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

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Abstract. The article contains an analysis of fresh water use in the Ural federal district for 2012-2015 years and waste waters characteristics. The material 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].
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 Sverdlovsk region (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-Mansiysk 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 (2022, 389 and 221 mln m$^3$ respectively) and in general in the Ural FD this volume made up 4689 mln m$^3$ (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, Sverdlovsk and 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 mln. m$^3$ | % | 2015 to 2012 (± mln. m$^3$) | The volume of used fresh water mln. m$^3$ | Of taken water, % | 2015 г. к 2012 г. (± mln. m$^3$) | Fresh water is not used mln. m$^3$ | Of taken water, % |
|--------------------------|-------------------------------------------------|---|-----------------------------|---------------------------------|----------------|-----------------------------|-------------------------------|----------------|
| Ural FD including: Tyumen (without autonomous district) | 4689 | 100.0 | 1294 | 4113 | 87.7 | 1322 | 576 | 12.3 |
| 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 m$^3$) and the Sverdlovsk region dominates by this
The least volume of fresh water for these purposes was used in Yamal-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 m$^3$) and Chelyabinsk (235 million m$^3$), 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 |
|--------------------------|---------------------------------|---------------------|----------------|
|                          | Of used water – in total, %     | Of used water – in total, % | Of used water – in total, % |
|                          | (± mln m$^3$)                   | (± mln m$^3$)        | (± mln m$^3$) |
| UralFD including:       |                                 |                     |                |
|                        | 805                              | 19.6                | -85            | 1988          | 48.3            | 98              | 1320           | 32.1            |
|                        | 74                                | 19.0                | 1              | 296           | 76.1            | 74              | 19             | 4.9             |
|                        | 67                                | 3.3                 | 2              | 890           | 44.0            | 141             | 1065           | 52.7            |
|                        | 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             |
|                        | Chelyabinsk                      |                     |                |               |                 |                 |                |                 |
|                        | 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 m$^3$) and Yamalo-Nenets AD (175 mln m$^3$) and in general in the Ural FD for these needs 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 m$^3$. Among the autonomous regions and districts, the Sverdlovsk region (952 million m$^3$) and the Khanty-Mansisk Autonomous district (838 million m$^3$) 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% (Kurganskaregion) 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 m$^3$ 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. m³) | Regulatory clean | Regulatory purified | polluted |
|--------------------------|--------------------------------|--------------------------|------------------|---------------------|---------|
|                          |                               |                          | Of the volume     | Of the volume       | Of the volume       |
|                          |                               |                          | mln. m³           | mln. m³             | mln. m³             |
|                          |                               |                          | In total, %       | In total, %         | 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                |
| Chelyabinsk              | 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 r. | 2014 r. | 2015 r. | 2012-2015 r. | Of the waste waters volume – in total, % | 2015 to 2012 (± mln. m³) |
|-------------------------|------|---------|---------|---------|---------------|----------------------------------------|--------------------------|
| 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).

| Federal district, region | 2012  | 2013  | 2014  | 2015  | 2012-2015 mln. m³ | 2015 2012 (± mln. m³) |
|--------------------------|-------|-------|-------|-------|-------------------|-----------------------|
| Ural FD                  | 32449 | 30575 | 29758 | 29108 | 30472             | -3341                 |
| including:              |       |       |       |       |                   |                       |
| Tyumen (without autonomous districts) | 1316  | 1293  | 1253  | 1005  | 1217              | -311                  |
| Khanty-Mansiysk AD      | 8773  | 8694  | 8460  | 8601  | 8632              | -172                  |
| Yamalo-Nenets AD        | 106   | 336   | 321   | 309   | 268               | 203                   |
| Kurgansk                | 348   | 321   | 304   | 304   | 319               | -44                   |
| Sverdlovsk              | 11359 | 10874 | 10831 | 10638 | 10925             | -721                  |

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 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 wastewater 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

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