Regional aspects of monitoring the quality of drinking water from centralized water supply

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Abstract. Despite the fact that substantial water resources are concentrated in the Irkutsk region, the research revealed the problems of providing the population with high-quality drinking water from centralized water supply systems. Monitoring the quality of drinking water from centralized water supply showed the presence of sources that do not meet sanitary and epidemiological requirements, which is associated in the overwhelming majority of cases with the absence of sanitary protection zones. The discrepancy with the adopted regulations of a part of sanitary-chemical and microbiological samples of drinking water was revealed. Deviations are mainly caused by an excess of the content of iron, aluminum, manganese, nitrates, magnesium, as well as general and thermotolerant coliform bacteria. The reasons for the unsatisfactory state of drinking water are detected and measures are recommended to ensure the appropriate quality for the sustainable development of the area under research.

The high-quality drinking water is one of the most important conditions for the successful socio-economic development of territories and ensuring the health of the population. In many regions of the Russian Federation there is a problem of providing quality drinking water [1, 2, 3, 4, 5, 6]. Large reserves of water resources are concentrated in the Irkutsk region, at the same time, the problem of providing high-quality drinking water occurs in every administrative district of the region. In this connection, monitoring the quality of drinking water from centralized water supply in the Irkutsk region is relevant.

Purpose of work is monitoring the quality of drinking water in the centralized water supply of the Irkutsk region. Research goals are analysis of the state of centralized water supply sources, parameters of drinking water samples from the distribution network of centralized water supply, determining the reasons for the unsatisfactory quality of drinking water and recommending measures to improve its quality. The object of the research is the quality of drinking water from the centralized systems of the region. Research methodology is conducting local operational monitoring the quality of drinking water [7, 8].

According to the regional report “On the state and protection of the environment of the Irkutsk region in 2019” of the Ministry of Natural Resources and Ecology of the Irkutsk region, the sources of drinking water in the region are mainly surface water bodies and groundwater. The need for drinking water is mainly supplied by surface water bodies, since they account for 86%, while underground sources account for 14%. The Rospotrebnadzor of the Irkutsk region controls 359 sources of centralized drinking water supply. In general, during the study period, there was a tendency to reduce the sources of centralized drinking water supply that did not meet sanitary and epidemiological requirements, however,
in 2019, compared to the previous year, there was an increase in the number by 20 units and, accordingly, an increase in the share by 7.2% (table 1).

Table 1. Condition of sources of centralized drinking water supply.

| Sources that do not meet sanitary and epidemiological requirements | 2017 | 2018 | 2019 | Growth rate by 2017 |
|---------------------------------------------------------------|------|------|------|-------------------|
| Total sources, including                                      | 73   | 40   | 60   | -12.7            |
| - surface                                                     | 7    | 6    | 8    | 67.2             |
| - underground                                                 | 66   | 34   | 52   | -19.2            |

Thus, 86.7% (52 out of 60) of centralized drinking water supply sources did not comply with the established sanitary and hygienic regulations due to the lack of sanitary protection zones. Out of 35 surface sources did not meet the accepted standards 8 (22.9%), and 7 (87.5%) out of 8 due to the absence of sanitary protection zones. Also, out of 324 underground sources, 52 (16%) did not meet the current regulations and 45 (86.5%) of them due to the lack of sanitary protection zones. Thus, the main reason for the discrepancy in the quality of drinking water from centralized drinking water supply sources is the lack of sanitary protection zones.

In 2019, as a result of the social and hygienic monitoring of the water quality of the centralized drinking water supply sources, 148 points were monitored (119 from underground and 29 points from surface water sources) in 34 municipalities of the region (table 2).

In general, in the Irkutsk region, monitoring studies of drinking water samples from centralized water supply revealed that in 2019, compared to 2017, there was a decrease in the excess of hygienic standards for sanitary and chemical indicators, while an increase of 73 units was observed for microbiological ones. There was no excess in parasitological parameters (table 2).

Table 2. Indicators of drinking water samples from centralized water supply exceeding hygienic standards.

| Indicators                              | 2017 | 2018 | 2019 | Growth rate by 2017 |
|-----------------------------------------|------|------|------|-------------------|
| Sanitary and chemical products          | 886  | 10.8 | 1052 | 11.2             | 850 | 10.3 | -4.1   |
| Microbiological studies                 | 439  | 3.9  | 619  | 4.1              | 512 | 4.2  | 13.5   |
| Parasitological diseases                | 0    | 0    | 0    | 0                | 0   | 0    | -      |

In the last year under study, in the municipalities of the region, the share of water samples from centralized systems with an excess of hygienic standards for sanitary-chemical and microbiological indicators was found in most territories (table 3).

Table 3. Ranking of the Irkutsk region municipalities according to the condition of drinking water of centralized water supply systems in 2019.

| №   | Municipalities | Share of water samples exceeding hygienic standards for sanitary and chemical indicators, % | Rank | Share of water samples exceeding hygienic standards for microbiological indicators, % | Rank | Share of water samples exceeding hygienic standards for parasitological indicators, % | Rank |
|-----|----------------|-------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------|------|
| 1   | Irkutsk region | 10.33                                                                                     | -    | 4.2                                                                                    | -    | 0                                                                                    | -    |
| 2   | Irkutsk City   | 13.6                                                                                     | 15   | 2.1                                                                                    | 25   | 0                                                                                    | 0    |
| 3   | Irkutsk district | 31.62                                                                                  | 8    | 5.83                                                                                  | 13   | 0                                                                                    | 0    |
Thus, the most negative situation developed with the excess of the share of water samples in terms of sanitary and chemical indicators and amounted to from one third to more than half percent in the territory of 10 municipalities.

At the same time, the most critical situation according to these parameters was created in the Alar district (56.25%), in the Kachugsky district (50%), in the Osinsky district (44.44%), in the Zalarinsky district (42.86%) and in the Bokhansky district (42.16%). An unfavorable situation with the proportion of water samples exceeding hygienic standards for microbiological indicators was determined in the territory of 8 municipalities in the range from 9.92% - 20.29%. High values were found in the Bokhansky district (20.29%), in the Mamsko-Chuysky district (17.56%), in the Kirensky district (15.13%) and in the Bayandaevsky district (13.16%).

The safest water from centralized water supply systems is supplied as a result of the excess absence according to sanitary and chemical regulations in four territories: the Nukutsk district and the cities of Ust-Ilimsk, Svirsk and Usolye-Sibirskoye, according to microbiological regulations in seven territories.

At the same time, since 2018, there has been a trend towards a decrease in the excess of sanitary and hygienic regulations for drinking water from centralized water supply systems. Monitoring studies
carried out in 2017 showed that an unsatisfactory position in hygiene standards for sanitary-chemical and microbiological indicators in drinking water from centralized water supply systems was found in 13 territories [5]. At the same time, in these territories, the share of samples with an excess is a quarter or more, according to sanitary and chemical standards from 22.6% to 80%, and microbiological standards from 21.4% to 25%.

The excess of the sanitary and hygienic regulations for drinking water from centralized water supply systems is due to the excess content of iron, aluminum, manganese, nitrates, magnesium in 6.6% of the samples studied. At the same time, the excess was most often found in iron in 14 and nitrates in 6 municipalities. The index of total hardness was present in 7.6% (indicator >= 10 mg / eq / l) of the studied samples on the territory of 7 municipal districts. In the Alar district, the excess reached 2.3 times, in the Bokhansky district 1.7, in the Bratsk district and in the Ekhirit-Bulagatsky district 1.5, in the Zalarinsky district 2.4, in the Irkutsk and Nizhneilimsky districts 1.1. The indicators of the epidemic safety of water in centralized water supply systems were exceeded due to the content of mainly common and thermotolerant (TCB) coliform bacteria.

Drinking water that does not meet the accepted sanitary and hygienic regulations leads to the development of various diseases [9, 10, 11]. The presence of excess in sanitary and chemical indicators contributes to the development of urolithiasis, kidney disease, cardiovascular system in different age groups of the population. Inconsistency in microbiological indicators causes the development of infectious diseases.

Monitoring studies have revealed that the main reasons for the unsatisfactory quality of drinking water in central water supply systems are:

- the absence of sanitary protection zones and, as a result, the unsatisfactory condition of aboveground and underground water sources due to their pollution;
- the unsatisfactory condition of water treatment and water purification systems;
- the deterioration of existing and slow construction of new sewage treatment and water intake facilities.

In order to provide the population of the region with good-quality drinking water, state and local authorities are advised to:

- to intensify the implementation of projects to create sanitary protection zones;
- to participate more actively in targeted and investment programs for the development and construction of municipal water supply and sanitation systems.

In accordance with this, the plans with actions bringing the drinking water of the central water supply systems in accordance with the current regulations for the sustainable development of the region’s territory should be adopted and implemented.

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