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INFLUENCE OF HEAT-AND-POWER ENTERPRISES ON THE HYDROSPHERE

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ABSTRACT: Power units of thermal power plants (TPP), state-owned district power plants (SDPP), combined heat and power plants (CHPP) are mega-complexes, the maintenance of which requires huge investments and significant natural resources (fossil fuels and water). The operation of the units leads to a permanent negative impact on the environment, in spite of strict standards for emissions and discharges. This article analyzes the impact of power plants on water bodies. The following measurements are given for the runoff of the Novocherkassk SDPP to the Don River (Russia, Rostov Region): temperature, odor, power of hydrogen (pH-value), transparency, suspended materials, dissolved oxygen, biological oxygen demand in 5 days (BOD_5), TBOD, chemical oxygen demand (COD), mineralization, chlorides, sulfates, hydrogen carbonates, alkalinity, calcium, magnesium, hardness, sodium + potassium, ammonium ions, nitrites, nitrates, phosphorus phosphates, total ferrum, copper, aluminum, synthetic surface active substances, petroleum products, toxicity. It is established that the indicators are within the permissible values established by regulatory documents (Russia).

Keywords: Thermal power plant, Wastewater, Monitoring, Pollution

1. INTRODUCTION

The work of TPP is based on the conversion of some types of energy into others and the use of the energy cycle of steam-water. The fuel burns in the boiler heat the water and turn it into steam supplied to the turbines. Turbines convert the thermal energy of steam into mechanical energy, which moves power generators that produce electricity.

In power engineering, deeply desalted water is used to make up the condensate-nutrient tract of power units. As a result, warm waters are formed, discharged into the aqueous medium, which changes the physicochemical properties of water, such as density, viscosity, surface tension, gas solubility, etc. Thermal pollution causes negative processes in the aquatic environment, for example, excessive growth of blue-green algae, called cyanobacteria or oxyphotobacteria. At present, the toxic nature of substances released into the water by blue-green algae has been established, which leads to a change in the composition of plankton and affects the dynamics of its abundance, disturbances in the structure of fish communities, and microclimatic changes.

The wastewater from TPP includes wastewater from water treatment systems and chemical water treatment system, releases of hydraulic ash removal systems, drainage waters of ash and slag disposal sites, etc. These drains contain a significant amount of suspended materials, chlorides, sulfates, hydrocarbons, heavy metals and so on.

Warm waters and wastewater from power plants cause significant damage to the flora and fauna of water bodies.

2. RELATED WORK

Let us consider the impact on the hydrosphere of warm waters and wastewater from TPP in different countries.

In the work [1] it has been shown that the decantate of the ash pond contains harmful heavy metals, such as B, As, Hg, which tend to leach over a certain period of time. In this regard, groundwater is polluted and becomes unsuitable for domestic use. At Ramagundam STPS (India) a leak of ash filtrate pond into a small natural channel was discovered. This is harmful to the fisheries and another aquatic biota in the water body. Similar findings were noted for Chandrapur. Similar studies in the surrounding water bodies were carried out at the Vijayawada Thermal Power Station (India) [2]. Surface and groundwaters have been found to be contaminated with heavy metals, such as Cr, Mn, Fe, Ni, Cu и Zn, which leach out of fly ash as a result of anaerobic conditions on the bottom of the reservoir. Fly ash falls on nearby fields and is being washed into the water during the rains.

Quality assessment of 12 samples of surface and groundwater around TPP in the area at Warora district, Chandrapur (MS) (India) was carried out in the work [3]. Physicochemical parameters such as temperature, conductivity, pH, total dissolved solid (TDS), turbidity, chlorides, total alkalinity, hardness, calcium, magnesium, sulfates and iron have been determined. The results have shown that most parameters are out of tolerance. The wastewater indicators of a thermal power plant at the inlet and outlet of a treatment plant located about 20 km from Nagpur (India) were analyzed [4]. The temperature values at the inlet to the installation were 31-33 ºC, at the outlet - 30-32 ºC, pH values at the inlet were 7.4-7.9, and at the output - 7.1-7.5. The observed COD values were 40-92 mgO_2/dm^3 at the inlet and 32-68 mgO_2/dm^3 at the outlet. The average concentration of Cr, Fe proved to be higher than the permissible limits set for discharge of river runoff in India.

The work [5] presents the analysis of sewage samples of the AL-Doura thermal power plant (Iraq) made in 2010, 2011 and 2012. It was found that total suspended solid and temperature significantly exceeded the normative indicators, especially in the summer. It was noted that the release of heated water directly into the river was more dangerous for the aquatic ecosystem than organic pollution. A higher temperature reduced the solubility of oxygen, chemical reactions took place at a faster rate, and water could become anaerobic with a catastrophic effect on its odor and appearance.

Jordan is a country with limited natural resources, especially water shortage, which is the most serious environmental problem for the country. The work [6] presents a study of the potential for the reuse of industrial wastewater at the A1-Hussein thermal power station (Jordan). Water quality assessment is carried out along the Tapi River (USA) upstream and downstream from the Deepnagar Power Station (DPP) [7]. Analysis of water samples showed that the discharge from DPP increased the load on pollution in the Tapi River. The heat flow from DPP causes a decrease in the level of dissolved oxygen, which already leads to a change in the species diversity of fish and their mass mortality.

Assessment of the thermal contamination of sewage discharged from Rovinari, Turceni and Craiova coal-fired power plants in Romania located along the river Jiu was conducted by Canadian and Romanian scientists in the work [8]. Wastewater from the cooling system of a power plant can be reduced by using waste heat for heating local houses or used in other industries.

Russia is one of the richest countries in water supply: one resident has more than 30 thousand m^3 of water per year. In Russia, there are more than 120 thousand rivers with a total volume of 4,691 km^3 [9]. The specific amount of heat withdrawn from the cooling water by heating it in condensers of turbines by 8-10 °C is about 4.3 kJ/(kW·h) at the TPP with a water discharge of 100-130 kg (kW·h). Salt discharges of water treatment plants contain neutral salts, acids and alkalis. These discharges lead to a significant increase in salinity of water bodies and a change in pH. With wastewater of pretreatment all of the trapped organic substances that increase BOD reservoir, suspended substances, iron and aluminum compounds, $Mg(OH)_2$ and $CaCO_3$ are also discharged.

In the works [1]–[9] researchers of various countries of the world are concerned with the problem of thermal contamination of the hydrosphere and heavy metal contamination of groundwater used for household drinking purposes.

In this paper, a water analysis was performed at the confluence of the discharge canals of the Novocherkassk SDPP to the Don River (Rostov Region, Russia). In the works [10]–[11] we determined the quantitative chemical composition of the ash and slag mixture formed as a result of the combustion of Donetsk culm, which was transported to the ash dump by means of hydro ash removal. Ash-disposal area is a hotbed of heavy metals (plumbum, copper, cadmium). Statistics of industrial emissions of NO_2, NO, CO, SO_2, C (soot) by power units of the Novocherkassk SDPP conducted from March 2015 to February 2017 showed that the emissions of each component were within the same level and were stable. However, the combustion products, getting into the atmosphere, are scattered by the wind around the neighborhood of the power station and are washed during the rains into the drainage canals of the state-owned district power plants and seep into the groundwater, which adversely affects the overall environmental situation.

3. METHODS

The water quality indicators studied are determined by the following regulatory documents (Russia): environmental regulatory document of the federal level (ERD F); Federal Register (FR); Guidance document (GD); State industry standard (SIS).

Temperature ERD F 12.16.1-10, odor ERD F 12.16.1-10, power of hydrogen ERD F ERD F 14.1:2:3:4.121-97, transparency, ERD F 12.16.1-10, suspended materials ERD F 14.1:2:4.254-2009, dissolved oxygen ERD F 14.1:2:3.101-97, BOD_5 ERD F 14.1:2:3:4.123-97, TBOD Calculation method, COD ERD F 14.1:2:3.100-97, mineralization, ERD F 14.1:2:4.261-10, chlorides GD 52.24.361-2008, sulfates ERD F 14.1:2.159-

2000, hydrogen carbonates SIS 31957-2012, alkalinity SIS 31957-2012, calcium, magnesium ERD F 14.1:2:3.95-97, hardness ERD F 14.1:2:3.98-97, sodium + potassium GD 52.24.365-2008, ammonium ions ERD F 14.1:2:4.262-10, nitrites ERD F 14.1:2:4.3-95, nitrates ERD F 14.1:2:4.4-95, phosphorus phosphates ERD F 14.1:2:4.112-97, total ferrum ERD F 14.1:2:4.50-96, copper ERD F 14.1:2:4.222-06, aluminum ERD F 14.1:2:4.166-2000, synthetic surface active substances (SSAS) ERD F 14.1:2:4.15-95, petroleum products ERD F 14.1:2:4.5-95, toxicity FR.1.39.2007.03222.

ERD F 12.16.1-10 "Determination of temperature, odor, color and transparency in wastewater, including treated sewage, stormwater and meltwater. Guidelines". The temperature is measured by a mercury thermometer with a graduating mark of 0.1-0.5 ºC by lowering it into a bottle of water, the temperature of which is preliminarily brought by immersion in water to the temperature of the water under test. The intensity of the smell is determined on the basis of a 5-point scoring scale (0 - not felt, 1 - very weak, 2 - weak, 3 - noticeable, 4 - distinct, 5 - very strong). Transparency is determined by measuring the maximum height of the water column at which reading the font (Snellen's font No. 1 with a height of 3.5 mm letters) became possible.

ERD F 14.1:2:3:4.121-97 "Quantitative chemical analysis of waters. The procedure for performing pH measurements in waters using the potentiometric method". To measure the pH value the potentiometric analysis method is used, which is based on the dependence of the electrical signal of the measuring electrode on the composition of the solution being analyzed.

ERD F 14.1:2:4.254-2009 "Quantitative chemical analysis of waters. Methodology for measuring mass concentrations of suspended solids and calcined suspended solids in drinking, natural and wastewater samples using the gravimetric method". Suspended solids are isolated from the sample by filtering water through a weighted paper filter and determining the weight of the filter sludge dried to constant weight at (105±2) ºC.

ERD F 14.1:2:3.101-97 "Quantitative chemical analysis of waters. Methodology for measuring the mass concentration of dissolved oxygen in samples of natural and wastewater using the iodometric method". The titrimetric method for determining the mass concentration of dissolved oxygen is based on its reaction with manganese hydroxide (II) in an alkaline medium. The latter quantitatively binds oxygen, passing at the same time to the compound of manganese (IV). When the sample is acidified in the presence of an excess of potassium iodide, iodine is formed, the amount of which is equivalent to the content of dissolved oxygen and is determined by titration with a thiosulphate solution.

ERD F 14.1:2:3:4.123-97 "Quantitative chemical analysis of waters. Methodology for performing biochemical oxygen demand measurements after n-days of incubation (TBOD) in surface fresh, underground (groundwater), drinking water, waste and treated wastewater". The method of biochemical oxygen demand (BOD) is based on the ability of microorganisms to consume dissolved oxygen in the biochemical oxidation of organic and inorganic substances in water.

ERD F 14.1:2:3.100-97 "Quantitative chemical analysis of waters. Methodology for measuring COD in samples of natural and wastewater using the titrimetric method". The essence of the method is in processing a sample of water with sulfuric acid and potassium dichromate at a given temperature in the presence of silver sulfate - an oxidation catalyst and mercury (II) sulfate used to reduce the effect of chlorides and determining COD values in a given concentration range by measuring the optical density of the solution at a given wavelength value using the calibration dependence of the optical density of the solution on the COD value.

ERD F 14.1:2:4.261-10 "Quantitative chemical analysis of waters. Methodology for performing measurements of the mass concentration of dry and calcined residues in drinking, natural and wastewater samples using the gravimetric method". The method for determining the dry residue is based on evaporation of an aliquot portion of the filtered analyzed sample, drying the resulting residue at a temperature of 105 ± 2 °C and weighing it. The method for determining the calcined residue is based on evaporation of an aliquot portion of the filtered analyzed sample, calcining the resulting residue at a temperature of 600 ± 20 °C and weighing it. Mineralization is an indicator of dissolved compounds that crystallize upon evaporation of water, and further calcination at 600°C allows to extract the water included in the chemical composition of crystalline.

GD 52.24.361-2008 "Mass concentration of chlorides in water. The procedure for performing measurements by the potentiometric method with an ion-selective electrode". The Guidance Document establishes a methodology for performing measurements of the mass concentration of chlorides in natural and treated wastewater in the range from 12 to 355 mg/dm^3 using the potentiometric method with an ion-selective electrode.

ERD F 14.1:2.159-2000 (FR.1.31.2007.03797) "Quantitative chemical analysis of water. Methodology for performing measurements of the mass concentration of sulfate ions in samples of natural and wastewater using the turbidimetric method". The method of measuring the mass concentration of sulfate ions is based on the formation of a stabilized suspension of barium sulfate in a hydrochloric acid environment followed by the measurement of light scattering in the direction of the incident beam (in units of optical density).

SIS 31957-2012 "Water. Methods for determination of alkalinity and mass concentration of carbonates and hydrocarbons". The essence of the method is in titrating the sample with a standard acid solution in the presence of indicators of phenolphthalein or methyl orange.

ERD F 14.1:2:3.95-97 "Quantitative chemical analysis of waters. Methodology for measuring the mass concentration of calcium in samples of natural and wastewater using the titrimetric method". The method is based on complexometric titration. Calcium ions bind to a strong complex with Trilon B at pH = 12 in the presence of an indicator of eryochromic black T, while the color of the solution changes from pinkish to blue.

ERD F 14.1:2:3.98-97 "Quantitative chemical analysis of waters. Methodology for measuring the total stiffness in samples of natural and wastewater using the titrimetric method". Methodology for performing measurements of the mass concentration of calcium, magnesium, total hardness in sewage and natural waters by volumetric titration with Trilon B. The essence of the method is in titrating the water sample with a solution of Trilon B (EDTA) in the presence of an indicator of black chromosome T (black chromogen), resulting in complex compounds of Trilon B with calcium and magnesium ions at a pH of about 10. Since the calcium complex is stronger than magnesium when the sample is titrated, Trilon B interacts with calcium ions and then with magnesium ions, displacing the indicator, the complex of which with magnesium ions is colored cherry red, and in free form has a blue color.

GD 52.24.365-2008 "Mass concentration of sodium in water. The procedure for performing measurements using the potentiometric method with an ion-selective electrode". Methodology for performing measurements using the potentiometric method with an ion-selective electrode. The measurement is based on measuring the potential of the ion-selective electrode, depending on the activity of sodium ions in the solution. The measurements are carried out in the presence of ammonia and indifferent electrolyte (calcium chloride), which maintain a certain pH and ionic strength in the solution being analyzed, which allows the instrument to be calibrated in units of concentration, rather than the activity of sodium ions. The concentration of sodium in the sample is found from the calibration dependence of the magnitude of the electrode potential on the inverse logarithm of the activity (concentration) of sodium ions (Na).

ERD F 14.1:2:4.262-10 "Quantitative chemical analysis of waters. Methodology for measuring the mass concentration of ammonium ions in drinking, surface (including marine) and waste water photometric using the method with Nessler reagent". The method is based on the interaction of ammonium ions with potassium tetramercurate in an alkaline environment (Nessler's reagent) to form a brown, water-insoluble salt of Milton base, which transforms into a colloidal form of yellow color with small amounts of ammonium ions.

ERD F 14.1:2:4.3-95 "Quantitative chemical analysis of waters. Methodology for measuring the mass concentration of nitrite ions in drinking, surface and waste waters using the photometric method with a Griss reagent". The determination is based on the ability of nitrites to diazotize sulfanilic acid to form a red-violet diazo compound with α-naphthylamine followed by photometric detection. The reaction process depends to a large extent on the pH environment.

ERD F 14.1:2:4.4-95 "Quantitative chemical analysis of waters. The methodology of measuring the mass concentration of nitrate ions in drinking, surface and waste waters using the photometric method with salicylic acid". The method is based on the interaction of nitrate ions with salicylic acid to form a yellow complex compound.

ERD F 14.1:2:4.112-97 "Quantitative chemical analysis of waters. Methodology for measuring the mass concentration of phosphate ions in drinking, surface and waste waters using the photometric method with ammonium molybdate». The method is based on the interaction of phosphate ions in an acid environment with ammonium molybdate and the formation of a phosphoric-molybdenum heteropolyacid, which is reduced by ascorbic acid in the presence of antimony-tartaric potassium (Segnetova salt) to a phosphor-molybdenum complex dyed blue, followed by photometric detection.

ERD F 14.1:2:4.50-96 "Quantitative chemical analysis of waters. The methodology of measuring the mass concentration of total iron in drinking, surface and waste waters using the photometric method with sulfosalicylic acid". The method is based on the formation of sulfosalicylic acid with iron salts of colored complex compounds, and in a weakly acidic environment, sulfosalicylic acid reacts only with iron (III) salts (red staining), and in a slightly alkaline environment with iron (II) and iron (III) salts (yellow coloration).

ERD F 14.1:2:4.222-06 (FR.1.31.2004.00987) "Methodical instructions 31-03/04. Methodology for performing measurements of the mass concentration of zinc, cadmium, lead and copper in drinking, natural and waste waters using the method of inversion voltammetry on analyzers of the TA type". The method of inversion voltammetry is based on the ability of the elements accumulated on the working electrode from the analyzed solution to electrochemically dissolve at a certain potential characteristic for each element.

ERD F 14.1:2:4.166-2000 "Quantitative chemical analysis of waters. Methodology for performing measurements of the mass concentration of aluminum in samples of natural, treated sewage and drinking water using the photometric method with aluminon". The method is based on the ability of an aluminum ion to form an aluminon complex compound of an orange-red color, which is photographed at a wavelength of 525-540 nm. The reaction is carried out in a slightly acidic solution at pH 4.5-4.65 in the presence of ammonium sulfate as the color stabilizer of the complex compound.

ERD F 14.1:2:4.15-95 "Quantitative chemical analysis of waters. Methodology for measuring the mass concentration of anionic surfactants in drinking, surface and waste waters using the extraction-photometric method". The method is based on the formation of a colored compound extracted by chloroform in the interaction of surfactant with methylene blue and subsequent photometric quantification.

ERD F 14.1:2:4.5-95 "Quantitative chemical analysis of waters. Methodology for measuring the mass concentration of petroleum products in drinking, surface and waste waters using the IR spectrometry". The method is based on the extraction of emulsified and dissolved petroleum products from water using carbon tetrachloride, the separation of petroleum products from the accompanying polar organic compounds of other classes on a column filled with aluminum oxide and the quantitative determination of petroleum products by the absorption intensity in the infrared region of the spectrum.

FR 1.39.2007.03222 "Biological methods of control. Methodology for determining the toxicity of water and water extracts from soils, sewage sludge, waste by mortality and the change in the fertility of daphnia". The methodology is based on the definition of mortality and changes in the fertility of daphnia (*Daphnia magna Straus*, *Cladocera*, *Crustacea*) when exposed to toxic substances present in the aqueous medium under study, compared to the control culture in samples that do not contain toxic substances (control).

4. RESULTS

Ensuring reliable and environmentally safe operation of TPP equipment is related to maintaining optimal technological parameters, both water treatment processes and wastewater treatment processes. The main means of observation is the Industrial Chemical Control (ICC).

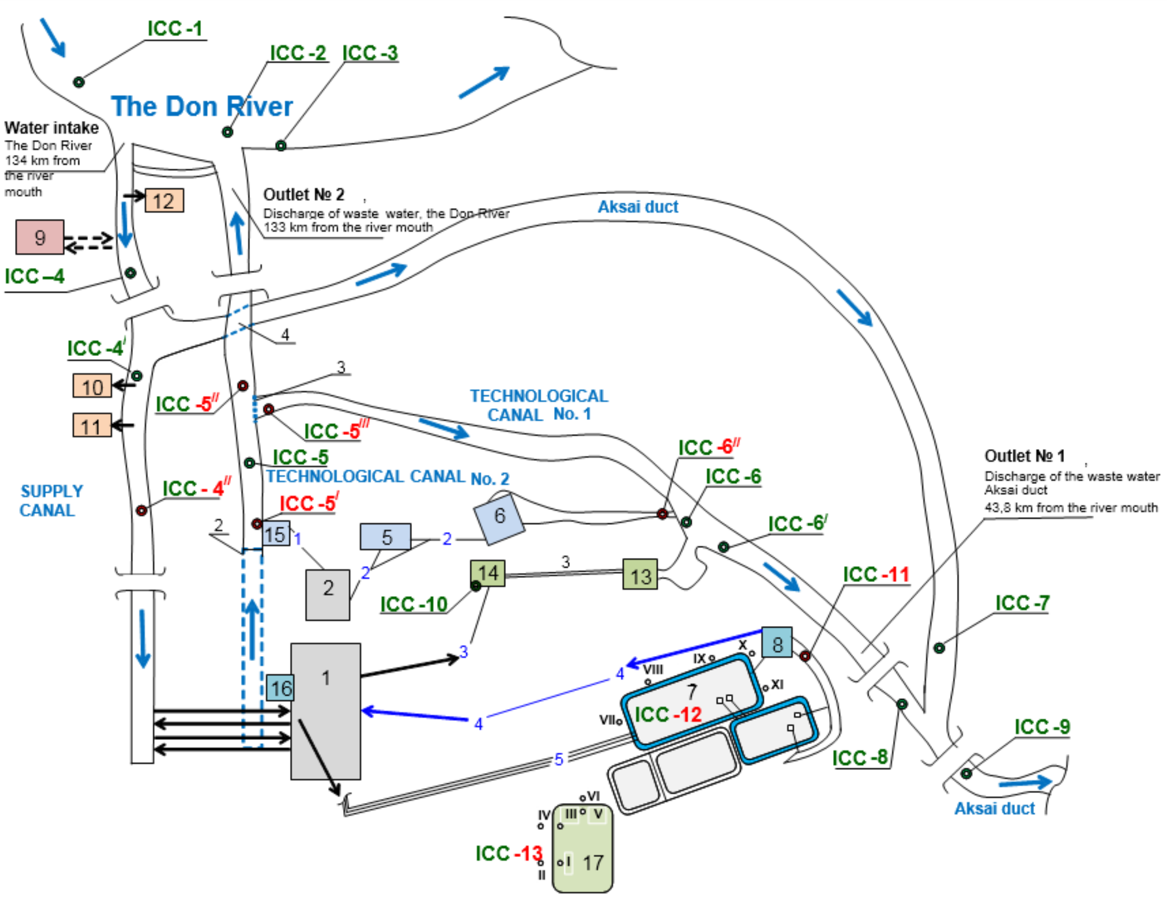
Wastewater includes water treatment effluents, chemical water purification, self-wash filters, storm treated water, household treated wastewater, and the warm water used in the cooling circuit. The spent condensate is recycled in the chemical plant, i.e. the technological process is cyclic. This means that there is practically no thermal pollution of the Don River by the drains of the Novocherkassk SDPP, since the temperature of the condensate used in the cooling circuit is significantly reduced when discharged into the drainage canal and is leveled off when it continues to move along the drainage canal before discharging into the Don River.

Figure 1 shows the layout of water withdrawal points. The following designations are accepted: 1. Main building; 2. Central Demineralizer (CD); 3. Gateway controller (shandoor); 4. Inverted syphon under the canal No. 2; 5. Neutralization pool; 6. Leveed pool; 7. Ash dump. Section No. 4 (38 ha); 8. Pumping station of clarified water; 9. Biological treatment plant (BTP) of the MUE "Gorvodokanal", Novocherkassk; 10. Water intake of JSC "NZSP"; 11. Water intake of the Branch "Kadamovskiy", JSC "Leningradskoye"; 12. Water intake of JSC "Bessergenevsky fish factory"; 13. FOS MUE "Gorvodokanal", Novocherkassk; 14. Metering skids; 15. Oil separator (sewage from CD); 16. Pumping station of the ash dump; 17. Landfill for solid industrial waste disposal.

The results of measurements of water quality indicators for March 2017 are given in Table 1.

Impact of thermal pollution is not revealed. The estimation of the water odor intensity is 0 points, which means that the dissolved substances and the pH value do not affect the water quality and correspond to the established norms. The pH of the environment is in the range of 7.4-8.3. Transparency is stable and is located on the boundary between low and transparent and corresponds to 30 cm. Suspended substances do not exceed 10 mg/dm^3.

The content of dissolved oxygen in water characterizes a sufficient oxygen regime of the reservoir, providing conditions for the respiration of hydrobionts. Biochemical oxygen demand (BOD and COD) indicates a low content of organic substances in water. Salinity, chloride, total ferrum, synthetic surfactant are around the normative values. Hydrocarbonates, alkalinity, calcium, magnesium, hardness, sodium + potassium are not currently standardized.



-1- pipeline of waste waters after washing mechanical filters and CD installations; -2- sewage pipeline after physico-chemical cleaning of filters of CD; -3- pipeline of domestic and fecal waters of Novocherkassk SDPP; -4- clarified water line from a clarified water pumping station; -5- ash dumps, transporting water from hydraulic ash removal systems

Fig.1 Scheme for the location of water sampling points in the vicinity of the Novocherkassk SDPP

Table 1 Water quality indicators in the vicinity of the Novocherkassk SDPP

Defined indicator	Unit of measurement	Aksai duct, 0.5 km above the outlet No. 1 (Tech. canal No. 1), 44.3 km from the river mouth (ICC 1)	Outlet No. 1 Technological canal No. 1, 43.8 from the confluence with the Don River		Aksai duct, 0.5 km below the outlet No. 1 (Tech. canal No. 1), 43.3 km from the river mouth (ICC 9)	the Don River, 1.5 km above the outlet No. 2 (Tech. canal No. 2), 134.5 km from the river mouth (ICC 2)	Outlet No. 2 Technological canal No. 2, 133.0 km from the mouth of the Don River		the Don River, 0.5 km below the outlet No. 2 (Tech. canal No. 2), 132.5 km from the river mouth (ICC 3)
			Actual concentrations	MAF Guidelines			Actual concentrations	MAF Guidelines	
March 2017									
Temperature	°C	2.6	3.4	-	2.9	2.5	3.4	-	2.8
Odor	unit	0	0	Up to 1 point	0	0	0	Up to 1 point	0
Power of hydrogen (pH)	pH units	7.4	7.4	6.5-8.5	7.4	7.4	7.45	6.5-8.5	7.4
Transparency	sm	30	30	-	30	30	30	-	30

Suspended solids	mg/dm^3	8.7	8.3	10.7	8.5	8.9	8.4	12.6	8.7
Dissolved oxygen	mg/dm^3	8.84	8.98	6.00	8.89	8.87	8.97	6.00	8.93
BOD_5	mgO_2/dm^3	1.59	1.45	1.62	1.55	1.56	1.44	2.00	1.53
TBOD	mgO_2/dm^3	2.11	1.93	2.32	2.06	2.07	1.92	3.00	2.03
COD	mgO_2/dm^3	15.9	14.7	17.8	15.8	15.7	14.6	25.0	15.5
Mineralization	mg/dm^3	813	793	754	807	817	792	793	808
Chlorides	mg/dm^3	130	129	116	130	129	129	121	129
Sulfates	mg/dm^3	185	175	182	183	185	176	192	182
Hydrogen carbonates	mg/dm^3	253	249	-	250	257	248	-	254
Alkalinity	$mmol/dm^3$	4.15	4.08	-	4.10	4.21	4.06	-	4.16
Calcium	mg/dm^3	55.7	51.2	-	54.6	56.5	51.3	-	55.4
Magnesium	mg/dm^3	30.6	29.8	-	30.4	31.3	29.9	-	30.8
Hardness	$mmol/dm^3$	5.3	5.00	-	5.22	5.39	5.02	-	5.29
Sodium + Potassium	mg/dm^3	159	159	-	159	158	158	-	157
Ammonium ions	mg/dm^3	0.34	0.29	0.31	0.28	0.32	0.26	-	0.31
Nitrites	mg/dm^3	0.056	0.052	0.060	0.054	0.055	0.05	-	0.053
Nitrates	mg/dm^3	1.48	1.4	1.86	1.47	1.48	1.43	-	1.45
Phosphorus phosphates	mg/dm^3	0.061	0.052	1.53	1.5	1.55	1.42	-	1.51
Total ferrum	mg/dm^3	0.11	0.10	0.09	0.064	0.059	0.057	-	0.062
Copper	mg/dm^3	0.0034	0.0032	0.10	0.10	0.11	0.09	0.11	0.10
Aluminum	mg/dm^3	0.022	0.020	0.0035	0.0040	0.0040	0.0039	0.0036	0.0040
Synthetic surface active substances	mg/dm^3	0.04	0.04	0.023	0.024	0.025	0.023	0.027	0.024
Petroleum products	mg/dm^3	0.04	0.04	0.042	0.05	0.05	0.04	-	0.04
Toxicity	-	not toxic		-	not toxic			-	not toxic

Water hardness can be estimated as medium. Ammonium ions, nitrites, nitrates, phosphorus phosphates, copper, aluminum, petroleum products do not exceed the normative indices. The presence of toxic pollutant chemicals in water has not been identified. Water is not toxic.

Figures 2-5 give, as an example, normative and measured values in mg/dm^3, suspended solids, dissolved oxygen, salinity (mineralization) and chlorides. Deviation in the direction of water quality deterioration does not exceed 15%.

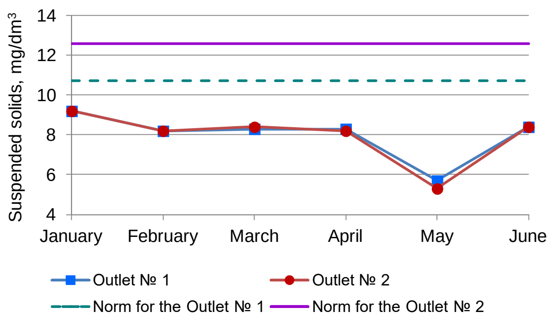


Fig.2 Content of suspended solids (Total suspended solids, mg/dm3)

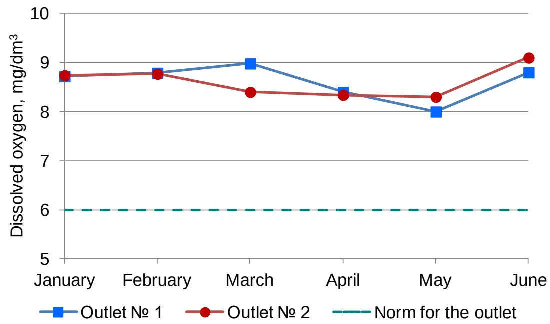


Fig.3 Content of dissolved oxygen (Dissolved oxygen, mg/dm^3)

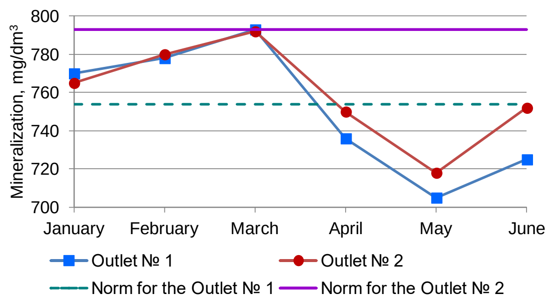


Fig.4 Salinity (mineralization) (Mineralization, mg/dm^3)

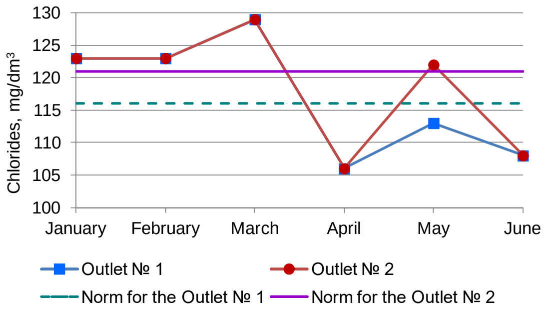


Fig.5 Content of chlorides (Chlorides, mg/dm^3)

5. DISCUSSION

TPP are the largest consumers of water, which leads to the formation of a large number of drains of various compositions. When such water is discharged into natural water bodies, self-purification processes of water are violated. Due to the deterioration of the ecological situation in the world, the requirements for regulatory indicators permitted for discharge into natural water bodies are toughened. Insufficiently effective wastewater treatment can lead to the death of flora and fauna of water bodies, and later of all mankind. No wonder there is a saying "Water is life". For people, the water is a source of energy and raw materials for production. In order to reduce the hydrosphere pollution, it is recommended to improve the purification systems and reuse the water in closed resource-saving and non-waste processes in industry.

6. CONCLUSION

The production chemical control of water bodies, where wastewater from energy complexes is being discharged to, allows to assess the impact of the energy facility on the hydrosphere and ensure the compliance with environmental quality standards in a timely manner.

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