HYGIENIC JUSTIFICATION OF PREVENTIVE MEASURES FOR PROVIDING HIGH QUALITY DRINKING WATER TO THE POPULATION OF SAINT PETERSBURG

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Abstract. High quality of drinking water is a result of execution of complex tasks. The priority tasks are development and introduction of modern technologies of water purification, effective mechanisms for industrial laboratory control, socio-hygienic monitoring, integrated approach to assessing the quality of drinking water, use of hygienically sound decisions in terms of water supply and sanitation.

Keywords: risk assessment, integrated assessment of drinking water, chemical safety of drinking water.

Providing the population with drinking water of a guaranteed quality with the purpose of preventing infection and non-infectious water-related diseases are one of the priority areas in providing high quality of life. The required level of water quality is achieved due to comprehensive solutions of a number of tasks that include mainly the development and implementation of modern water purification technologies, effective mechanisms of industrial laboratory control, social-hygienic monitoring, integrated approach to assessing the quality of drinking water [1, 3], use of hygienically sound decisions in terms of water supply and sanitation.

In St. Petersburg, this work is implemented in close collaboration between the St. Petersburg Regional Department of the Federal Service on Customer Rights Protection and Human Well-Being Surveillance (hereafter – Department) and State Unitary Enterprise “Water Supply and Waste Water Treatment of St. Petersburg”. The quality of drinking water is assessed with the help of a database of study results conducted within social and hygienic monitoring and industrial control of the State Unitary Enterprise “Water Supply and Waste Water Treatment of St. Petersburg” at all stages of water treatment (source, exit from the water treatment facility, water distribution network). The database includes the results of lab studies conducted at 228 locations of the Department and 174 locations of the State Unitary Enterprise “Water Supply and Waste Water Treatment of St. Petersburg” which allows for timely decisions to regulate water treatment processes. Total number of studies is over 90 thousand a year.

The source water that is later used as drinking water in St. Petersburg comes from a surface water-supply source – the Neva River; the river provides for 98% of the city’s demand in water. Water in the Neva is considered natural water of high color in the range of 20-60 degrees due to the content of composite humic compounds of peat origin [3, 5, 6]. Another characteristic of the Neva water is its low mineral content including low content of calcium and magnesium. Seasonal changes in the quality of water include, mainly, concentration of suspended material, color, oxidation and alkali content [5, 6]. According to GOST classification 2761-84 “Sources of centralized service-utility water supply. Hygienic, and technical requirements and selection

1 Translated by Ksenya Zemnlyanova
guidelines”, the Neva River as a source of centralized water supply is referred to class III. The water supply network of St. Petersburg is designed based on zoning. Each zone has water intake and water treatment installations, booster pumping plants and water distribution systems. There are currently three water supply zones in the city and five large water treatment facilities that draw water from the Neva River: Glavnaya, Yuzhnaya, Severnaya, Volkovskaya and Korchmino [3, 5, 6].

The monitoring showed that the share of drinking water samples that did not meet the hygienic requirements was significantly lower in St. Petersburg as compared to the average in the Russian Federation. In 2011, the volume weight of poor drinking water samples in St. Petersburg totaled 5.6% according to sanitary and chemical indicators as compared to the average of 16.9% in the Russian Federation, and 0.13% according to microbiological indicators as compared to the average of 4.6% in the Russian Federation. Deviations from the hygienic standards according to the sanitary and chemical indicators can be explained by higher iron content, concentration of suspended material and color – indicating organoleptic impact mechanisms.

Required quality of drinking water is achieved as a result of the water supply improvement activities developed by the Department, the State Unitary Enterprise “Water Supply and Waste Water Treatment of St. Petersburg” and St. Petersburg municipal authorities. Several regional task-oriented programs are implemented to provide quality drinking water to the population in accordance with the following hygienic standards and programs: “Comprehensive development of the communal infrastructure of St. Petersburg in the areas of electric power, heat, and water supply until 2015”, “Cessation of liquids disposal with no prior treatment into the aquifers for the period of 2006-20150”, “Clean Water of St. Petersburg Program for 2011-2025”, etc. [6].

“Water Supply and Waste Water Treatment of St. Petersburg” Enterprise conducted a series of hygienic justification activities aimed at providing high quality of drinking water in accordance with the standards, including modernization of reaction treatment systems; preliminary water ozonizing is now added to UV purification for finer purification from bacterial and virus contamination. The use of dosed powdered activated coal in the water treatment process allows for the removal of organic compounds – odorizers and oil products – as well as decrease in oxidation. An automatic flocculant dosing system was installed to improve the process of surface water purification; a light-filter based water conditioning technology was installed to decrease the iron content and improve organoleptic indicators. Special attention was paid to water quality control at all the stages of water treatment including an automated water quality control system with maximum automation of technological processes and the use of online control devices. A biomonitoring system is used to detect toxic substances in the source water that exceed the background values [5, 6].

Joint efforts of the Department and the Water Supply and Waste Water Treatment Enterprise of St. Petersburg led to significant improve in the drinking water safety and hazard level indicators. A new water treatment and drinking water control system had a major positive effect on the infection rate. The incidence of dysentery went down two-fold in 2011 from 22.6 to 11.4 (per 100 thousand population). As compared to 2005, it went down 30-fold. In 2011, the
morbidity rate was at 3.33 (per 100 thousand population) which is 1.3 times lower as compared to the country’s average [6]. A trend data analysis of the water-related infectious disease rate, in particular, viral hepatitis A and dysentery, shows that the drinking water in the municipal distribution network is safe and that it has not transferred any infectious diseases in the last several years.

Current condition of the chemical contamination of drinking water does not have any significant impact on public health which was confirmed by an integral drinking water assessment conducted by the Department in collaboration with the North Western State Medical University name after I. Mechnikov, following the Guidelines MR 2.1.4.0032-11 “Integral assessment of drinking water for chemical safety in the centralized water supply systems” [1, 3].

Integral assessment of the drinking water allowed us to conduct a trend data analysis of the qualitative characteristics of the drinking water in terms of health effects at all the production and transportation stages and to evaluate the effectiveness of technological solutions at St. Petersburg water supply stations, determine priorities and develop proposals for an optimal realization of technological solutions by the Water Supply and Waste Water Treatment Enterprise of St. Petersburg [3].

The implemented activities proved the hygienic justification and effectiveness of the activities conducted by the Water Supply and Waste Water Treatment Enterprise of St. Petersburg and the practicality of water treatment technologies improvements; they also allowed detecting the most effective water supply modernization areas [1].

The main achievement is transition to modern water treatment technologies with complete abandoning of the one-step purification system. The current two-step water purification technology includes preliminary ozonizing, coagulation, storage in tanks with thin-layered modules (shelf storage), filtration with fast filters; two-step disinfection: chloramine and UV; rinsing water treatment in a shelf container with an in-built sludge consolidation tank and centrifugal drying; this two-step system is one of the most effective technologies for the treatment of water drawn for a surface source – the Neva River [5]. The materials obtained during the implementation of the above activities are currently used by the Water Supply and Waste Water Treatment Enterprise of St. Petersburg to develop the guidelines for the water quality assessment (in terms of chemical safety) at the exit from a water treatment station.

Some questions concerning providing quality and healthful drinking water to the population of St. Petersburg, however, still remain unresolved and require a comprehensive approach and time-effective decisions.

1. The condition of the main source of water supply of the Neva River is unsatisfactory. Laboratory control study results show a high volume weight of poor samples of the Neva water. In 2011, the share of the Neva water samples that do not meet the standards totaled 87.1% in terms of microbiological indicators against 21.2% of the RF average (2009), and 44.4% in terms of sanitary and chemical indicators against 16.2% of the RF average (2009).

The main reason for unsatisfactory quality of the Neva water is anthropogenic contamination: pollutants discharges by industrial enterprises in the four subjects of the Russian Federation; unsatisfactory maintenance of the nearshore zone; discharges of untreated or poorly treated waste via discharge outlets of the service-utility or storm water drain at St. Petersburg
and Leningrad Region facilities; run-offs from the city and village water-collecting zones, and violation of the sanitary protection zone rules [5, 6]. High contamination of water in the Neva makes it necessary to continue the large-scale water-treatment activities and modernization of water treatment technologies at the municipal water supply stations; high bacterial contamination requires special multi-step water treatment and disinfection methods.

2. The quality of drinking water in several districts of St. Petersburg does not meet the standards for the iron content, concentration of suspended sediment and color which is determined by a high wear-and-tear of water pipes and the presence of dead-ends [6]. Moreover, utility companies, as a rule, do not control the quality of drinking water which prevents the authorities from timely replacement of the cold-water supply utility pipelines.

3. The Neva River being a surface water supply source is characterized by low mineral content. The Neva water lacks fluoride, calcium, potassium and a number of other elements [6]. This factor leads to a deficit in micronutrients which are required for normal life-sustaining activities and, as a result, has a negative impact on public health in St. Petersburg [5]. Statistics shows that iodine deficiency in drinking water promotes the development of congenital abnormalities and imbecility, fluoride deficiency promotes tooth decay, and calcium and magnesium deficiency increases the severity of cardiovascular diseases [3, 4, 5, 6]. Almost every citizen of St. Petersburg is at risk of diseases related to the use of drinking water with low mineral content which leads to diseases of the musculoskeletal, cardiovascular and endocrine systems. For this reason, providing the population with safe and healthful drinking water of full quality with a balanced mineral content is the most important preventative activity in St. Petersburg.

In 2008, St. Petersburg Regional Department of the Federal Service on Customer Rights Protection and Human Well-Being Surveillance, the Center of Hygiene and Epidemiology in St. Petersburg (Federal State health Center), the Water Supply and Waste Water Treatment Enterprise of St. Petersburg, St. Petersburg State Medical Academy named after I. Mechnikov, and Sysin Scientific Research Institute for Human Ecology and Environmental Hygiene jointly developed the Guidelines for Providing the Population with Drinking Water of Full Quality, provided full hygienic justification for its main concept and started the development of a technological solution for the production of drinking water of full quality [5, 6].

The RF Law of 07/12/2011 №416-FZ On Water Supply and Water Disposal calls for additional tasks related to the quality and safety of water supplied through the cold and hot water utility systems. Following the law, the Water Supply and Waste Water Treatment Enterprise of St. Petersburg in collaboration with the Department develop and implement a series of activities aimed at improving the barrier functions at the municipal water supply stations. St. Petersburg has started the renewal of the main water supply facilities. In 2011-2012, an additional purification unit with a deliver capacity of 350 thousand cubic meters per day was put into operation at Yuzhnaya water supply station in order to provide additional ozonizing of water. Overall, in order to provide the population of St. Petersburg with safe and healthful drinking water of guaranteed quality that would meet the legislative requirements related to the sanitary and epidemiological well-being of the population, in our opinion, it is necessary to carry out the following activities:
- To provide for a full transition to effective and modern two-step drinking water treatment technologies at all water supply stations and to develop the water supply system in rural areas;
- For the executive authorities of the subjects of the North-Western Federal District - To develop a program aimed at decreasing the level of the Neva River pollution;
- To implement the Guidelines for Providing the Population with Drinking Water of Full Quality to preserve and improve public health in St. Petersburg.

References


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