

Drinking water quality

the text below is based on the chapter Drinking water quality published in yearbook Prague Environment 2006

(the text below is based on the chapter *Drinking water quality* published in yearbook Prague Environment 2006)

In 2005 Prague was supplied for 11 months from two water treatment plants (Želivka and Káraný), for two months from three water treatment plants – Želivka, Káraný, and Podolí.

Since the end of 2002 the Water Treatment Plant Podolí has been serving as a spare source for Prague then. In February 2005 (1–26 February 2005) the Water Treatment Plant Podolí was under checking month-long operation with water distribution to the water supply network and water produced there was supplied to consumers. For the rest of the year water from this plant was not delivered for distribution into the network.

In February 2005, following and detailed preparation, the steel-made supply mains DN 1600, which delivers water from the WTP Káraný to the water reservoir Ládví I, was flushed. The mains length is 21 km and the flushing was carried out in the Labe River 3 km from the WTP Káraný. The flushing was unique either due to the mains profile either the main part of the flushing was carried out counter-currently the ordinary water flow direction, that means from the reservoir Ládví I into the Labe River. The flushing removed 1,335 insoluble matter from the supply mains, which will not further cause secondary deterioration of water quality if the flow direction in the mains is changed. The flushing lasted for 15 hours, and in total 68 thousand cubic metres of water were discharged into the Labe River.

The drinking water quality was monitored pursuant to the Decree No. 252/2004 Code, in wording of the Decree No. 187/2005 Code, establishing requirements for drinking water and hot water, the scope and frequencies of the drinking water control. The amended Decree No. 187/2005 Code has been valid since 1 June 2005 and regulates namely misprints and also includes certain more precise terms.

This is an executive decree to the Act No. 258/2001 Code on the public health protection in valid wording thereof. The aforementioned regulations are in accordance with the EU requirements for drinking water.

In 2005 the drinking water production process was monitored by laboratories at respective water treatment plants within the scope of indicators inevitable from the technology standpoint. Analyses in the full scope of requirements of the Decree were carried out at the Department of Laboratory Control Prague (OLK Praha). Since 2001 all laboratories of the company of PVK, a. s. (for the quality control of drinking water as well as waste water, including sampling thereof) have been merged into the Department of Water Quality Control. The drinking water laboratories of OLK Prague, OLK Káraný, and OLK Želivka are accredited, in compliance with the Czech Standard EN ISO/IEC 17025, including the sampling, by the Czech Institute for Accreditation (ČIA), certificates No. 1247; 1247,1; and 1247,2.

The programme of water quality monitoring, both for the water treatment plants and the distribution network, was developed for the year 2005 in accordance with requirements of the applicable legislation and those of the Public Health Authority of the Capital City of Prague and the Regional Public Health Authority of the Central Bohemia Region, respectively and following needs of respective water treatment plants and requirements of respective technologists.

Tab. The scope of drinking water monitoring in 2005

Locality	Total number of samples taken for microbiological and biological analyses / number of parameters	Total number of samples taken for chemical analysis / number of parameters
WTP Želivka	374 / 2 350	374 / 3 175
WTP Káraný	407 / 2 616	401 / 4 224
WTP Podolí	19 / 128	88 / 508
Distribution network – water reservoirs, mains	561 / 4 335	523 / 9 205
Distribution network – end consumer	2 488 / 17 430	2 701 / 42 948
Total	3 849 / 26 859	4 087 / 60 060

Out of the total number of the drinking water analyses carried out there were 1.25 % non-compliant with the Decree.

Source: PVK, a. s.

Drinking Water Treatment Plant Želivka

The Drinking Water Treatment Plant Želivka is the most up-to-date and largest water treatment plant serving Prague. The drinking water is transported through a shaft influent conduit 2.64 m in diameter and 51.97 km long. In 2005 the share of the Drinking Water Treatment Plant Želivka supply of the total drinking water supply to the City was 75.15 %. The Drinking Water Treatment Plant Želivka also supplies drinking water to areas of the Central Bohemia Region and Vysočina Region.

With its maximum peak output of 6,900 l.s⁻¹ of drinking water and output in 2005 of approx. 99.4 million m³ per year the Drinking Water Treatment Plant Želivka belongs to the largest water treatment plants in Europe and is the largest one in the Czech Republic.

In 2005 treated water quality met limit values as established in the valid legislation. The only troublesome parameter of the treated water was microscopic image in the course of the spring and autumn circulation. These natural effects in the water management reservoir require reinforced technology measures in critical nodes, both in the water treatment technology line and in the course of the treated water distribution in order to deliver water of required quality to customers. In the relation to the increased number of micro-organisms the newly included parameter of microcystin-LR was purposefully monitored; all results of the treated water fall below the limit of detection and were entirely compliant with valid legal regulations.

Because of the raw water source nature (surface water) the mineral content is very low and water, even if treated with final alkalizing, does not have the optimum calcium-carbonate equilibrium. According to the TNV 75 7221 water was classified of the second degree of aggressiveness concerning corrosion of metallic pipelines, which means the water is medium aggressive. The Želivka's water corrosiveness is reduced by addition of optimized dose of hydrated calcium oxide to final adjustment of the pH of water treated to 8 to 8.5, as the current legislation allows.

Since 2001 PVK, a. s. has been purposefully monitoring the family of triazine herbicides. Namely following the flood situations, alarming concentration values nearing the limit value for drinking water of these compounds were determined in raw water. Concentration values of these compounds several times exceeding the limit value (100 ng.l⁻¹ for respective pesticide, 500 ng.l⁻¹ for sum of the pesticides) were repeatedly found in tributaries to the water reservoir. In the Švihov Dam Lake the companies of PVK, a. s. and Povodí Vltavy, s. p. carry out jointly monitoring concerning basic chemical and microbiological parameters and on the basis of findings of triazine-based herbicide occurrence the joint monitoring programme was expanded to cover these compounds since 2004.

Water from buffer water reservoir of the Drinking Water Treatment Plant Želivka is led through shaft mains into the water reservoir in Jesenice, and from this reservoir, after being after-chlorinated to required level, it is distributed across Prague.

Drinking Water Treatment Plant Káraný

The Drinking Water Treatment Plant Káraný, as the only plant, produces and supplies groundwater to the City that features excellent quality parameters resulting in beneficial biogenic properties. This groundwater features balanced contents of ions, which in positive way affects organoleptic properties of water.

In Káraný the drinking groundwater is acquired from three systems: natural groundwater recharge, artificial groundwater recharge, and artesian water sources (water of extraordinary quality collected from 7 artesian wells 60–80 m deep). Iron is removed from the artesian water by aeration and sand percolation. The water is, after the compulsory sanitary chlorinating, pumped to Prague through three pump water mains of identical length 23 km.

In 2005 quality of the water from the Plant Káraný met limit values of all indicators monitored according to the valid legislation. Organic pollutants monitored in compliance with the valid legislation have been permanently below the limit of determination. Concerning corrosion the water is close to calcium-carbonate equilibrium having very little corrosion effects on metallic pipelines. According to the TNV 75 7221 water was classified at the brink of 1 st and 2 nd category of aggressiveness, which means the water is slightly to medium aggressive. The Act on Water (No. 254/2001 Code) deals with protective zones of water sources in the form of general protection. Therefore the operator shall provide for control monitoring of quality of abstracted water and raw water in the Jizera River, including other check localities of the area concerned. Since 2004 the mathematic model of the whole catchment area Káraný has been in use for the treatment plant operation and the catchment area monitoring. The targeted “monitoring of nitrates” at abstraction series of bank recharge has been still under operation. The mathematical model is, on the basis of monitoring results, calibrated once in two years.

In 2005 the share of the Drinking Water Treatment Plant Káraný of the City total drinking water supply accounted for 24.0 %, in 2005 the Plant produced approximately 31.7 mil. m³ high quality water (close to groundwater in its characteristic).

Drinking Water Treatment Plant Podolí

As already stated in the introduction since the end of 2002 the Drinking Water Treatment Plant Podolí has been serving as a spare source to Prague. The Plant is regularly maintained in such shape to be able to start the drinking water production any time as the need may be.

In 2005 the Plant produced water to the distribution network for the period of February, when raw water quality was very good in terms of its treatability. Quality of produced water complied with all requirements of the Decree. It may be stated that raw water quality in 2005 was within usual range of values and it was treatable to obtain drinking water as laboratory tests proved.

Because of the raw water source nature (surface water) the treated water, even after the final alkalizing, does not have the optimum calcium-carbonate equilibrium. According to the TNV 75 7221 water was classified of the second degree of aggressiveness concerning corrosion of metallic pipelines, which means the water is medium aggressive.

The triazine-based herbicides are systematically monitored in raw water year-round, that means even in the period when the Plant Podolí does not produce water for the network. The monitoring is carried out to have the Plant ready for start-up as a spare source. In the case of increased concentration of triazine herbicides in treated water at the Plant output (the current technology in the Plant is not able to eliminate the herbicides) it is necessary to mix the water treated with water from other sources so no limit value at the end consumer is exceeded in the distribution network. In case of the emergency start-up of the treatment plant as a spare source, if increased concentrations of pesticides are found, this regime of „source mixing“ shall be applied.

In 2005 the share of the Water Treatment Plant Podolí in the drinking water supply to Prague was approx. 0.85 %, the total volume of drinking water produced in the one month operation was approx. 1.15 mil. m³.

Fig. Comparison of water treatment plants and public water supply systems on the basis of selected parameter

Source: PVK, a. s.

Water Supply System Network

In the course of drinking water distribution quality has been changing due to:

- effects of materials in contact with drinking water (secondary increased iron content due to corrosion);
- in relation to the drop in water consumption residence time of water in the distribution network (hereinafter as the DN) has been prolonging, flow velocity is decreased (decrease in final volume of Cl₂ J potential for microbiological non-compliance);
- high failure rate of the distribution network;
- handling operations caused by reconstruction of water mains;
- in the period of increased bioeston in raw water in the case of the Želivka Water Dam doses of ozone and Cl₂ are increased at the plant outlet. Therefore an increase of chlorination by-products (THMs) at consumer is found in the DN. Neither respective trihalogen methane derivatives nor the total sum of THMs exceeded permitted limit values established in legislation in 2005;
- due to the prolonged residence time of water it was necessary to provide for additional-chlorination of determined DN sections in order to ensure microbiological innocuousness. Except for stable locations of additional disinfection (Cl₂, NaClO), it is possible on the basis of accidents found to provide ad-hoc disinfection of a target section of the DN by means of a mobile battery unit;
- analogically to the treatment plants all accumulation facilities and pumping stations of the DN were regularly sanitised with water quality control following the cleaning;
- for the sake of water quality improvement in the DN the "Sludge Removing Code for Major Distribution Mains" has been applied since 2002. Besides target flushing of local troublesome areas of the DN are carried out. In 2005 the principal flushing of the supply mains from the WTP Káraný was carried out as given here above.
- In areas of the Prague's DN where limit values of iron are permanently exceeded (due to corrosion of pipe material) the Public Health Authority issued a time-limited exemption for the limit value of this parameter. Till the exemption expiration the situation shall be fixed either by reconstruction of the existing pipeline or by the replacement of the pipeline system. Concerning water quality these areas under exemption have been favoured in planned repairs and/or investments.

The aforementioned reasons have caused quality deterioration that is reason for approximately 1% increase in non-compliant parameters determined compared to percentage of non-compliant analyses at the outlet from the treatment plants.

The Public Health Authority of the Capital City of Prague controls quality of drinking water in the distribution network on a regular basis. In 2005 no serious fluctuations in water quality were found in samples monitored within the super-control activities of the Public Health Authority of the Capital City of Prague. Since 2004 the results of water quality at consumers tested have been handed over in an electronic form to the National Monitoring Programme of the Public Health Authorities (software PiVo), as this duty is established by the Act No. 258/2000 Code in valid wording thereof. Results of control radiological analyses of treated water at the treatment plants are, in compliance with the requirement of the valid legislation, annually handed over to the State Institute of Nuclear Safety (SUJB). The supplied water quality was fully in compliance with requirements for the acceptable content of radioactive materials pursuant to the Decree of the SUJB No. 307/2002 Code.