Pro Index | Journal of Science in Medicine and Life

Volume: 2 Issue: 3 Year: 2024

http://journals.proindex.uz

Comparison of Water Quality in the Don River Pool, Russia, During 2011-2012

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Abstarct: The 2012 water quality analysis in the Don basin, a region in southern Russia, revealed a higher water content in 2012 compared to 2011, with the highest water consumption during spring floods and lowest during summer-autumn and winter low water periods. The basin's surface waters are highly diverse due to anthropogenic factors and physical and geographical conditions. Pollution sources include wastewater water from housing and communal services enterprises, chemical, petrochemical, metallurgical, agricultural, shipping, and small fleets.

The water content of the Don River increased by 10-48% in 2012, accounting for 62-129% of the average multi-summer. The distribution of pollutants in the water from Donskoy to Azov remained unchanged, with sulfates being the largest and nitrite nitrogen being the smaller. Wastewater from various sources, such as Novomoskovsk City Vodokanal, remained a source of pollution.

The level of water pollution in the Don River below Donskoy decreased by 3 times to 2 and 4 MPC, and by sulfates by 2 times to 2 MPC on average. The critical level of stability for water pollution in both sections was achieved for ammonium nitrogen, with average annual concentrations reaching 15-18 MPC. Downstream, the river water was characterized by the 3rd class of quality, with slight increases in water pollution in 9 out of 16 sites.

The pool river Don

Analysis of water quality in the river basin Don in 2012 was carried out based on the results of data on the chemical composition of water samples taken from 47 water bodies, at 93 points, 149 sections.

The Don basin is located in the southern part of the European territory of Russia, extending from the Central Russian uplands in the north to the Stavropol plateau in the south, from the Donetsk Ridge in the west to the Volga and Ergeninskaya uplands in the east, covers in whole or in part the territories of 15 constituent entities of the Russian Federation (Tula, Oryol, Ryazan, Lipetsk, Voronezh, Tambov, Belgorod, Kursk, Penza, Saratov, Volgograd and Rostov regions, Stavropol and Krasnodar territories, the Republic of Kalmykia (1).

The Don region has a fairly developed river network belonging to the Azov Sea basin. Its main waterway is the Don River; The Don basin includes such significant rivers as Voronezh, Khoper, Bear, Sal, Seversky Donets.

In total, in the territory under consideration there are about 9,900 watercourses with a total length of 68,826 km, however, the share of rivers with a length of 500-1000 km or more accounts for only 0.05%, the predominant ones here are small watercourses with a length of less than 10 km, which is 87%.

The Don River and its tributaries are lowland steppe rivers. They feed mainly on waters, formed from the melting of winter snow reserves (60-65%), to a much lesser extent - ground (25- 30%) and rainwater (3-5%).

According to the hydrological regime, the rivers of this basin belong to the type of rivers with spring floods and floods in the warm season.

The water content of most rivers in the Don River basin in 2012 was higher than the water content in 2011 and amounted to 50-158% of average long-term.

The highest water consumption was recorded during the spring flood period, the lowest during the summer-autumn and winter low water periods.

The chemical composition of surface waters in the Don River basin is highly diverse, which is due to anthropogenic factors and differences in physical and geographical conditions in which surface waters are formed.

The main sources of pollution of surface waters in the Don River basin are still wastewater water from housing and communal services enterprises, chemical, petrochemical, metallurgical, agricultural and other industries, shipping and small fleet.

The Don River is one of the largest rivers in the European territory of Russia. It is the seventh largest basin in terms of area and the eleventh longest river in Russia. The Don River begins on the spurs of the Central Russian Upland in the region Novomoskovsk (Tula region), has a length of 1870 km and a catchment area of 422.5 thousand km2. The absolute height of the source is 179 m, the slope of the river is insignificant - 10 cm per kilometer of length. The average speed of the river is low and does not exceed 1.0 m/s during low water, and 2-3 m/s during high water. The river flows into the Taganrog Bay of the Sea of Azov. This is a typical lowland river with a smooth longitudinal profile and a wide floodplain (2).

Environmental changes and pollution of the waters of the Don River

In 2012, the water content of the Don River was higher than in 2011 by 10-48% and amounted to 62-129% of the average multi-summer .

Distribution in the water of the Don River from the city of Donskoy (upstream) to the city of Azov (mouth) of pollutants, average annual the highest concentrations of which in 2012 exceeded the MPC are presented in Fig. 1.

The volume of wastewater discharged into the Don River in the Tula region in the area of Donskoy in 2012 was not changed and amounted to 12869 thousand m. Among the pollutants, the largest share was sulfates (746 tons), the smaller one is nitrite nitrogen (0.34 t). Wastewater from the LSC remains a source of river pollution "Novomoskovsk City Vodokanal", LSC "Life Support Systems" (branch "Vodokanal Don"), NUS "Novomoskovsk Utility Systems", DRCP "Donskoy Radio Components Plant", etc (5)

In 2012, the level of water pollution in the Don River below the city of Donskoy with nitrite and ammonium nitrogen decreased by 3 times to 2 and 4 MPC, and by sulfates by 2 times to 2 MPC on average. The frequency of cases of exceeding the MPC by ammonium and nitrite nitrogen has decreased from 97 and 100% to 69 and 62%, 10 MPC by ammonium nitrogen from 57% up to 12%. The values of SCWPI and the coefficient of complexity of water pollution decreased to 4.67 and 42.0%, As a result, the category “b” changed to the category “a” within the 4th quality class.

The values of the specific value of the combinatorial index of water pollution and the coefficient of complexity of water pollution in the river above the city of Donskoy changed little and amounted to 5.17 and 37.0% (5.22 and 46.1% in 2011). The river water in both sections of the city in 2012 was assessed as “dirty”. Ten of the 14 ingredients and water quality indicators considered in the comprehensive assessment were contaminants. The critical level of stability of water pollution in both sections was achieved for ammonium nitrogen, the average annual concentrations of which were 4 MAC, the maximum reached the level 15-18 maximum permissible concentration, the cause

of which was the discharge of contaminated wastewater by Novomoskovsk City Vodokanal and Utilities Don.

The most typical pollutants of the river water in these sections, in addition to ammonia nitrogen, included nitrite nitrogen, difficult-to-oxidize organic substances (based on COD), compounds of iron, copper, sulfates, phenols were added to them in the section above the city of Donskoy, average annual (maximum) concentrations which amounted to 2-3 (2-13) MPC. The frequency of cases of exceeding the MPC ranged from 50-92% (above the city) and 62-100% (below the city) (Fig. 2). Water pollution was characteristic, but at a low level rivers in city sections with easily oxidizable organic substances (according to BOD5), average annual concentrations which were within 1 MPC, the maximum did not exceed 3 MPC with repeatability of cases of exceeding MPC 58 and 75%. The content of oxygen dissolved in water in 2012 did not decrease below 4.16-4.48 mg/l.

River water pollution Don downstream in the section of the city of Dankov - village. Novaya Kalitva was smaller. The river water was characterized mainly by the 3rd class of quality: category "a" - in most background sections, category "b" - in control sections, with the exception of the section 2.5 km southwest of the city of Novovoronezh - 4th class category "a" and was rated as "polluted", "very polluted" and "dirty". In 2012, in 9 sites out of 16 on this in the area there was a slight increase in water pollution, which was manifested in an increase in the values of the specific value of the combinatorial index of water pollution from 1.48-2.97 to 2.41-4.02, in some sections - the complexity coefficient up to 19.7-34.6% .

The number of pollutants increased from 4-8 to 6-9. The average annual content of compounds in water increased slightly iron up to 3 MPC below the city of Novovoronezh, phosphates in the sections of the city of Pavlovsk and near the village. Novaya Kalitva up to 2 MPC, ammonium nitrogen and copper compounds up to 2 MPC near the village. New Kalitva; maximum concentrations reached 3-9 MPC.

There was an increase in the frequency of cases of exceeding the maximum permissible concentration by nitrite nitrogen below the city of Zadonsk up to 79%, above the city of Liski up to 60%; oil products in the sections of Voronezh up to 46-62%, below Novovoronezh up to 50%, above Liski up to 40%; phosphates in the sections of Pavlovsk, phosphates and copper compounds near the village (5). Novaya Kalitva up to 60%. In 2012, the quality class of most of the sections in the section of the city of Dankov - village. Novaya Kalitva changed towards deterioration by 1 category, below the city of Novovoronezh and near the village. New Kalitva for 2 categories. The river water was characterized as “polluted” in 37.5% of the sections, “very polluted” – in 56% of the sections, “dirty” – below the city of Novovoronezh (3,7).

The water quality of the Don River in the middle and lower reaches (Kazanskaya station - mouth) was influenced by transit transfer of pollutants from the upper reaches of the Don, with the water of the Seversky Donets River and its tributaries (territory of Ukraine, Belgorod and Rostov regions), discharge of insufficiently treated and contaminated wastewater from industrial enterprises, housing and communal services enterprises, washout of mineral fertilizers, organic substances from farmland and livestock farms located along the banks of the rivers of the Don basin, intensive shipping and small fleet (4,6).

In 2012, the water quality of the river. The Don on the section Serafimovich - Kalach-on-Don has not changed. The water was still described as “very polluted.” The most characteristic of the river water in this section remained contamination with easily oxidized organic substances (according to BOD5), to which iron compounds were added above the city of Serafimovich, average annual concentrations were 2-3 times higher than the maximum permissible concentration, violation of standards was found in every sample and in 83% of water samples . In the river sections below the town of Serafimovich (10).

In the city of Kalach-on-Don, there was an increase in cases of ammonium nitrogen exceeding the maximum permissible concentration (up to 100%), while the average annual concentrations were within or slightly higher than the maximum permissible concentration (8,9).

In 2012, compared to 2011, there were no significant changes in the quality of surface waters in the Don River basin happened. The frequency of high concentrations of petroleum products, ammonium nitrogen and chlorides increased. The number of cases of exceeding 10 maximum permissible concentrations by petroleum products, ammonium nitrogen, increased - iron compounds. Over the past 3 years, there has been a tendency to reduce the frequency of cases of nitrite nitrogen exceeding 10 MPCs (3).

The most typical water pollutants in the water bodies of the Don River basin in 2012 were easily oxidized (based on BOD5) and difficult to oxidize (based on COD) organic substances, nitrite nitrogen and sulfates, the frequency of detection of which in concentrations above the maximum permissible was 73.5% and 87.3%, 51.2%, 54.2%. Exceeding 50 MAC was observed for sulfates.

Conclusion

In 2012, as before, in the surface waters of the upper and middle reaches of the Don River basin, water of the 3rd quality class, the lower reaches of the Don River - 4th quality class. In 2012, compared to 2011, the water quality of the Azov rivers (Mius River, Kirpili River, Kagalnik River) did not change, the water was still assessed as “dirty” (4th quality class, category “a”) (3).

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