

# Water treatment of drinking water

## Definition

“drinking water is defined as water that is harmless to health and that does not cause illness or health disorders even when consumed permanently due to the presence of microorganisms or substances affecting the health of natural persons and their offspring through acute, chronic or late effects, whose sensory properties and quality does not prevent its consumption and use for the hygienic needs of natural persons.” (Decree 376/2000 Coll.)

## Water by origin

Drinking water is obtained by treating raw water.

The **sources** from which water is obtained in the Czech Republic can be divided into underground and surface.

1. **underground** - about 45% of resources
  - In the case of groundwater, this usually involves the removal of carbon dioxide, iron removal and manganese removal.
2. **surface** - about 55% of resources
  - Water from surface sources is considered to be of lower quality and reliability because its quality can change rapidly depending on changing natural conditions (the quality deteriorates after spring snowmelt and after floods).
  - Organic substances, colloidal substances and suspended substances (algae) contribute the most to pollution, it is necessary to remove turbidity, in some cases also iron and manganese.

In the case of water from both sources, it is necessary to ensure that it is safe for health, especially with regard to the content of bacteria.

## Pollution of drinking water

Drinking water pollution can come from a variety of sources. Agriculture, transport, industrial production, mining, services, but also natural resources contribute the most to it. Specifically, water pollution occurs through the discharge of waste water from factories and households or during agricultural production. We must not forget that pollution is not only caused by human activity, but also by natural processes, such as volcanic activity, landslides, leaching of toxic substances from the subsoil or a large number of simultaneously dead organisms. The finding of increased radioactivity water from the leakage of radioactive substances (for example in the energy industry) and thermal pollution are also considered pollution.

Sources of drinking water are mainly polluted by:

1. **organic substances**
  - proteins, carbohydrates, fats and their breakdown products (fecal pollution)
  - carcinogenic aromatic substances (industry)
  - industrial fats and oils
  - organic solvents (industry)
  - phenols, surfactants (cleaning agents)
  - pesticides (agriculture)
  - petroleum products
  - microbial pollution (pathogenic germs)
  - overgrowth of plankton due to increased nutrient content - mainly nitrogen and phosphorus (eutrophication)
2. **inorganic substances**
  - toxic substances (mercury around aluminum plants, cadmium as part of phosphate fertilizers)
  - inorganic industrial sludge
  - inorganic salts (agriculture, chemistry)
  - phosphates (washing powders)
  - soil and clay particles washed into the water by erosion.

## Water pretreatment

Pre-treatment of water is a measure that modifies the water and better prepares it for cleaning in the treatment plant. Pretreatment can take place directly at the site of pollution. So-called bioeliminators are used, which are organisms that consume excess nutrients in the water, thereby cleaning it of excess nitrogen and phosphorus. Furthermore, denitrifying bacteria are used, which process nitrates as a source of electrons, thereby reducing their concentration.

## Water treatment

Water treatment takes place in drinking water treatment plants on a mechanical, biological, chemical or physico-chemical basis. Raw water is treated if its quality does not meet the requirements set by the drinking water ordinance.

## Editing Procedures

### Settling in settling tanks

It removes coarser suspended particles (sludge) from the water.

### Clearing

After adding chemicals - coagulation agents (aluminum sulfate, ferric chloride, slakice green), flocculation takes place. Flakes have a negative charge and bind microbiological substances to each other. This step increases the particle size and allows for better filtration.

### Filtering

- **Slow filters:** contain a layer of river sand and diatomaceous earth; a so-called filter skin is formed on their surface - a waxy layer of unfiltered algae that increases the efficiency of the filter and should not be removed immediately. According to Kabrhel, the filtration effect is up to 7000:1, which means that one out of seven thousand microorganisms will pass through.
- **Quick filters:** Filtration takes place under pressure, which shortens the time required for filtering and allows for the purification of a much larger volume of water. However, it is less effective. We distinguish between pressure and gravity rapid filters.

### Sorption

By sorption, it is possible to remove low-molecular natural organic substances, low-molecular petroleum substances, surfactants, pesticides, phenols, chlorinated hydrocarbons, etc. from water. It takes place in active materials (capture of residues on activated carbon). The sorbent is dosed directly into the water or the water is filtered through a granular sorbent. This treatment method is expensive and is not used in all treatment plants.

### Oxidation and disinfection

Oxidation and disinfection is a procedure applicable to the partial disruption of the organic substances present by the oxidation of some inorganic components ( $\text{NH}_4$ ,  $\text{NO}_2$ ,  $\text{Fe}^{2+}$ ,  $\text{Mn}^{2+}$  etc.). Chlorine, chloramine B, sodium chlorate or chloroxine are used for chlorination. Chlorination destroys bacteria, spores and viruses. Microorganisms are not eliminated by chlorine itself, but by molecular oxygen, which (together with hydrochloric acid) is created when chlorine reacts with a water molecule. UV radiation and ozonation also disinfect, remove odors and, unlike chlorine, do not change the taste of water. However, they can only be used where there is a new and high-quality water pipe, guaranteeing that the water is not contaminated on its way to the consumer.

### Aeration (aeration)

Aeration serves to saturate the water with oxygen and remove odorous substances (ammonia and sulfane). Another important function of aeration is the oxidation of ferrous cations to ferric (which are insoluble) and their subsequent precipitation.

### Iron removal and manganese removal

Iron removal and manganese removal are used to remove iron and manganese using aeration, alkalization, oxidation.

### Microbiological and biological methods of water treatment

Slow biological filtration and microbiological denitrification serve to remove organic matter, nutrients and bacterial pollution.

### Other methods of water treatment

- ion exchange
- deionization
- decarbonization
- demineralization, disinfection – chlorine, ozone

## Water storage

Treated water is transported via water supply pumping stations to storage reservoirs, where withdrawal differences are balanced, reserves are created or pressure is equalized.

# Links

## Related Articles

- Water hardness and its health significance
- Water treatment under field conditions
- Drinking water
- Mass water supply

## References

- BENCKO, Vladimír. *Hygiene : teaching texts for seminars and practical exercises*. 1. edition. Prague : Karolinum, 1995. pp. 52. ISBN 80-7066-985-3.