

ICEST 2022**III International Conference on Economic and Social Trends for Sustainability of Modern Society****THE STATE OF ECOLOGY IN THE TERRITORY OF THE
CHECHEN REPUBLIC**

Khazan N. Askhabova (a)*, Mansur S. Ozdikhanov (b), Yakha N. Sirieva (c)

*Corresponding author

(a) Department of chemistry, Kadyrov Chechen State University, L. Yashin str., 31, Grozny, 364049, Russia,
h.askhabova47@mail.ru

(b) State Budgetary Institution «Environmental Control Laboratory» Grozny, Kutuzova srt. 5, Grozny, 364020,
Russia, Ozdyhanov90@mail.ru

(c) Department of chemistry, Kadyrov Chechen State University, L. Yashin str., 31, Grozny, 364049, Russia,
ysirieva@mail.ru

Abstract

The aim of the work was to study the ecological condition of the atmospheric air, soil on the territory of 5 cities and 4 settlements of the Chechen Republic in 2019. The study of the air environment of the cities of Grozny, Argun, Gudermes, Urus-Martan, Shali and 4 settlements of Achkhoy-Martan, Itum-Kali, Tolstoy-Yurt, Shatoi revealed that inorganic pollutants (NH₃, NO, NO₂, CO₂, H₂S, dust) were subject to sanitary standards and concentrations did not exceed the maximum allowable (MAC) limits. Soil chemical composition in terms of heavy metals and oil products content was in compliance with hygienic norms. The concentrations of oil products were minimal, did not exceed the maximum permissible limits and remained within 59.0-87.9, which indicates a favourable environmental situation in the territories of the studied settlements of the Chechen Republic. Sufficiently low concentrations of pollutants, a high dissolved oxygen value of 8.2 mgO₂/dm³ and 8.6 mgO₂/dm³ and a pH of 7.5 in the Terek and Sunzha rivers respectively, indicate good environmental conditions in both rivers in 2019.

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1. Introduction

At present it is necessary to take into account the huge anthropogenic impact of activities on the environment, which causes problems not only in maintaining the balance of nature, but also in the survival of mankind on the planet.

The President of the Russian Federation Putin in a decree (Decree of the president of the Russian federation of 19.04.2017 no. 176, 2017) cites alarming figures: "As a result of air pollution, 7-8 million people die each year in the world. This applies to our country as well." The annual damage to the environment reaches 6% of GDP, taking into account the negative impact on human health, reaches 15%. It is vital to drastically reduce gaseous and solid emissions into the environment. "Garbage is dumped where and how it should be. Landfills occupy almost 48 thousand hectares," said the President of the Russian Federation.

The Chechen Republic is a subject of the Russian Federation, therefore the Federal Law (Federal law of 4 may 1999 no. 96-fz, 1999) and the decree of the Russian President on the necessity of preventing an ecological disaster and preserving the environment oblige us to take care of natural resources.

Seven years of hostilities (1994-2001) have plunged the Chechen Republic into environmental disaster. Fires at oil refineries and oil fields as well as radioactive and chemical pollutants have caused immense damage to the environment. Contamination of the environment (water, air, and soil) with chemicals, heavy oil product residues, and uncontrolled radioactive sources exceeded the maximum allowable concentrations dozens of times (Askhabova & Dzhabrailova, 2009).

Thanks to the measures taken in 2012, the extremely dangerous ecological situation with regard to the pollution of soil, atmospheric air, and water body pollutants met sanitary standards and significantly improved. For example, the concentrations of dust, nitrogen and carbon oxides, and ammonia and hydrogen sulfide in the atmosphere of the Chechen Republic conformed to hygienic standards and remained within 0.01 to 0.53 MPC; mercury vapor was not detected, and the radiation background was within the norm (Tashligov, 2021). Concentrations of heavy metals (arsenic, mercury, zinc, lead, cadmium, copper) in the soil were in compliance with sanitary standards and varied within 0.001 - 0.157 MPC, oil products - (0.146 - 0.470 MPC), in the water of Terek and Sunzha rivers, the content of pollutants remained within 0.16-0.37 MPC that states compliance with sanitary standards (Askhabova et al., 2019).

2. Problem Statement

Studies of the ecological state of the environment on the territory of the Chechen Republic.

3. Research Questions

Concentrations of nitrates, chlorides, sulfates and chemical pollutants in the air basin, heavy metals in the soil, river water (Terek and Sunzha), permanganate oxidation, BOD₅.

4. Purpose of the Study

Study of the content of the main pollutants in the air, soil and main rivers of the Chechen Republic.

5. Research Methods

Dust was determined by gravimetric method, spectrophotometric method - concentrations of chemical pollutants in the atmospheric air, heavy. Concentrations of heavy metals in soil, oil products were determined using an inversion voltammetry and a concentrator KN-2M, respectively. Hydrochemical analyses were performed according to the generally accepted methods (Methods of quantitative chemical analysis. Drinking water, natural, sea, waste purified, 2008; Semenov, 1977). The analyses were carried out in the laboratory of environmental control of GBU. (Accreditation certificate № RA.RU.21CHR01).

6. Findings

The ecological state of the environment is mainly determined by emissions from industrial enterprises and vehicles. Urban transport makes a significant contribution to air pollution, according to experts, motor vehicles account for up to 70% of total emissions in cities. The content of chemical pollutants in the air, and especially their constant increase in the lower layers of atmospheric air, worsens the quality of the environment, which is detrimental to public health. Chemical toxicants contained in the lower layers of the air lead to an increase in various diseases and mortality of the population and, as a result, cause significant economic damage (Kislitsyna et al., 2020; Surzhikov & Ilyin, 1991). Every year, the increase in private and industrial transport with car exhausts introduces a huge amount of chemical pollutants into the environment. To assess the level of pollutants in the air basin, soil, residential areas of 5 cities such as Grozny, Argun, Gudermes, Urus-Martan, Shali and 4 villages of Achkhoy-Martan, Itum-Kali, Tolstoy Yurt, Shatoi of the Chechen Republic were studied. Laboratory analyzes of inorganic pollutants in the air basin on the territory of 9 settlements in the Table 1.

Table 1. Average annual concentrations of pollutants in the air basin of the Chechen Republic in 2019, mg/m³

Settlement point	Chemical pollutants							
	Residential area							
	dust	nitrogen oxide	nitrogen dioxide	sulfur oxide	carbon oxide	hydrogen sulfide	ozone	ammonia
Grozny	0.30	0.065	0.053	0.062	1.155	0.00	0.00	0.041
Argun	0.20	0.035	0.024	0.042	1.120	0.00	0.00	0.014
Gudermes	0.25	0.048	0.032	0.007	1.150	0.00	0.00	0.012
Urus-Martan	0.30	0.065	0.054	0.038	1.140	0.00	0.00	0.034
Shali	0.27	0.063	0.046	0.022	1.150	0.00	0.00	0.034
	Rural areas							
Achkhoy-Martan	0.22	0.046	0.032	0.016	1.140	0.00	0.00	0.042
Itum-Kali	0.20	0.041	0.030	0.015	1.110	0.00	0.00	0.032

Tolstoy-Yurt	0.20	0.043	0.030	0.012	1.130	0.00	0.00	0.015
Shatoi	0.20	0.036	0.029	0.019	1.110	0.00	0.00	0.013
Environmental limit concentration	0.15-0.50	0.4	0.2	0.5	5.0	0.008	0.16	0.2

Atmospheric air polluted with suspended dust particles has a negative impact on the human body. Dust is generally considered to be particles up to 100 microns in size, while smoke generally accumulates smaller particles. One of the most important air pollutants is atmospheric dust, which is an accumulation of solid particles of natural and anthropogenic origin.

Depending on the nature of origin, dust is divided into two groups: natural and anthropogenic dust (Mukesh et al., 2021).

Natural dust fractions consist of particles of different minerals: gypsum, carbonates, silicates, asbestos. The chemical composition of man-made dust fractions are oxides of nitrogen, sulfur, carbon, arsenic, soot emissions, etc.

Selite ecosystems are extremely vulnerable to anthropogenic activities. Dust has a resorptive effect on the body: absorption accumulates in the blood, is found in organs, has mutagenic, carcinogenic and other side effects (Teplaya, 2013; Yasser et al., 2021). Accelerating concentrations of various pollutants in the atmosphere of urban areas affects the health and well-being of the population and monitoring of air pollutants is essential for environmental decision-making.

As can be seen from Table 1, the atmospheric air dust content on the main roads in the territory of Urus-Martan, Grozny, Gudermes, Shali settlements exceeded the lower level of MPC by 1.5-2.0 times. The other settlements are in a more favorable environmental situation in terms of air dust content, and the dust content slightly exceeded the lower limit of MPC in the Table 1.

The main contribution to air pollution, is the fact that every year there is an increase in parking and poor fuel quality, increasing the anthropogenic load on the atmosphere of the Chechen Republic. It should be noted that this study of the chemical composition and quantitative content of pollutants in the atmospheric air showed that the greatest emission of pollutants occurs during intensive vehicle acceleration. Nitrogen monoxide is a toxic gas in the composition of combustion products and affects the respiratory tract when inhaled, causing shortness of breath and dizziness. The maximum level of nitrogen oxides in the air was observed in the atmosphere during one year. Grozny, Urus-Martan and amounted to 0.065 mg/m³, the minimum - in the atmosphere of the settlements. Shatoi 0.036 mg/m³. Nitrogen dioxide is also one of the products of gasoline combustion. Nitrogen dioxide in small quantities causes irritation of respiratory tract, in large - pulmonary edema. For example, the concentration of nitrogen dioxide in the air of Grozny was the maximum and amounted to 0.053 mg/m³, the minimum - in the atmosphere of the settlement Shatoi 0.029 mg/m³.

In the atmospheric air of Grozny. A significant content of sulfur dioxide 0.062 mg/m³ was observed in the atmospheric air of Grozny. This figure is due to the quality of motor fuel. Sulfur compounds contained in gasoline are emitted into the air in the form of sulfur dioxide during its combustion in the car engine. Penetration into the respiratory tract leads to respiratory and circulatory disorders.

Although the content of pollutants (dust, NO, NO₂, CO, SO₂, H₂S, NH₃) met the sanitary standards and did not exceed the MPC. However, the constant impact of polluted air on the human body is expressed in the growth of morbidity and mortality. The growth of chronic respiratory diseases and, as a consequence, various cardiovascular diseases depends not only on the level of their concentration, but also on the length of time during which the population breathes this air.

The main threats to the population from motor vehicle emissions are nitrogen dioxide, sulfur dioxide and carbon monoxide. It has been found that the increase of these pollutants in the air correlates more with the increase of bronchial asthma cases than with the manifestation of infection. Hydrogen sulfide and ozone were absent in air samples on the main roads of all settlements.

As a result of anthropogenic activity, pollutants (waste from industrial enterprises, garbage from burning plants, heating boilers, etc.) enter the environment and are accumulated in the soil by watercourses. The result of soil contamination is the deterioration of the balance of the geochemical environment and living organisms. Pollutants enter the soil from the environment with watercourses and from atmospheric air. Pollutants are wastes from heavy industry, incinerators, boiler plants, etc., which leads to a permanent disruption of the unity of living beings and the geochemical environment (Teplaya, 2013; Yasser et al., 2021).

Soil pollutants, heavy metals (more than 40 metals), including arsenic, mercury, zinc, lead, manganese, are highly toxic and have the ability to bioaccumulate, at relatively low concentrations for living organisms behave as toxic and ecotoxic substances. Self-purification processes are slow, so there is an accumulation of pollutants in the soil, which leads to deterioration of soil chemistry (Antonio et al., 2017, Gibadullin et al., 2019).

The change and accumulation of pollutants in the soil cover is facilitated by slow self-purification processes. Therefore, the study of soil contamination by toxic metals is a must, since heavy metals are among the priority pollutants (Erneste et al., 2018, Hong-gil et al., 2021).

Laboratory analyses of soil cover for heavy metals and petroleum products in the Table 2.

Table 2. Average annual concentrations of pollutants in soil in the Chechen Republic in 2019, mg/kg

Settlement point	Pollutants, mg/kg								
	coppe r	zinc	lead	cadmiu m	arseni c	mercur y	nicke l	manganes e	oil product s
Residential area									
Grozny	1.00	1.19 7	1.49 2	<0.10	0.10	0.10	<0.50	236.70	86.90
Argun	1.00	1.15 9	1.40 2	<0.10	<0.10	<0.10	<0.50	227.10	87.90
Gudermes	<1.00	1.45 2	1.18 1	<0.10	<0.10	<0.10	<0.50	226.20	64.90
Urus-Martan		1.20 9	1.40 2	<0.10	<0.10	<0.10	<0.50	265.2	71.4
Shali	<1.00	1.29 6	1.33 9	<0.10	<0.10	<0.10	<0.50	256.9	83.9
Rural areas									
Achkhoi- Martan	<1.00	1.26 0	1.31 6	<0.10	<0.10	<0.30	<0.50	216.4	66.7
Tolstoy-Yurt	<1.00	1.13 8	1.10 1	<0.10	0.10	0.10	<0.50	237.0	86.9

Shatoi	<1.00	1.55 6	1.53 9	<0.10	0.10	0.10	<0.50	224.90	68.4
Itum-Kali	1.00	1.41 9	1.17 9	<0.10	0.10	0.10	<0.50	231.5	59.0
environmental limit concentration	3.0	23.0	32.0	2.0	2.0	2.1	4.0	1500	500

Concentrations of heavy metals and oil products were compared with (MPC). Concentrations of heavy metals in the soil of 9 settlements met the requirements of sanitary norms and were in insignificant amounts in the soil samples. Laboratory analyses showed that manganese concentrations in the soil were 216.4-265 mg/kg and did not exceed MPC.

A significant environmental hazard is posed by petroleum products. Oil products getting into the air, soil and water bodies cause irreparable damage to the environment.

At present, the source of pollution of the environment with petroleum products is an increase in the car fleet, exhaust and poor technical condition of cars, low quality fuel and filling stations.

Therefore, controlling the distribution of petroleum products in the air, water bodies and soil is a must. Laboratory analyses of the soil cover of residential areas showed that the content of petroleum products in soil samples did not go beyond 64.9 - 97.2 mg/kg. In the soil cover of rural areas of the Chechen Republic, the content of oil products met sanitary standards and was in the range of 66.7-87.9 mg/kg.

The degree of purity of water bodies directly depends on the ecology of the habitat: air and soil. The main pollutants enter surface waters with atmospheric precipitation and soils with wastewater. The key criteria determining the environmental safety of river water are the degree of pollution by such substances as nitrate nitrogen, sulphates, chlorides, organoleptic indicators, COD (chemical oxygen demand) and BOD₅ (biochemical oxygen demand). The results of the average annual studies of the chemical composition of water bodies are shown in the Table 3.

Table 3. Average annual concentrations of Terek and Sunzha water pollutants in 2019 mg/dm³

Rivers	Pollutants							
	Nitrates	pH	Chlorides	Sulfates	Oxygen content	BOC ₅	Permanganate acidity	Dry residue
1 Terek	8.6	7.5	140.5	101.3	8.2	1.6	3.2	370
2 Sunzha	7.5	7.5	128.1	86.7	8.6	1.8	3.4	303
environmental limit concentration	45	6.5-8.5	350	500	no less than 4.0 mg O ₂ /dm ³	not more than 4.0 mg O ₂ /dm ³	not more than 5.0	1000

Water bodies are the main resources of economic, food and energy security of the state (Shashulovskaya et al., 2021). River water of the Terek and Sunzha were sampled from the surface horizon. Hydrochemical studies of river water for 16 indicators were conducted. The results of the hydrochemical composition of the rivers for 8 indicators are given in the Table 3. The main indicators of anthropogenic impact are permanganate acidity and chlorides. Presence of chlorides and permanganate acidity are indicators of river water pollution by surface domestic sewage. Permanganate acidity depends

on the concentration of pollutants not only of anthropogenic origin, but also organic substances of plant origin and soil humic acids.

Concentration of chloride anions did not exceed MPC in river water of Terek and Sunzha in the Table 3.

In water bodies easily oxidizable organic compounds is characterized by the value of biological oxygen demand (BOD₅). Biological oxygen demand (BOD₅) in Terek and Sunzha water samples met the requirement of hygienic standards, average annual values were 1.6 and 1.8 mgO₂/dm³, respectively.

People's health and life expectancy directly depend on the quality of drinking water. The presence of nitrate ions in water bodies adversely affects the quality of river water, damages various kinds of living organisms, interacts with blood hemoglobin, and contributes to the risk of various diseases of the population (Klein & Vekovshinina, 2020).

The average annual nitrate content in the Terek and Sunzha in 2019 also met the hygienic standard and did not exceed the maximum permissible concentration in the Table 3.

It has been shown that sulfates entering water bodies are not of anthropogenic origin (Abramova et al., 2021). The main sources of sulfate ions in water bodies are domestic and agricultural wastewater. The average annual sulfate content in Terek and Sunzha complied with hygienic standards (table 3). The content of dissolved oxygen in the aquatic environment depends on a number of factors, including partial pressure and temperature (Reshetnyak & Komarov, 2021).

As shown in the Table 3, high oxygen concentrations in the Terek and Sunzha rivers showed that water quality meets hygienic standards, pollutants are an order of magnitude lower.

Mineralization of water, increased salt content, negatively affects many industries. In agriculture, high mineralization of water has a negative impact on plant and animal organisms, also causes salinization of soils, at drinking water supply enterprises scale formation on the walls of boilers, causes corrosion (Proceedings of Karelian scientific centre of the Russian Academy of Sciences, 2021).

The insignificant dry residue content in the river was 0.30 - 0.37 MAC, indicating compliance of salt content with hygienic standards in 2019. It should be noted that according to organoleptic indicators (odor, turbidity) the river water had neither odor nor taste throughout 2019, however, during atmospheric precipitation and during snow melt in the spring period the Terek and Sunzha rivers were turbid.

7. Conclusion

The study of pollutants in the atmosphere, soil and main rivers of the Chechen Republic showed that the content of pollutants in the air, soil, Terek and Sunzha met the requirements of sanitary standards. For example, the average annual content of carbon monoxide in the atmospheric air was 1.1-1.2 mg/m³. The chemical composition of soil in terms of heavy metals and petroleum products corresponded to hygienic norms. The concentration of oil products was minimal, did not exceed the maximum permissible value and remained within 59.0-87.9, which indicates a favorable environmental situation in the territories of the studied settlements of the Chechen Republic. Sufficiently low concentrations of pollutants, a high dissolved oxygen value of 8.2 mgO₂/dm³ and 8.6 mgO₂/dm³ and a pH of 7.5 in the Terek and Sunzha rivers respectively, indicate a good environmental condition of both rivers in 2019.

The favorable ecology of the habitat and the absence of industrial facilities in the Chechen Republic enable the development of agriculture, tourism, and the sanatorium and resort complex. Nevertheless, the presence of pollutants in the atmosphere, soil, rivers, and increasing anthropogenic load, population growth indicates the need to control and monitor the ecological condition of the environment in order to study their content and identify the source of ingress into the environment.

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