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AIR POLLUTION CONTROL ON KARACHAGANAK FIELD

Abstract

Karachaganak field is one of the largest in the world and its industrial development is accompanied by large volumes of pollutant emissions into the atmosphere. This article focuses on the results of environmental air monitoring of Karachaganak field. There was a comparative analysis of pollutant emissions into the atmosphere from industrial activity of Karachaganak field for 2013-2015 years.

Keywords: *air pollution, air monitoring, Karachaganak field, oil and gas industry, emissions.*

The dynamic development of oil and gas industry is very important for the economy of Kazakhstan. Currently, it plays a decisive role in the economic structure of the Republic of Kazakhstan.

However, it is an economic good has a reverse side, in the form of environmental risks of oil and gas industry, among which, first of all, air pollution.

However, compliance with legal requirements for regulation of the environmental aspects of production activity allows to save the environment [1].

Undertaking necessary operations associated with Karachaganak field development and operation of existing infrastructure facilities inevitably affects the environment including ambient air.

The Company's air emission control activities are carried out as permitted by the limits established in the Environmental Emissions Permit. Emissions to the air principally arise from routine fuel gas combustion for the operation of the gas-turbine power plants, boilers, process heaters and compressors as well as from operational flaring events. In 2015 emissions to the air decreased by 19% in comparison with 2014 and totaled 11 thousand tonnes. Table 1 shows data on the permissible and actual KPO's emissions for the period of 2013-2015.

Table 1 – Permitted and actual volumes of pollutant's emissions, 2013-2015

Annual volume of emissions by pollutants, in tonnes:	2013	2014	2015
Permitted:	**15,321**	**16,168**	**14,807**
Actual, including:	**11,320**	**14,005**	**11,314**
Nitrogen oxides	2,068	2,240	1,594
Sulphur dioxides	5,703	7,346	6,113
Carbon monoxide	1,637	2,229	1,723
VOCs	1,700	1,718	1,515
Hydrogen sulphide	29	31	29
Solid particles	110	325	90
Others	73	116	249

In 2015 specific emissions per unit of production amounted to 0.42 tonnes per thousand tonnes of hydrocarbons (HC) production.

The decrease in emissions between 2014 and 2015 were mainly due to a reduction in well operations with 17 wells completed in 2015 compared with 19 in 2014. The reduced scope of well operations resulted in a reduction of flaring of associated gas by 24% through well test and clean-up

operations in 2015. In addition, liquid hydrocarbons of the base volume flared were reduced to 40% by the use of hydrocarbon liquid recovery equipment [2-4].

Conducting activities to manage the air emissions based on the limits established according to the Environmental Emissions Permit, over the last three years KPO has performed its activities without exceeding the permissible limits.

This is confirmed by the results of production environmental control of KPO b.v..

Production environmental control of oil and gas companies is aimed at the prevention, detection and suppression of violations of legislation in the field of environmental protection, enforcement of requirements by subjects of economic and other activity, including standards and regulatory documents in the field of environmental protection [5].

In Kazakhstan, the implementation of production environmental control by large oil and gas companies is well-functioning and effective environmental measure, meets the international practice.

KPO performs large-scale environmental monitoring as provided by the Production Environmental Control Programme (PEC). Within the scope of PEC, monitoring of both the environmental emissions (emissions to air, discharge of wastewater, and the treatment and disposal of wastes) and the quality of environmental components (air, surface and underground water and soil) is conducted to assess the impact of production activities on the environment. The PEC Programme determines sampling/measuring locations, the list of components to be identified and monitoring frequency.

The PEC is conducted within the Karachaganak field, at the Sanitary Protection Zone boundary, in the nearby villages, along the motor road and at the facilities of the KPC – Bolshoi Chagan – Atyrau export condensate pipeline.

Pursuant to article 132, item 9 of the RK Environmental Code, environmental monitoring shall be carried out by the production or independent laboratories, certified as per the procedure established by the RK Law "on Technical Regulation" [6]. KPO conducts air monitoring by means of a contracted certified laboratory, which performs sampling, sample analysis and performs instrumental measurements in accordance with the PEC Programme.

To evaluate the air quality, the health-based exposure limits (maximum permissible concentrations) are used. Recorded concentrations of controlled components are compared with the health-based exposure limits, indicating the level of pollution in % of maximum permissible concentrations.

In addition to legislative compliance, KPO carries out continuous air monitoring by means of stationary automatic environmental monitoring stations (EMS). Each station has four analysers designed for continuous measurement of hydrogen sulphide (H_2S), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO) content in the air. The EMS also activates a warning alarm in case of high concentration of emissions in the air.

As well as continuous air emissions monitoring by the EMS, the certified Contractor laboratory conducts air sampling at the boundary of the SPZ once a day. The samples are analyzed for the content of the same four components measured at the EMS: hydrogen sulphide (H_2S); sulphur dioxide (SO_2); nitrogen dioxide (NO_2); and, carbon monoxide (CO) this sampling also measures methane (CH_4) and methylmercaptan (CH_3SH) content.

In 2015 no exceedance of the maximum permissible air concentration of the monitored components at the KOGCF SPZ was recorded. Average concentrations of the monitored air components at the boundary of the SPZ for 2015 are given in the table 2.

Table 2 – The average annual concentrations of the monitored air components recorded at the SPZ boundary in 2015

Monitored components	Actual annual average concentration, mg/m^3	MPC one-time, mg/m^3	Exceedance of MPC
H_2S	0.002	0.008	no
SO_2	0.004	0.5	no
NO_2	0.028-0.030	0.2	no
CO	0.479-0.491	5.0	no

CH_4	1.402-1.463	50**	no
CH_3SH	Below limit of detection	0.006	no

The certified Contractor laboratory also has stationary air monitoring stations in 8 villages located around the field (Berezovka, Bestau, Zharsuat, Zhanatalap, Dimitrovo, Karachaganak, Priuralnoe, Uspenovka) and in the town of Aksai which perform air sampling 4 times a day (at 1:00 am, 7:00 am, 01:00 pm and 7:00 pm). Sampling of air is carried out by the permanent personnel of the contracted laboratory who reside in the villages where the stationary air monitoring stations are located.

Moreover, unscheduled air sampling is performed at the stationary monitoring stations if a complaint is received from the residents, such as a complaint regarding an unusual odour. Air samples are taken to the laboratory located in the town of Aksai where the samples are chemically tested for the content of the 4 main components: hydrogen sulphide (H_2S), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO) that are monitored in accordance with the State Standard and Ruling Documents. In addition, once in 10 days the air is monitored for concentration of volatile organic components: benzene (C_6H_6), toluene (C_7H_8), xylene (C_8H_{10}). In the village of Berezovka, monitoring also includes the air concentration of methylmercaptan (CH_3SH).

Monthly results of air monitoring are published in local printed media and sent to the villages for posting on public information boards. The disclosure includes details of local community complaints received in relation to emissions and odours.

While the average monthly MPC of NO_2 was not exceeded in 2015, there were a total of eight exceedances of the daily average MPC measured out of 53,910 measurements: 1 occurrence in Karachaganak village — by 1.025 times, 2 occurrences in Zharsuat — by 1.025 times and by 1.225 times, 3 occurrences in Zhanatalap village - once by 1.1 times, twice by 1.175 times; and 2 occurrences in Uspenovka village — by 1.05 times. MPC exceedance of other monitored components was not recorded throughout 2015.

Annual average concentrations of monitored air components in the villages in 2015 are given in the table 3.

Table 3 – Annual average concentrations of monitored air components in the villages adjacent to KOGCF in 2015

Monitored components	Actual annual average concentration, mg/m^3	MPC daily average, mg/m^3	Exceedance of MPC daily average
H_2S	0.002	0.008*	no
SO_2	0.004	0.05	no
NO_2	0.028-0.029	0.04	no
CO	0.432-0.485	3.0	no
C_6H_6	0.092-0.098	0.3*	no
C_7H_8	0.013 — 0.014	0.6*	no
C_8H_{10}	0.013 — 0.015	0.2*	no
CH_3SH	Below limit of detection	0.006*	no

As in previous years, the main contribution to the KPO total emissions volumes in 2015, resulted from flaring at flare stacks at the process facilities and from flaring during well operations. Nevertheless, the total volume of flared gas in 2015 amounted to only 0.15% of the total volume of produced gas by KPO or 0.88 tonnes per thousand tonnes of produced hydrocarbons. This flaring emissions intensity in 2015 shows very strong operational performance when compared to worldwide industry averages of 14.8 tonnes per thousand tonnes, and a European average of 3.5 tonnes per thousand tones as reported by IOGP in 2014.

KPO continues to work towards further emission reduction technologies, with a particular focus in the area of well testing and well clean-up reductions.

In 2015, in addition to the use of new equipment for partial oil recovery during well clean-up, KPO also used the Megaflow equipment which results in a reduction of emissions to the air. As a result of adopting these initiatives, the volume of liquid hydrocarbon flaring decreased by almost 40 thousand tonnes through adoption of recovery systems, which totaled 60% of the oil volume produced during well completions. The Megaflow system reduced gas flaring during the well clean-up to 20 mln m^3 considerably lower than the volume permitted in 2015 of 55.7 mln m^3.

In 2015, KPO achieved the gas utilization rate of 99.85% (99.81% in 2013). Once again this proves the KPO world-class level compared to the performance target of 99.6% approved by the RK regulatory authorities within the 2015 Associated Gas Processing and Development Programme [4].

Despite the fact that KPO annually introduces new technology to reduce the negative impact on the environment, and according to the production and state environmental monitoring environmental conditions in the territory of the Karachaganak and the villages adjacent to the Karachaganak field is considered harmless, it is observed that the activity of the company affects the health of the local population. Proof of this is the relocation of the residents of Bestau and Berezovka villages to the environmentally safer place. In this regard, we consider that it is necessary to pay more attention to the impact of production activities of oil and gas companies on the health of the population.

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ТҮЙІН

Қарашығанақ мұнай-газ конденсат кен орны әлемдегі ең ірі кен орындарының бірі болып табылады. Өндірістік жобалауы үлкен көлемде атмосфераға ластаушы заттардың шығарындыларымен бірге жүреді. Атмосфералық шығарындылардың негізгі көлемі күнделікті отындық газдардың және газтурбиналық қондырғылардың, қазандықтың, технологиялық пештердің, компрессордың жануы нәтижесінде пайда болады.

Қарашығанақ кен орнының жыл сайын жаңа технологиялық енгізуге қарамастан қоршаған ортаға теріс әсерін азайту үшін өндірістік және мемлекеттік экологиялық мониторингі бойынша қауіпті емес деп саналады, алайда мекеменің қызметі жергілікті халықтың денсаулығына әсер ететіні байқалады.

РЕЗЮМЕ

Карачаганакское нефтегазоконденсатное месторождениие является одним из крупнейших в мире и его промышленная разработка сопровождается большими объёмами выбросов загрязняющих веществ в атмосферу. Основной объем атмосферных выбросов образуется в результате сгорания топливного газа в рамках повседневной эксплуатации газотурбинных установок, котлов, технологических печей и компрессоров.

Несмотря на то, что КПО каждый год вводит новые технологии для снижения негативного воздействия на окружающую среду, а по данным производственного и государственного экологического мониторинга экологическая обстановка на территории месторождения считается неопасной, наблюдается, что деятельность предприятия влияет на здоровье местного населения.