Criteria for the Environment Assessment After Oil and Gas Exploration in the Arctic

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ABSTRACT

The paper reviews the impact of anthropogenic activities in the Arctic. An oil and gas field was selected as the object of study, on which only exploration drilling was carried out 30 years ago. Samples of soils, water and bottom sediments from surface water bodies were taken. An analysis of their composition was carried out *in situ* and in the laboratory.

Introduction. The problem of the correct assessment of the effects caused by oil and gas exploration is actual for Russian Arctic. The environment after all regulated activities does not always return to its original state. If the necessary actions to eliminate the consequences of economic activity were not performed in full, then the environment changes significantly. One of the important tasks in this area is the assessment of environmental pollution in the area of the gas production activity for timely and adequate calculation of damage and decision-making on mitigation. The aim of this study is to determine the composition of water and bottom sediments in lakes and soils in the vicinity of the mothballed gas production wells

Object. The studied hydrocarbon field is located on the Yamal Peninsula. The exploration work was carried out with the drilling of more than 20exploration wells in the 80-90s of the last century. Up to now, near-well production sites remain littered with various industrial and household waste (residues of drilling equipment, tractor equipment, tanks, chemicals, cement, electricity core, and other industrial waste).

Methods. During the work of the expeditionary team samples of background and anthropogenically modified soils, water samples, and bottom sediments were taken from surface water bodies (lakes and ponds) located near 25 wells.

Unstable parameters were determined on site using portable instruments, the rest - in an accredited laboratory. Laboratory and analytical studies of the provided samples were carried out according to measurement methods certified in accordance with Russian standard [1] for the pH values, total nitrogen, nitrate, phosphate, chloride, sulfate, ammonium ions, oil products, toxicity, surfactants, Cu, Pb, Zn, Mn, Cu, Ni, Cd, Cr (VI), Hg, As, Ba, benz(a)pyrene, phenols. Hydrochemical analysis of surface water samples for the content of the acidity, ammonium, nitrate, phosphate, sulfate, chloride ions, anionic surfactant, petroleum products, phenols, Pb, Zn, Mn, Cu, Ni, Cd, Cr (VI), Hg, and As.

Results.

Water. Water samples taken in the area of the wells correspond to the level of fresh (judging by the concentration of sulfates and chlorides) natural surface waters with neutral pH values and, in general, with a favorable oxygen regime. Oil products concentrations exceeded the maximum permissible content (in some ten to one hundred times)according to [2]. At a number of points, the excesses are duplicated both in water and in solid samples, that is, these are places where oil products flow continuously, rebooting in sorbed form in bottom sediments. These objects require special attention in terms of reclamation. In almost all water bodies, an excess of the maximum permissible concentration of manganese was found, but these values are included in the range of river waters and may be a feature of this region.

Assessment of the ecological status of water bodies demonstrates that most of the objects belong to clean and conditionally clean waters of class 1. Nine samples belong to the 2nd and 3rd class of water quality (conditionally contaminated samples and contaminated). There is a need for environmental monitoring at reservoirs near six wells due to the presence of high and extremely high excesses of maximum permissible concentrations of oil products.

Soil. Soil samples taken from the territory subjected to a technogenic impact contain a number of consequences of this effect, which is reflected in their comparison with the composition of the corresponding soil samples selected as a background. Based on the data obtained, it can be noted that the soil is contaminated with oil products, sulfates, barium, zinc and phenols. But at the same time, numerous excesses of the MPC (if there is an appropriate parameter in the regulatory documents) were established only for zinc and arsenic, and for both elements high concentrations were also noted in background samples, which can be considered a feature of the region.

According to the total pollution index, fourteen soil samples are classified as hazardous, one sample is classified as moderately hazardous, and the remaining 35 samples can be called "extremely dangerous" according to the above gradation. The main contribution to the total pollution indicator is made by petroleum products. Soil samples are classified by pollution categories: "Permissible" - 11 soil samples; "Moderately dangerous" - 11 samples; "Dangerous" –20 samples; "Extremely dangerous" - 8 samples.

It should be noted that in addition to one specific sample, substantially contaminated with oil products, all soil samples taken are not toxic to living organisms.

Bottom sediments

Bottom sediments are deposition media that interact with water, accumulate information on the anthropogenic and anthropogenic pressures during the development of the water system; currently there are no MPC standards, there are data on background concentrations only forpetroleum products, manganese, copper, nickel and zinc in the bottom sediments of the

Yamal region. The concentration of manganese in bottom sediments exceeds the background values in the area of six wells by 1.5-3 times. Copper concentrations above background in ten bodies of water are on average 2-5.5 times, nickel and zinc - in the region of nine and six wells, respectively, 1.5-2.5 times.

The concentration of oil products exceeds the background values in the bottom sediments of the Yamal region in all studied samples, with the exception of one. In ten samples, the ratio of exceeding the background values is 2–9 times; in the bottom sediments of reservoirs near 7 wells, the concentration of oil products is higher than background by more than 10 times.

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