branches of the economy are the main stationary sources of harmful emissions into the atmosphere of the country. With the starting of the work of international contracts on the oil production in the Caspian Sea, it will be possible to increase the oil production for 4-5 times in the forthcoming decade. Emissions to the atmosphere resulting from extraction, preparation, transportation, refining and use of oil significantly contribute to the sum of environmental damage by the oil industry. Light hydrocarbons, nitrogen, carbon and sulfur oxides and secondary products of their conversions play an important role in the existence of the green-



house effect, acid rains, photochemical smoke, ozone hole and other atmospheric phenomena. These atmospheric effects related with air basin pollution lead to significant damage to the environment of the country, especially the populous site of Baku. Therefore, the various scientific and public organizations of the country, related to the environment protection, have been working on joint projects to search for rational ways to prevent air pollution for the last 5-6 years. In this paper, some results of these investigations have been concluded.

2 Methods

We have conducted an environmental inventory of air pollutant sources in more than 60 industrial objects of the country during the years between 1991-1998. In these studies, the instrumental and estimation methods of environmental inventory of harmful substance sources and determination of common and specific emissions were used in addition to financial terms of the environmental damages for air pollution. The instrumental techniques consist of the arrangement for selection of gaseous samples and of analytical equipment such as chromatograph, photocolimeter and gas analysis apparatus "testo-350".

Some data on the common emissions were received from Academy of Sciences, Statistical Committee, Ecological Committee and State Oil Company of Azerbaijan Republic.

3 Results and discussion

The change dynamics of harmful emissions from stationary sources in the country territory for 10 years have been presented in Table 1.

Table 1. The change dynamics of harmful emissions into atmosphere from stationary sources in the country for 12 years.

Harmful emissions	Quantities, 1000 ton				
	1986	1990	1995	1997	1998
TOTAL	920.9	2108	878.6	389.6	352.4
Solids	272.7	148.1	20.6	22.0	21.6
Gases and liquids	648.2	1960.4	855.9	367.6	330.8
SO ₂	164.2	90.3	50.0	37.8	41.3
CO	103.7	70.6	21.6	22.7	15.2
NO _x	66.8	59.2	31.6	26.2	25.3
VOC	302.6	1733	749.8	263.4	224.0
Others	10.9	7.5	2.9	17.5	24.3



As seen in Table 1, the total emissions of harmful substances were decreased by 5.9 times for the last 8 years connected with changes of production structures and stopping many industrial objects at post-soviet period. The quantity of harmful substances emitted from stationary pollutant sources in 1998 was 352 thousand tons. About 29.7 % of harmful substances have been caught by the application of purification techniques.

The change of contribution of transport in air pollution in the period of 1 990-1998 is shown in Table 2.

Table 2. Contribution of transport in the air pollution of the country

Years	1990	1993	1995	1997	1998
Contribution of the transport, %	25.9	26.5	33.7	54.1	47.1

The regional distribution of harmful emissions in the country are: 75-76 % of harmful emissions belong to the industrial objects of Baku, 4-5 % of Sumgait, 6-7 % of Ali-Bayramli and 7-8 % of Mingechevir. So about 95-96% of emissions belong to the oil and oil-refining industry of the Baku-Apsheiron region and the energy-production industry of Ali-Bayramli and Mingechevir cities.

At present there is a stable activity in the oil industry and energy. More than 90 % of emissions belong to the oil industry, power production and transport. The contribution of the oil industry objects to the pollution of the air atmosphere by stationary sources are adduced in the Table 3.

Table 3. The contribution of oil industry objects in the pollution of air atmosphere by stationary sources.

Years	1990	1995	1996	1997	1998
Contribution of oil industry in air pollution by stationary sources, %	52.7	68.4	70.2	73.7	70.5

The contribution of oil industry objects in air pollution abatement of Baku exceeds 70 % (42-43 % for NO_x, 35-38 % for SO₂, 30-32 % for CO and 95-98 % for hydrocarbons) are in connection with the large emissions of hydrocarbons for oil production in the Caspian Sea.

Air pollution by the oil industry has been investigated in more detail. It should be noted that the main sources of emissions of harmful substances are energy-supply systems of the oil industry objects.

Our estimates [1-2] indicate that the energy consumption at the extraction processes is 1.8-2%, transportation 0.1 %, separation 3.6 % and refining 8.4 % of extracted oil.

The use of instrumental analysis allowed it to estimate capital coefficients of emissions of harmful substances from the energy-supply per each ton of oil for



individual branches of the oil industry of the country. The results are given in Table 4.

Table 4. Capital emissions of harmful substances from energy-supply systems of oil industry objects.

Processes	Emissions, g/ton				
	NO ₂	SO _x	CO	CH	C ₂₀ H ₁₂ 10 ⁻³
Extraction	8.5	190	70	3.2	0.3
Separation	5.7	4.9	684	93.2	0.5
Transfer	0.45	10.2	3.7	0.2	0.015
Refining	1.5	60.7	230	168	3.56
Total	16.15	265.8	987.7	264.6	4.4

In this work we will discuss in detail the air pollution by oil extraction and transportation processes in the Azerbaijan oil industry. The exploitation of offshore oil-fields, mainly at the Chirag offshore platform in the Caspian Sea, began in April 1999. The preparing and transportation of raw oil is realized in Sangachal terminal on the Western route to Supsa by oil pipe-lines.

Emissions of harmful gases at the Chirag platform and Sangachal terminal for an oil production capacity of about 5 mln tons are given in the Table 5.

Table 5. Annual emissions (ton/year) into atmosphere from "Chirag" platform and Sangachal terminal.

N	Pollutants	Chirag-1	Sangachal terminal
1	Carbon dioxide	216735.0	415821.0
2	Nitrogen oxides	697.9	469.8
3	Carbon monoxide	477.3	1089.0
4	Sulfur dioxide	93.9	0.3
5	Solid particles	18.3	12.9
6	Non-saturated VOC	818.5	4592.0
7	Methane	862.2	120.3
	Total	219703.1	422105.3



The inventory of emission sources in the oil pipeline objects on this route has been worked. It has been shown that the main emission sources are Sangachal and Supsa terminals, pump stations, power generators and reservoirs for diesel fuels.

The data on the emissions of combustion products and hydrocarbons from these main sources have been presented in the Table 6.

Table 6. Emissions at the oil transportation by pipeline on the route Baku -Supsa

N	Objects	Emissions sources		Total emissions, ton/year			
		Name	Number	NO _x	CO	SO _x	RH
1	Pump stations (6 unit)	Pumps	18	5.1	47.9	15.1	20.4
		Generators	12	0.94	8.87	2.78	3.78
		Reservoirs	18	-	-	-	0.11
2	Pressure reduction Station (3 unit)	Generators	2	0.2	1.87	0.59	0.80
		Reservoirs	2	-	-	-	0.02
3	Supsa terminal	Pumps	3	0.75	8.1	3.2	5.2
		Generators	3	0.18	2.0	0.8	1.3
		Reservoir for Diesel fuel	1	-	-	-	0.006
		Reservoir for raw oil	4	-	-	-	41.4
Total, ton/year				7.17	68.7	22.5	73.0
Specific emissions, g/ton				1.43	13.7	4.5	14.6

Significant increases in oil production and of its processing planned for the near future will also be accompanied by a 4-5 times increase of the harmful emissions to the atmosphere. This can lead to undesirable social consequences. In this connection, after the reclamation of the independence the Azerbaijan Parliament has adopted a series of new laws and normative documents defining the State policy in the sphere of environment protection. The laws on protection and the use of natural resources, series of decrease on normative of emissions and outflows to the environment, economical damage to environment, sums of payments and fines for its pollution, etc have been adopted. By using of these normative data were estimated environmental damage, fines and payments for air pollution in oil-industry objects [1]. It is necessary to solve the following problems with the aim of prevention of excessive air pollution of the country connected with developing of oil industry and transport:



- Application of ecologically clean techniques and technology,
- Employing of effective purification technology for cleaning of exhaust gases,
- Creation of natural conditions for sanitation of air basin,
- Organizing of permanent monitoring for atmosphere air state and for harmful substances emissions by separate industrial objects and transport,
- Improvement of legislative and standard documents for air pollution in the country.

The scientific researches in the field of decreasing of the harmful gas emissions by energy-supply objects of the oil industry are being carried out in the scientific centers of the country.

The effective non-traditional photochemical, radiation-chemical, plasma-chemical and thermal methods of cleaning of organic fuels and their gaseous products of combustion from S, H₂S, SO₂, NO_x, CO have been proposed. The thermal method for simultaneous purification of SO₂ and CO from smoke gases was worked out by Gurbanov et al. [4]). The essence of the method conclude injection 1 % solution of H₂O₂ to the chimney. At the optimal conditions the purification degree reaches 85-90 % for CO and 20 % for SO₂. A photochemical method of purification of natural gas from H₂S has been proposed in [5]. As a result of selective absorption of UV-radiation with L=250 nm and chemical reaction of H₂S→H₂+S, the purification degree reaches up to 98%. The effective radiation-chemical methods of desulfurization of coals [6] and their semicoking and combustion products have also been worked out.

At present the application of more effective methods on an industrial scale with the aim of prevention of air pollution is recommended.

On the basis of these research results the Ecological Society "Ruzgar" is organizing the ecological propagation for creation of the international public movement in Caspian countries for protection of the air basin at exploitation of offshore oil deposits in the Caspian Sea. One of the basic aspects of this movement is internationalization of problems of air pollution in Caspian countries that include the following issues:

- Mutual agreement of standards and legislative acts on the protection of air basin in the Caspian countries,
- Timely information on the accident emissions,
- Agreements on the procedure of mutual producing of economical sanctions for air pollution,
- Mutual acquaintance and agreement on the projects realized in Caspian Sea. The ways of the decision of this problem by cooperation with IUAPPA are offered.



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