THE ANALYSIS OF RESULTS OF MONITORING OF QUALITY WATERS OF PERM CITY WATER ABSTRACTIONS

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Providing the population of Russia with drinking water is one of the priority problems to solve for health protection, better working conditions, and higher living standard. It has been a spike of ecological catastrophes lately in this country, obstructing reliable and quality uninterrupted water supply (Khabarovsk, Saratov, etc.). This unfavourable situation can be explained by used water supply systems, which have been in operation since the time of the Soviet Union without sufficient investment into support and development; it is also due to the fact that operators and municipalities have been paid little attention to the issues of providing quality life support.

The City of Perm is a regional center with a population of 1,000,000 people consuming 420,000 m^3 of drinking water daily. What is significant for water supply in Perm is that water is abstracted from several artificial surface sources or water reservoirs. The water for the city supply is treated at three water treatment plants: Chusovskaja, Bolshekamskaja and Kirovskaja.

A criterion of any harmful chemical substance level is its maximum allowable concentration or MAC; in case of its violation water is not suitable for one or more applications in terms of water use. Water quality has been determined according to the fish industry standards.

For the raw water quality analysis we have used the data of FGU Kamvodexpluatatsiya, a federal agency providing water quality control in the water abstraction areas. The chemical composition of water has been evaluated on the basis of extreme values of the chemical elements for the years 2003-2006. Water sampling was performed against the water abstractions along the navigation pass of the water reservoirs.

The water of the Chusovaya, Bolshekamsky, and Kirovsky Water Abstractions (WA) differs in terms of mineralization and basic ion content as follows:

1. Water specific conductance (σ) of the Chusovaya WA is within 200-500 μS/cm in the filling period, 300-650 μS/cm during summer-autumn level stabilization, and 250-700 μS/cm (maximum level) during winter drawdown. At the Bolshekamsky and Kirovsky WAs the values are 90-120, 250-500, and 450-700 μS/cm, respectively.
2. The solid residual is higher at the Chusovaya WA during spring and summer (up to 0.5 MAC) with 0.3 MAC at the Votkinskoye Reservoir WAs. In winter the water amount is low resulting in larger solid residual up to 0.6 MAC at the Chusovaya and Bolshekamsky WAs and 0.9 MAC at the Kirovsky WA.
3. The level of hydrocarbonates (HCO3-) is different depending on the water content periods and defined by natural factors. The ion level at the Chusovaya WA is 50-140 mg/l with a maximum value of 170 mg/l during winter drawdown. Downstream of the Kama power plant dam this value lowers to 10-40 mg/l during the filling period, goes up to 20-100 mg/l during water level stabilization, and reaches its maximum in winter low water (60-140 mg/l).
4. The WA sulphate level is similar to the one of hydrocarbonates: minimum in spring – 50-170 mg/l at the Chusovaya WA, 20-30 mg/l at the Bolshekamsky WA, and 20-50 mg/l at the Kirovsky WA; SO42- is higher during the summer-autumn period – up to 70-400 mg/l, 10-100 mg/l, and 40-130 mg/l, respectively; maximum SO42- level in winter – 50-180 mg/l upstream of the town and 60-120 mg/l in the town. The sulphates are above the MAC values at all WAs during the summer-autumn and winter periods. The Chusovaya River natural background with high level of the SO42- ions causes high concentration of the element during the spring filling at the Chusovaya WA.
5. Most chlorides come from the waters of the Kama Reservoir and industrial wastewater of Perm City. The chloride is the main component of the water reservoir chemistry in winter. In spring the level of chlorides is low (5-10 mg/l); during the summer-autumn period it goes up to 10-50 mg/l at the Chusovaya WA and up to 5-20 and 20-70 mg/l at the Bolshekamsky and Kirovsky WAs, respectively. The maximum level of chlorine ions has been noted in winter – up to 80 mg/l at the Chusovaya WA and up to 200 mg/l within the boundaries of Perm City.
6. The Kama Reservoir water has a low content of calcium, which does not exceed the MAC value. In spring Ca2+ has a minimum level of up to 30 mg/l at the Chusovaya WA and up to 70 mg/l at the Bolshe-

kamsky and Kirovsky WAs. During the summer-autumn period it rises up to 90 and 60 mg/l, respectively.

7. It reaches its maximum during winter drawdown – 40-120 mg/l at the Chusovaya WA and 50-90 mg/l at the Bolshekamsky and Kirovsky WAs.

The biogenic matter level varies significantly as follows:

1. In different seasons at the Perm WAs the concentration of ammonium nitrogen ranges from 0.1 to 3.5 MAC. At the Chusovaya WA it reaches its maximum of 1.5 MAC during winter drawdown when the water volume is the least. During other seasons the content can vary within 0.1-1.0 MAC. The water mass in the Votkinskoye Reservoir is greatly influenced by industrial contaminants. During the filling period the NH4+ MAC value is 1.3-2.4 at the Bolshekamsky WA and 1.6-3.6 at the Kirovsky WA, which is also connected with the Kama water drawdown and a low water level in the Votkinskoye Reservoir. During stabilization of the water level the nitrogen content does not exceed the MAC value. The winter drawdown period is unfavourable, since the NH4+ level is within 1.4-2.9 MAC.

2. The level of other biogenic substances – NO2-, NO3-, and P – is within 0.0- 0.3 MAC. Any specific reduction/grow trends along the WAs or in different seasons have been not traced.

The levels of most microelements described constitute a hydrological risk for the water users by reason of high concentrations and violation of the MAC values.

1. Fe varies within 0-12 MAC. During the filling period it grows from 2.0 at the Chusovaya WA up to 7.0 at the Kirovsky WA. A similar picture can be observed during the stabilization period: growth from 1.0 to 5.0 MAC. The highest level is typical for the winter period with 12 MAC at the Chusovaya WA down to 3-7 MAC at the Kirovsky WA.

2. Cu is also much higher than the MAC value (Figure 2): from 10 MAC at the Chusovaya WA to 24 MAC at the Kirovsky WA in spring; 26 MAC at the Bolshekamsky WA and 10-11 MAC at the other WAs in summer and autumn. In winter its concentration grows up to 18 MAC at the Chusovaya WA and 27-25 MAC at the Bolshekamsky and Kirovsky WAs.

3. During the spring filling period the level of manganese grows along the WA sites from 0-5 MAC at the Chusovaya WA up to 5-13 at the Kirovsky WA. (Figure 2). In summer it is 1-6 and 3-18 MAC, respectively. During the low water stand the Mn concentration varies significantly from 7-18 MAC at the first WA, to 12-33 MAC at the second WA, and up to 5-37 MAC at the third WA. It highly depends on operation of local factories. During winter drawdown the Mn level in the basin water reaches its maximum, for the water dilution process slows down significantly.

4. Pb belongs to heavy microelements and has a negative impact on living organisms. Observations have shown its low level, not exceeding the MAC value (up to 0.1 MAC), with one exception of a higher concentration at the Bolshekamsky WA during the navigation period due to water vessels (up to 0.5 MAC in spring and 1.0 MAC in summer).

The gas conditions generally define the evaluation of biota in reservoirs. The oxygen conditions are formed under the influence of a series of positive (wind-and-water-induced mixing, flowage, etc.) and negative (industrial contamination, water bloom, etc.) factors. Their interaction determines favourable water saturation with oxygen during the open channel period (8-10 mg/l in spring, 9-11 mg/l in summer and autumn) and its significant shortage during freeze-up (4-7 mg/l). The worse conditions are in the areas of industrial pollution. At the Chusovaya WA the oxygen level is within 0.5-0.9 MAC with minimum values in winter. The city impact is noted at the Bolshekamsky and Kirovsky WAs: 0.6-0.7 MAC during the reservoir filling period, 0.5-1.2 MAC in summer and autumn (especially when bacteria and algae are most active), and 0.5-1.3 MAC in winter.

The following is typical for the Perm WAs:

1. High element content when the water level is close to the lowest operating one. Such conditions are typical for late winter right before ice movement, as well as for the beginning of filling the reservoir in spring.

2. Among the biogenic elements, exceeding MAC is typical for NH4+ in all water regime phases, especially in spring (up to 3.6 MAC) and winter (2.9 MAC). This situation is determined by a low water mass volume of the reservoir resulting in poor self-cleaning ability.

3. The level of all elements significantly exceeds MAC, especially during the winter drawdown period.

4. The level of dissolved oxygen in the reservoir is low both in winter (while freezing up) and in summer (during algae bloom), i.e. 4.6 and 5.0 mg/dm3 or 1.3 and 1.2 MAC, respectively. At the same time the BOD and COD are up to 1.9 and 2.6 MAC, respectively.

The percentage of non-standard samples taken from the drinking water sources in Perm is 40% in terms of the sanitary and chemical performance and 15% as for microbiological parameters.

The main risk is connected with the water supply organisational plan. The major city WAs, the Bolshekamsky and Chusovaya, are located on the left bank of the Kama Reservoir, while the right-side water supply is provided through the inverted siphon laid on the bottom of the reservoir. Currently, water is supplied to the right bank through a single line with the other one under rehabilitation. So the water supply is not reliable enough. Moreover, life of the Bolshekamsky water works supplying water to the down town has almost run out for highly deteriorated and obsolete equipment.

Any local measures would not help. The best solution is total system rearrangement providing two independent water supply systems on the right and left banks of the river.

Drinking water supply through the river is to be eliminated due to construction of a new right-bank water treatment plant in the Kama Reservoir water pool. The inverted siphon will be used as an emergency crossover between two separate water supplies located on different river banks. The obsolete Kirovsky and Bolshekamsky WAs are supposed to be abandoned.

On the one hand, such measures will allow avoiding the above situations and, on the other hand, they will improve the quality of water supplied to the system, for construction of a new treatment plant will enable to use up-to-date and effective methods of water treatment.

The article is admitted to the International Scientific Conference "Ecological monitoring"; Turkey (Kemer) of the August 6-13, 2007; came to the editorial office on 26.06.07

ECOLOGICAL ENVIRONMENT AND HEALTH OF THE POPULATION OF THE REPUBLIC OF KAZAKHSTAN

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The purpose of research. To estimate possible influence of the toxic substances acting in an environment as a result of activity of the enterprises of oil-and-gas branch, on a state of health of the population in the Republic of Kazakhstan.

Object and subject of research. As modeling regions the basic oil and gas extraction areas of the Republic are chosen: Mangistauskay and Atirauskay in which territory 188 oil fields and gas or 81.7% of the deposits revealed in the Republic of Kazakhstan are located.

During the work the resource security of public health services and the basic parameters of health state of the population carried out: the demographic situation, including the analysis of number and structure of the population (1996-2005) is determined; primary and total morbidity of the population: on classes of illnesses of the whole population, adults and children. Groups: adults and children - covers 93.8% of the whole population of the Republic.

Mangistauskay oblast on primary diseases of the whole population and adults takes first place in the Republic, and Atirauskay oblast which has as well as Mangistauskay oblast a plenty of oil-and-gas deposits, the last - 14 place on all investigated groups of the population. Taking into account high morbidity of Mangistauskay oblast population the basic researches carried out in this area.

The sanitary condition of water, atmospheric air, maintenance of the population with good-quality food, epidemiological conditions are also investigated.

Methods of research. The analysis was carried out by a method of quantitative measurement of effects of environment influence on health of the population, a method of codification, by an estimation of risk for health of environment factors and its management.

Results of research and discussion. Atirauskay oblast population estimates 472.4 thousand person (3.1% from the Republic population), and Mangistauskay oblast – 374.4 thousand person (2.5% from the Republic population). Atirauskay oblast urban population was equal - to 269.1 thousand person (57.0%), Mangistauskay oblast - to 263.06 thousand person (70.2%), and rural - 203.3 and 111.4 thousand person accordingly (43.0% and 29.8%). Mangistauskay oblast, undoubtedly, concerns to industrial regions as three quarters of its population live in cities, in the Republic the urban population estimates - 57.1%.

In structure of the population of oblasts the number of adults is less, than in the Republic (64.5% in Atirauskay, 63.4% in Mangistauskay and 69.7% in the Republic), and the number of children is more than 28.6%; 30.1% and 24.2% accordingly) at equal relative quantity of women in fertile age in oblasts and the Republic (28.3%, 28.3% and 28.5%). This fact, can be connected, with higher common factor of fruitfulness in oblasts - 1.00 and 1.06; in the Republic - 0.85.

In Atirauskay oblast from 1996 to 2005 the population has increased for 8.5%, in Mangistauskay oblast on 11.2%, and in the Republic during this period the amount of inhabitants has decreased for 5.3%. Obviousiy one of the reasons of population increasing in oblasts is the process of immigration or installation of the population in oblasts. There was a positive balance of migration (the number of coming and leaving): 288 person in Atirauskay oblast and 3730 person in Mangistauskay.

The system of public health services in Mangistauskay and Atirauskay oblasts has typical structure. The Security of the population of oblasts material resources of public health services for 11 years, basically, corresponds or exceeds middle republic level (Charges on 1 inhabitant in one year, scheduled capacity of the polyclinic organizations, security of the population with beds). Security of the population of modeling oblasts with the staff of medical workers is lower than middle republic level.

Atirauskay oblast and Mangistauskay oblast have higher level of birth rate, a natural increase and a low death rate in comparison with republic (progressing demographic structure) that is caused by social factors i.e. the advanced infrastructure of the industry including oil and gas extraction and a high average level of wages: in Atirauskay oblast - 415 dollars, in Mangistauskay oblast - 400 dollars; at middle republic