Need for development of an optimal method for calculating the risk of action of contaminants on human health

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Abstract. According to the annual monitoring of water bodies in the Tyumen Oblast, it can be concluded that more than half of the samples taken from drinking water supply sources according to sanitary and toxicological criteria did not meet the normative values out of the total number of 54.3\% taken in 2018. Compared to 2016, this indicator has increased by 7.1\%. The dynamics of increasing pollution of water bodies is confirmed by the fact that in 2015 the quality of surface sources of drinking and domestic water supply did not meet the standards of 20.6\% of the analyzed samples, which is 1.4\% higher than in 2014. The current situation is partly explained by flood phenomena accompanied by surface runoff contamination of the water area, partly by peculiarities of hydrological and hydrochemical nature, partly by anthropogenic activities: operation of existing enterprises and commissioning of a number of industrial facilities: Tyumen Waste Incineration Plant, Antipinsky Oil Refinery, etc. It was noted that iron, silicon and ammonia in surface water sources exceeded MAC up to 5 times.

1. Relevance
The problem of environmental pollution in Russia is a topical problem today. It defines health of the person, influences objects of environment - microorganisms, an animal and vegetation world. With food, when applied to the soil as fertilizer or when it is polluted; when drinking; when breathing air into the human body can get alien toxic chemicals - xenobiotics, which have a devastating effect on living organisms. Most of them are resistant to destruction in the external environment and can persist in it for a long time. The migration of amino and nitro compounds, polycyclic aromatic hydrocarbons (PAH) in all biological systems (water, soil, water and soil), the food chain is possible. Nowadays there is a theory of progressive accumulation of foreign substances regardless of biological system of their migration. But some systems have a more pronounced corresponding effect, for example, water system and food chain [1,2].

In water biological system hydrobiotics have imperfection of detoxification system of xenobiotics, significant accumulation of which is observed in internal environments of a living organism. In addition, according to the ecological and hygienic concept of nutrition, the higher the trophic position of a living organism, the more polluents it receives with food. That is, if the primary link of the food chain contains a small amount of any xenobiotic, then each subsequent element in the food chain, in which the previous subject acted as the primary food source, will accumulate much more of this xenobiotic than the previous one. Up to 10 times more toxicants may, according to some evidence,
accumulate in each successive food chain than in the preceding one. Therefore, taking into account the features of the system of detoxification of hydrobionts, in the water trophic chain material accumulation of contaminants is the most actual [3,4]. Since man is the final stage of a certain food chain, this type of toxic substance intake acquires paramount importance, in which water plays a weighty role [3,4]. Besides, water is used by man for drinking purposes, domestic needs, which also determines the importance of its quality. This fact emphasizes the exceptional value of water resources, especially in the conditions of industrial development of gas and oil resources of northern regions of Russia - Tyumen region. Today the xenobiotic load on water bodies in Tyumen city and the Tyumen region is not quite favorable. In the Oblast, against the background of increased natural content of silicon, common iron, ammonia, and manganese in water, these elements are often found even after water treatment - in the breeding network. Thus, as a result of human activity during industrial development of resources of the region there is a significant anthropogenic accumulation of pollutants in the environment and water objects, which will definitely have a negative impact on public health [5-7].

2. Objective
To develop optimal approaches for assessment of water bodies with unfavorable habitat as a result of high anthropogenic pressure. To substantiate the necessity to develop an optimal methodology for calculating the risks of anthropogenic contaminants action on humans and water objects [8,9]. Further, justify the measures to reduce the negative effects of xenobiotics on humans and the environment with subsequent determination of the likely consequences of water pollution.

The scientific novelty of the study is an in-depth analysis of the results of anthropogenic action on drinking water sources.

Theoretical significance of the study lies in the theoretical development of the concept of a unified understanding of the impact of anthropogenic pressure on water bodies in the Tyumen region and the city of Tyumen.

The practical significance of the study lies in the implementation of practical recommendations for the improvement of water basin sources for drinking needs in the Tyumen region and the city of Tyumen.

3. Materials and methods
At the bases of the Tyumen State Industrial University and the Tyumen State Medical University the analysis of pollution of water bodies of the Tyumen region and the city of Tyumen was carried out as well. The assessment of the main contaminants typical for anthropogenic activities was carried out. About 1000 water samples taken from various water sources were analyzed. Statistical processing was carried out with further assessment of the reliability of the obtained values. The resulting figures were compared with those presented by the Department of Subsoil Use and Ecology of the Tyumen Oblast. The analysis of weather comparison of pollution dynamics starting from 2015 was carried out [10]. Assessment of the degree of water pollution was carried out by comparison with relevant elements of the classification proposed by Roshydromet Hydrochemical Institute. In accordance with this classification, water quality was assessed in five classes. Water was considered conditionally clean (belonging to class 1), slightly polluted (class 2), polluted or very polluted (class 3), dirty or very dirty (class 4), extremely polluted (class 5). Own research was conducted in the summer-autumn period of 2018.

4. The results of the research and their discussion
As a result of the survey, water in terms of pollution in various water sources of domestic and drinking water supply in the Tyumen Oblast was characterized from conditionally clean - first class (underground water sources) to very dirty - fourth class (surface).

In the Tyumen Oblast, of the total number of water samples taken in 2017, microbiological indicators did not meet the regulatory criteria of 4.1%, in 2016. - 3.7%, while the proportion of non-
compliance with sanitary and toxicological criteria was 54.4% and 47.5% respectively. In 2017, in terms of microbiological indicators, 10.6% of samples in surface sources of domestic drinking water supply did not comply, compared to 2016 (8.4%), this is 13% higher, and the number of samples of sanitary and chemical analysis showed a similar failure to comply by 12% (24.7% in 2017 and 20.5% in 2016). In all samples from drinking water supply sources, there is an excess of ammonia compounds, which may indicate active organic pollution of water bodies under anthropogenic activity.

In 2018, monitoring of water supply sources in the region revealed increased iron content. At the same time a reliable positive connection between the areas of high anthropogenic pressure and the iron content was recorded. Iron content in water was recorded, which exceeded the maximum permissible concentrations, more than five times in a number of areas with active industrial and economic activity and in the city of Tyumen. A reliable excess of silicon was noted in some water intakes.

Non-compliance with the maximum permissible concentrations on sanitary and toxicological indicators was found in 12.5% of samples in the breeding network. At the same time, the total excess of iron and ammonia more than 5 times, manganese - from 1.1 to 2 times, silicon - from 2 to 5 times was registered in different regions of the region and Tyumen. Repeatedly, the turbidity indices did not meet the standards. [11-13].

In groundwater in 2015-2018 there were pollutants belonging to 1, 2 and 3 class of hazard on the organoleptic and sanitary and toxicological characteristics. In 2015 there were observed excess of normative criteria of concentrations of bromine, boron, cadmium, nitrates and petroleum products.

On territories of agricultural appointment in ground waters the raised maintenance of aluminium - to 7.5 MAC, barium - to 5.1 MAC, ammonia - to 4.5 MAC, bromine - to 4.2 MAC, beryllium - over 1.9 MAC, boron - to 1.8 MAC, mercury - to 1.4 MAC, cadmium - over 1.2 MAC was fixed.

The critical complex assessment of water bodies in the Tyumen Oblast has revealed the leading pollutants of water bodies - iron, aluminium, ammonia. The increased content of iron, ammonia, and manganese may be due to the natural geochemical nature of soils and, accordingly, the quality of water. But these substances, along with a number of other compounds - surface-active substances, hydroxybenzene, cadmium, may indicate water area contamination due to anthropogenic activity in the region. In 2018, with the commissioning of industrial facilities - Tyumen Waste Incineration Plant, Antipinsky Oil Refinery, a number of other oil refineries and other present studies, it was found that the regulatory values of the main xenobiotics exceeded (Table 1).

| Substance     | MPC Hazard class | Limiting indicator          | Exceeding the MPC | Rang |
|---------------|------------------|-----------------------------|-------------------|------|
| Aluminum      | 0,2(0,5)         | 3 organoleptic              | 4,2               | 1    |
| Iron          | 0,3(1)           | 3 organoleptic              | 3,3               | 2    |
| SPAV (Surfactant) | 0,5          | 2 sanitary and toxicology  | 2,6               | 3    |
| Nitrates      | 45               | 3 sanitary and toxicology  | 1,5               | 4    |
| Chlorides     | 350              | 4 organoleptic              | 1,4               | 5    |
| Nitrates      | 3,3              | 2 sanitary and toxicology  | 1,4               | 6    |
| Hydroxybenzene| 0,001            | 4 organoleptic              | 1,3               | 7    |
| Sulphates     | 500              | 4 organoleptic              | 1,2               | 8    |
| Petroleum products | 0,1        | 4 organoleptic              | 1,1               | 9    |

Excess of maximum permissible concentrations was noted in groundwater: up to 1.2 times in cadmium, 1.4 times in mercury, 1.8 times in boron, 4.3 times in bromine, 4.6 times in ammonia, 7.4 times in aluminium. In the city of Tyumen and various districts of the Tyumen region in a breeding network more than 12% of samples exceeded sanitary and chemical norms - to 2 times excess of manganese, to 5 times - silicon, more than 5 times - ammonia and iron.
In the Tyumen region the most important influence on the hydrodynamics of underground water sources becomes: high volumes of water consumption from different types of sources not only for cultural and domestic and economic needs, but also for technical needs; significant volumes of water consumption for mining: gas and oil; significant volumes of water consumption necessary for filling the voids in the reservoirs of used and developed gas and oil fields, which are formed as a result of field exploitation.

Thus, the greatest worsening of a situation in movement of underground waters was noted on those places of extracted minerals which consume water more than 1000 m$^3$/day. The territory of the Tyumen Region and the city of Tyumen contains about 14 large water intakes with the operation of such volumes. A large number of them are intended for servicing the development, industry and population of the city of Tyumen.

There are no significant fluctuations of water levels during well operation or possible level differences do not exceed critical values. This testifies to the absence of depletion of water reserves and the stability of the water supply regime established for various facilities in the region. This fact is confirmed by the long-term stability of forms and sizes of depression funnels formed at the initial stage of oil and gas development operation.

The analysis of investigated data on ground water fluctuation has shown the cyclicity of hydrodynamic regime, which has a frequency of 3-5 years. Thus, in 2017 their rise by 0.2-0.7m was fixed in comparison with 2014. These fluctuations often have natural causes due to hydrometeorological and climatic specifics of the territory.

At present, there are also regional hydrological features in the Tyumen Oblast due to the flatness of the territory accompanied by swampy areas, excessive moisture content and poor soil drainage. This, in turn, affects the hydrochemical status of groundwater, which is confirmed by the increased content of manganese, iron, and silicon, combined with high oxidation and color. At the same time, there is a high occurrence of groundwater in relation to the ground surface with the actual absence of clayey waterproofing in the area of overlapping sediments [14-16]. This fact may also indicate a high probability of contamination of the underground water basin.

At the same time, not only the natural characteristics determine this hydrodynamic and hydrochemical regimes, but also anthropogenic activity, even in slightly disturbed beds of hydrological objects.

5. Conclusions
1. Weak natural protection of the underground basin is observed in the greater part of the Tyumen Oblast, which in combination with increased anthropogenic activity may adversely affect its quality. This is accompanied by an increased risk of contamination of water bodies with chemicals. Leading water basin contaminants have been identified in the city of Tyumen and the Tyumen Region. Natural observations of water bodies will help to develop an algorithm of protection and prevention from their possible negative impact on the environment and the population of the region.
2. The increased content of copper, iron and other xenobiotics in the underground sources can be the cause of exacerbation or development of chronic diseases, remote processes, either in direct water consumption or indirectly - on the principle of food chains.
3. The conducted researches confirm the necessity to develop an optimal method of calculating the risks of action of technogenic origin contaminants on water objects and humans to justify the measures to reduce the negative effect of xenobiotics on both humans and the environment.

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