

PAPER • OPEN ACCESS

Assessment of Water Resources Using and Protection Main Parameters in Ural Federal District

To cite this article: V A Sapega and V S Petukhova 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **272** 022191

View the [article online](#) for updates and enhancements.

Assessment of Water Resources Using and Protection Main Parameters in Ural Federal District

V A Sapega¹, V S Petukhova¹

¹Tyumen Industrial University, Volodarsky Street 38, Tyumen , Russia

E-mail: sapegavalerii@rambler.ru

Abstract. The article contains an analysis of fresh water use in the Ural federal district for 2012-2015 years and waste waters characteristics. The materials used for the study included the data on the protection of the environment in Ural Federal district. The carried out analysis has shown that due to the water objects, the largest amount of fresh water is taken in Khanty-Mansisk autonomous district and Sverdlovsk region; the largest amount of used fresh water is in Khanty-Mansisk and Yamalo-Nenets autonomous districts (2022 and 389 mln. m³), and also in Tyumen region (221 mln. m³). In general, in the Ural federal district during 2012-2015 the largest amount of fresh waters is used for the industrial needs (in total - 48.3% of the used water). And among the autonomous districts and regions, Khanty-Mansisk AD and Sverdlovsk region dominate by this index. Maximal volume of the waste waters is noted in Sverdlovsk region (952 mln. m³). In the time course, significant decrease of their volume was revealed only in Sverdlovsk and Chelyabinsk regions. Sverdlovsk and Chelyabinsk regions are characterized by the largest volume of the waste waters, requiring treatment on the average for 2012-2015 years (79.4% and 88.9% of waste waters volume - in total). In general in the Ural federal district in 2012-2015 the volume of circulating and reused water supply systems made up 30472 mln m³. In the time course this volume has decreased in the Ural federal district, and also in the regions

1. Introduction

The water relates to the renewable and inexhaustible resources. However, the growing chemical pollution of the oceans, seas, surface and underground objects lead to the decrease of the quality of water resources [1-4].

The resources of water bodies pollution are numerous and rather different. The main reason of water body pollution is discharge to the water bodies of unpurified or insufficiently purified waste waters of the industrial, agricultural enterprises and enterprises of communal services [5-8]. General damage from the pollution of the water bodies for the population, fields of economy and natural environment is evaluated almost in 70 billion rubles annually [1].

Nowadays the growing deficit of the fresh water in Russia is among the most acute problems not only of regional but also macroeconomical and geopolitical levels. The problem of provision of population with quality drinking water has large significance and topicality of the life support and health protection [9-13].

The growth of cities, the rapid development of industry, the intensification of agriculture, the significant expansion of irrigated land areas, the improvement of cultural and living conditions and a number of other factors increasingly complicate the problems of water supply [14-16].



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

At the modern stage, the main directions of rational use of water resources are the fuller use and expanded reproduction of freshwater resources, as well as the development of new technological processes to prevent pollution of water bodies, and to minimize the consumption of fresh water [17-20].

In connection with the above mentioned, it is timely to assess the main indicators of water resources use and protection in the Ural Federal District and the temporal dynamics of their change.

2. Materials and Methods

The environment protection data of 2012-2015 in the Ural Federal district serves as the material of study [21].

An analysis of the fresh water taken from the natural water objects has shown that on the average for 2012-2015 the largest amount of water is taken in Khanty-Mansisk AD and Sverdlovskregion (43.5 and 23.75 correspondingly of all volume of taken water in the Ural federal district) (table 1).

In the temporal dynamics (2015 in comparison with 2012) it was revealed the increase (Ural FD, Tyumen region, Khanty-Mansisk AD) as well as decrease (Kurgansk, Sverdlosk and Chelyabinsk regions) of the taken water volume.

The largest volume of used fresh water on average for 2012-2015 was characteristics of Khanty-Mansisk AD, Tyumen region and Yamalo-Nenets AD (222, 389 and 221 mln m³respectfully) and in general in the Ural FD this volume made up 4689 mln m³ (table 1). In the temporal dynamics the changes of volume of used fresh water bears the same character as the changes of the volume of the taken water.

As it's seen from the given data, not the whole volume of the taken water is used in the Urals FD as well separately in the areas of federal district. The largest volume of unused water on average for 2012-2015 is on average accounts for Chelyabinsk, Sverdlovskand Kurgansk regions (26.2, 26.1 and 22.7% of the taken water volume respectfully) (table 1). These volumes of unused water are, first of all, connected with its loses in the technological processes using the water.

Table 1. Volume of taken and used fresh water, 2012-2015.

Federal district, region	Volume of the fresh water taken from the natural water objects			The volume of used fresh water			Fresh water is not used	
	mln. m ³	%	2015 to 2012 (± mln. m ³)	mln. m ³	Of taken water, %	2015 г. к 2012 г. (± mln. m ³)	mln. m ³	Of taken water, %
Ural FD including:	4689	100.0	1294	4113	87.7	1322	576	12.3
Tyumen (without autonomous district)	412	8.8	82	389	94.4	88	23	5.6
Yamalo-Nenets AD	2042	43.5	1450	2022	99.0	1431	20	1.0
Yamalo-Nents AD	234	5.0	2	221	94.4	1	13	5.6
Kurgansk	75	1.6	-12	58	77.8	-10	17	22.7
Sverdlovsk	1112	23.7	-151	822	73.9	-131	290	26.1
Chelyabinsk	814	17.4	-77	601	73.8	-57	213	26.2

In general, for the Ural Federal District on average for 2012-2015, the largest amount of fresh water is used for production needs (48.3% of the used– in total), and among the autonomous districts and Khanty-Mansiysk Autonomous District (890 million m³) and the Sverdlovsk region dominates by this

index (436 million m³) The least volume of fresh water for these purposes was used in Yamalo-Nenets autonomous district (8.6% of the used water – in total).

For drinking and household needs, the largest amount of water is used in Sverdlovsk (377 million m³) and Chelyabinsk (235 million m³), which is directly related to the population. Very little amount of water is used for drinking and household needs in the Khanty-Mansiysk and Yamalo-Nenets autonomous districts (3.3 and 11.8% of the total used fresh water, respectively).

Table 2. Fresh water characteristics, 2012-2015.

Federal district, region	For drinking and household needs			For production needs			For other needs	
	mln. m ³	Of used water – in total, %	2015 to 2012 r. (± mln. m ³)	mln. m ³	Of used water – in total, %	2015 to 2012 r. (± mln. m ³)	mln. m ³	Of used water – in total, %
UralFD including:	805	19.6	-85	1988	48.3	98	1320	32.1
Tyumen (without autonomous districts)	74	19.0	1	296	76.1	74	19	4.9
Khanty-Mansiysk AD	67	3.3	2	890	44.0	141	1065	52.7
Yamalo-Nenets AD	26	11.8	-2	19	8.6	1	176	79.6
Kurgansk	26	44.8	-3	27	46.6	-8	5	8.6
Sverdlovsk	377	45.9	-46	436	53.0	-94	9	1.1
Chelyabinskaya	235	39.1	-35	320	53.2	-16	46	7.7

In the temporal dynamics of the analyzed period in the regions of the Ural FD there was revealed the decrease of fresh water use for the drinking and household and industrial need.

The largest volume of fresh water for other needs is used in Khanty-Mansiysk AD (1065 mln m³) and Yamalo-Nenets AD (175 mln m³) and in general in the Ural FD for these need it's used 32.1% of the used water – in total (table 2).

The analysis of waste water showed that its volume on average for 2012-2015 in the Urals Federal District totaled 3,030.2 million m³. Among the autonomous regions and districts, the Sverdlovsk region (952 million m³) and the Khanty-Mansiysk Autonomous district (838 million m³) are characterized by the maximum value of this index (table 3).

In the temporal dynamics there was a slight decrease in the total volume of waste water in the Yamalo-Nenets Autonomous District and the Kurgansk Region and a significant decrease in the Sverdlovsk and Chelyabinsk Regions.

In the general volume of waste waters in general in the Ural FD the polluted waters prevail - 60.5% of all waste waters and the share of regulatory clean and purified waters made up 34.4 and 5.1% correspondingly (table 3).

The largest amount of recognized water wastes is noted in Tyumen region (70.7%) and Khanty-Mansiysk AD (60.80%), and the least – in Yamalo-Nenets AD (2.6%).

The volume of normatively treated wastewater is insignificant in average for the analyzed period. In fractional terms, it varied from 0.5% (Kurgansk region) to 30.8% (Yamalo-Nenets AD) (Table 3).

The largest volumes of polluted waste water were recorded in the Kurgan and Chelyabinsk regions (99.5 and 87.9% of the total volume respectively), and the lowest in the Tyumen Region (88 million m³ or 25.3% of the total volume of wastewater).

Table 3. Waste waters characteristics, 2012-2015.

Federal district, region	Waste waters volume – in total		2015 to 2012 (± mln. m ³)	Including					
	mln. m ³	%		Regulatory clean		Regulatory purified		polluted	
				mln. m ³	Of the volume – In total, %	mln. m ³	Of the volume – In total, %	mln. m ³	Of the volume – In total, %
Ural FD	3030.2	100.0	94	1043	34.4	154.2	5.1	1833	60.5
including:									
Tyumen (without autonomous districts)	348	11.5	61	246	70.7	14	4.0	88	25.3
Khanty-Mansiysk AD	838	27.7	222	510	60.8	46	5.5	282	33.7
Yamalo-Nenets AD	39	1.3	-1	1	2.6	12	30.8	26	66.6
Kurgansk	40.2	1.3	-5	-	-	0.2	0.5	40	99.5
Sverdlovsk	952	31.4	-116	196	20.6	74	7.8	682	71.6
Chelvyabinsk	813	26.8	-67	90	11.1	8	1.0	715	87.9

The amount of waste water that needs to be cleaned varies considerably from year to year. In general the largest number in the Ural FD was recorded in 2014 and 2015 (respectively, 2189.2 and 2141.2 million m³), and on average for 2012-2015 in the Sverdlovsk and Chelyabinsk regions (79.4% and 88.9%, respectively, of the total volume of wastewater) (Table 4).

In the temporal dynamics, there was revealed a decrease in the volume of wastewater requiring treatment in all areas, except for the Khanty-Mansiysk autonomous district, where their volume in 2015 increased by 380 million m³ compared to 2012.

Table 4. Volume of the waste waters requiring treatment (mln. m³).

Federal district, region	2012	2013 г.	2014 г.	2015 г.	2012-2015 гг.		2015 to 2012 (\pm mln. m ³)
					mln. m ³	Of the waste waters volume – in total, %	
Ural FD	1837.9	1771.2	2189.2	2141.2	1985	65.5	303
including:							
Tyumen (without autonomous districts)	109	99	100	98	101	29.0	-11
Khanty-Mansiysk AD	118	115	578	498	327	39.0	380
Yamalo-Nenets AD	37	39	37	37	38	97.4	± 0
Kurgansk	43.2	40.2	39.2	38.2	40.2	100.0	-5
Sverdlovsk	786	763	748	725	756	79.4	-61
Chelyabinsk	744.7	715	687	745	723	88.9	-0.3

In all regions of the Ural FD there was noted not large volume of circulating and reused water supply in 2012, except Yamalo-Nenets AD (table 5).

Table 5. Circulating and reused water supply (mln. m³).

Federal district, region	2012	2013	2014	2015	2012-2015 mln. m ³	2015 2012 (± mln. m ³)
Ural FD	32449	30575	29758	29108	30472	-3341
including:	1316	1293	1253	1005	1217	-311
Tyumen (without autonomous districts)	8773	8694	8460	8601	8632	-172
Khanty-Mansiysk AD	106	336	321	309	268	203
Yamalo-Nenets AD	348	321	304	304	319	-44
Kurgansk	11359	10874	10831	10638	10925	-721
Sverdlovsk	10547	9057	8589	8251	9111	-2296

On the average in 2012-2015 the largest volume of such water supply was characteristics of Sverdlovsk and Chelyabinsk regions (10925 and 9111 mln. m³), and in general in the Ural FD it made up 30472 mln. m³.

In the temporal dynamics there was revealed the decrease of volume of circulating and reused water supply. Its significant reduction in 2015 compared with 2012 was noted in Chelyabinsk and Sverdlovsk regions, and in general in the Ural FD the volume of such water supply decreased by 3341 mln. m³.

3. Conclusions

1. In the Ural FD, Khanty-Mansiysk AD is characterized by the the largest volume of taken and used water and increase in the temporal dynamics of these parameters.
2. Independently on the autonomous districts and regions of the Ural FD in the fresh water use, the production needs prevail.
3. In general volume of the waste waters the largest share includes the polluted waters that indicates to the not efficient enough work of economic complex of the region on the implementation of the advance technologies directed to the decrease of polluted waste water discharge as well as treatment technologies.
4. The volumes of circulating and reused water supply as an index of efficient water consumption and water demand, decreased in the temporal dynamics of the analyzed period that requires increase of work of economic subjects in this area.

4. References

- [1] Opekunov A U 2006 Environmental standardization and environmental impact assessment *Publishing house S.-Petersburg. University* (St. Petersburg) p 261
- [2] Korobkin V I 2003 and Pereadelsky L V Ecology (Rostov-on-don) p 576
- [3] Ignatova A Yu and Novoselova A A and Papin A V 2016 Method of improvement of the efficiency of biological treatment of wastewater from chemical enterprises *Water and Ecology* pp 37-51
- [4] Mikhailova M V and Zolotarev K V and Belyaeva N F and Kashirtseva V N 2016 Assessment of environmental risks and risks to human health caused by pollutants of water bodies in the *European Union, in the USA* pp 63-80
- [5] Sapega A V 2015 Water resources and landscape-estate urbanization of the territories of Russia in the 21st century (Tyumen) pp 290-295
- [6] Lipunov I N and Vasilenko L V et al 2001 Environmental protection (Ekaterinburg) p 538

- [7] Ignatchik S Yu and Kuznetsov P N Methods of assessment and ways to reduce wastewater discharges into the environment pp13-23
- [8] Feofanov Yu A and Mishukov B G 2017 Features of formation of surface sewage composition and selection of facilities for their purification pp 49-65
- [9] Krasnova T A and Tymoshchuk I V and Shulzhenko Yu S 2015 Development of technology for additional purification of drinking water from organic substances prepared with ozonization pp 3-9
- [10] Markova T I and Yagov G V 2013 Instrumental support of analysis of organic carbon in water - 2013 pp 23-35
- [11] Semenov I E 2014 Water of the air *Water and Ecology* **3** 70-80
- [12] Semenov I E 2014 Water of the air pp 70-80
- [13] Kobylansky V Ya 2015 Integrated assessment of drinking water quality in the city's water supply network pp 20-28
- [14] Novikov M G 2007 Problems of providing Russia with non-malignant water and ways to solve them pp15-18
- [15] Alexeev E V 2015 Ecological aspects of wastewater treatment containing biologically resistant organic substance pp 68-77
- [16] Golub N B 2013 Increase in the yield of energy carriers during the wastewater treatment pp 41-50
- [17] Feofanov Yu A 2016 Improvement of the technical water supply system at the metallurgical plant on the basis of a computer model pp 13-25
- [18] Vishnyakov Ya D and Zozulya P V et al 2013 Environmental protection 288
- [19] Khutorynyuk G N and Gundyreva T M et al 2009 Experience of removal of biogenic elements from the waste water pp 37-40
- [20] Arakcheev E N and Petkova A P and Brunman M V 2016 Disinfection and purification of water with the help of anolyte and sodium ferrate and installation for their integrated production (*Water and Ecology*) pp 26-36
- [21] Yermolin Yu A and Alekseev M I 2017 Industrial wastewater treatment as a controlled process (*Water and Ecology*) pp 18-26
- [22] Environmental protection in the Tyumen region (2011-2015): Stat. collection *Territorial body of the federal service of state statistics for the Tyumen region* (Tyumen) p 100

Acknowledgments

Published under licence in *Journal Title* by IOP Publishing Ltd.