Module 7

Drinking Water Quality

Summary

Water that reaches our home usually comes either from surface water (water from small rivers, streams, rivers and lakes) or groundwater. About 80% of tap water in Bulgaria comes from lakes, rivers or other surface sources. Underground water sources and municipal wells provide about 20%. Most people believe that they receive clean, safe and healthy drinking water. Unfortunately, this is not always the case. Depending on the original source of drinking water and other factors, it may show various impurities. A description of the most important parameters for drinking water, such as technical guidelines, and related health risks are given in this module. In addition, maximum allowed concentrations of the related substances, as they are established by the European Union Drinking Water Directive, are presented.

Objectives

The pupils can describe water substances in drinking water and related health or technical risks.

Key words and terms

Contamination, pathogens, health risks, microorganisms, bacteria, chemicals, corrosion, indicators, parameters, Drinking Water Directive, nitrate, fluoride, arsenic, cadmium, lead, copper, iron, calcium, magnesium, manganese

Preparation/materials

Materials	Preparation
Drinking Water Directive	Research on the Internet or cooperation with the water supplier
Water analyses results of the local central water supply system	Cooperation with the water supplier
Interviews with water and health authorities, citizens	Questionnaires (Module 19)

Drinking water quality

Introduction

Drinking water quality management has been a key pillar of primary prevention for over one-and-a-half centuries and it continues to be the foundation for the prevention and control of waterborne diseases. Water is essential for life, but it can and it does transmit diseases in countries on all continents – from the poorest to the wealthiest. Infectious diseases caused by pathogenic bacteria, viruses and parasites (e.g. *protozoa and helminths*) are the most common and widespread health risks associated with drinking water. The most predominant waterborne disease, diarrhoea, has an estimated annual incidence of 4.6 billion episodes and causes 2.2 million deaths every year. The sources of most of those pathogens (disease-causing microorganisms) are water contamination with animal or human faecal substances. However, natural and anthropogenic chemical substances in drinking water can also cause different diseases, depending on the geological condition. Furthermore, there are chemical substances without health risks, but due to technical reasons, unwanted by the water supplier in special amount.

1. Microorganisms: the most common and widespread disease causes

Life would be impossible without microorganisms. Microorganisms, like the group of coliform bacteria, are indispensable for the proper digestive functioning of human beings and animals. However, the bacteria should not appear in drinking water and can cause diseases in vulnerable persons. They can also cause problems if they enter the body via contaminated food or drinks. Particular pathogens that cause diarrhoea leave the body via the faeces; and they are then transmitted to humans, who can become ill when they ingest the pathogen. This is called faecal-oral transmission. For pathogens transmitted by the faecal–oral route, drinking water is only one vehicle of transmission. Contamination of food, hands, utensils and clothing can also play a role, particularly when domestic sanitation and hygiene are poor. There are several variants of water borne disease transmission. These include contamination of drinking water catchments (e.g. by human or animal faeces), water within the distribution system (e.g. through leaky pipes or obsolete infrastructure) or stored household water (as a result of unhygienic handling).

1 gramme of faeces can contain
10 million viruses
1 million bacteria
1,000 parasitic cysts
100 parasitic eggs

Table 1: Microorganisms in faeces
Source: New Internationalist Issue 414, 2008, http://www.newint.org/features/2008/08/01/toilets-facts/

Table 1 gives an overview of the number of microorganisms that can be present in one gramme of faeces and the causes of water borne diseases. Hence, adequate sanitation measures are required from every step of the drinking water supply system to avoid any drinking water contamination. Hygienic handling of water in all stages of the water supply and personal hygiene (regular hand washing) are essential precautionary measures to minimise water related health risks. Microbial drinking water safety is not only related to faecal contamination. Some organisms live naturally in the water and can become problematic if they grow in large numbers in piped water distribution systems (e.g. *Legionella*). Whereas the larvae of others occur in the water source, e.g. guinea worm (*Dracunculus medinensis*), and may cause individual cases or outbreaks. Improvements in the quality and availability of safe water, adequate excreta disposal and general hygiene are all important in reducing faecal–oral disease transmission.

Cause	Water-borne diseases
Bacterial infections	Diarrhoea, Typhoid fever, Cholera, Botulism, Paratyphoid fever, Bacillary dysentery, Legionellosis
Viral infections	Hepatitis A and E (jaundice), Poliomyelitis
Protozoa infections	Amoebic dysentery, Cryptosporidiasis, Giardiasis

Table 2: Causes of water-borne diseases
Source: adapted from http://en.wikipedia.org/wiki/Waterborne_diseases

1.1. Contamination of drinking water with faecal matter

As illustrated in Table 1, faeces can contain millions of useful microorganisms, but can also harbour pathogens. Laboratory testing for specific disease causing microorganisms (e.g. *Salmonella typhimurium* and *Vibrio cholerae*) can be expensive, and if the bacteria are present only in low numbers, they may not be detected. Instead, more common bacteria are analysed as an indication of faecal pollution of the water, such as coliform bacteria. In many countries, evidence of the faecal coliform bacteria family serves as an indicator for faecal contamination of the drinking water. There are hundreds of coliform bacteria species in the human and animal intestine, and in the environment as well. On the contrary to several other bacteria, viruses and parasites, the bacteria *Escherichia coli* and *faecal streptococci* are rather easy to analyse. The presence of those bacteria in water is an indication of recent faecal pollution (see also module 8 and 9). In the following section, some bacteria are presented that are analysed for monitoring the microbiological drinking water quality.

Faecal coliforms

Faecal coliforms are conditionally pathogenic bacteria that are present in the intestinal tract of humans and most mammals. They are called conditionally pathogenic since they can cause diseases only under certain conditions (high concentrations, increased susceptibility and reduced human immune defence). The presence of faecal coliforms in water indicates faecal contamination and most likely the presence of pathogens. The most common health problems that may result from contact with faecal coliform contaminated water are dysentery, typhoid, hepatitis, and gastroenteritis.

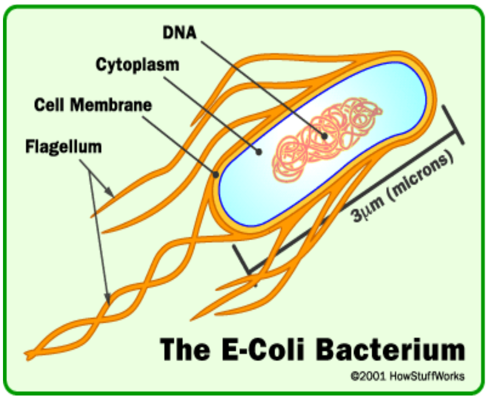

Figure 1: The E-coli Bacterium
Source: ©2001 HowStuffWorks

Escherichia coli (E.coli)

90% of faecal coliforms are types of *Escherichia coli* (E. coli). This bacterium lives in the colon of warm-blooded animals and is necessary for proper digestion of food. Yet this bacterium can cause several infections outside of the colon. E. coli exists abundantly in nature, but the presence of E. coli in water is a sign of faecal contamination. E. coli is the most common cause of urinary tract infections, but can also cause many other diseases such as diarrhoea, pneumonia, meningitis. There are many types (serotypes) of the *E. coli* with different properties. For example, *E. coli* type O157: H7 releases a powerful toxin, leading to severe and bloody diarrhoea with abdominal cramping's. It can cause Haemolytic Uraemic Syndrome (HUS) in children, often with fatal consequences. In Canada, a waterborne epidemic caused by E. coli 0157:H7 infected more than 1.500 persons and resulted in 10 deaths during the year 2000.

Faecal Streptococci/ Intestinal Enterococci

Faecal streptococci and *intestinal enterococci* bacteria are normally present in the intestinal tract of warm-blooded animals. Outside the intestinal tract, the bacteria cause common clinical diseases, such as urethra infections, bacterial endocarditis, meningitis and diseases of the colon. Enterococci infection may be the reason for bladder infections and health problems with the prostate and male reproductive system. They also develop resistances against antibiotics and are sometimes difficult to treat. Wound infections with *faecal streptococci* can result in rapid skin damage and sepsis (blood poisoning), sometimes with fatal outcomes (amputation, death). In the environment, faecal streptococci are more resistant than *E. coli,* and they can survive longer in water.

Clostridium perfringens

C. perfringens is a Gram-positive, rod-shaped, anaerobic, spore-forming bacterium. It occurs in the soil, and in the intestinal tract of humans and other vertebrates. In contrast to the aforementioned and easy detectable *E. coli, C. perfringens* is able to survive in a sleeping stage because they form long-lasting spores. These spores can be used as an indicator for faecal contamination too. For the quality control of drinking water derived from surface waters, it is recommended to test on C. perfringens and its spores. They can serve as an indicator for the occurrence of harmful protozoa like *Cryptosporidium* or *Giardia lamblia. C. perfringens* effects the nervous system and can cause meningitis,Surface water and water catchment areas with intensively grazing livestock are especially threatened by *C. perfringens*. The spores of *C. perfringens* are very resistant to chlorine treatment.

1.2. Contamination of water with Legionella bacteria

The *Legionella pneumophila* bacterium was identified in 1977 as the cause of a severe pneumonia outbreak in a convention centre in the USA. This bacterium is associated with outbreaks of Legionellosis (Legionnaires disease) that are linked to poorly maintained artificial water systems; particularly in cooling towers, air conditioners, hot and cold water systems (showers) and whirlpools. Legionella can be spread by aerosols and infections can occur by inhalation of contaminated water sprays or mists.
The bacterium is found worldwide in aquatic environments, but artificial water systems sometimes provide environments for growing Legionella bacteria. The bacteria colonize in water systems at temperatures of 20 to 59 degrees Celsius (optimal-35^{o}C).

1.3. Microbiological parameters for the quality of drinking water

The EU Drinking Water Directive (90/313/EEC) mentions that member States should take measures to ensure that water intended for human consumption is wholesome and clean. This means that drinking water has to be free of any microorganisms and parasites, and of any substances that causes potential danger to human health! None of the *Escherichia coli* and *enterococci* faecal bacteria may appear in 100ml drinking water. See also module 14.

Frequency of monitoring the quality

The EU Drinking Water Directive also determines the frequency of water sampling and analyses intended for human consumption (also e.g. used in food-production enterprises), and how water is supplied from a distribution network (e.g. from a tanker). The frequency depends on the volume of water distributed or produced each day within a supply zone.

Microbiological Parameters	Parametric value (number/100 ml)
Escherichia coli (E. coli)	0
Enterococci	0
Coliform bacteria *	0
Clostridium perfringens*	0

Table 3: Microbiological requirements of drinking water
** Indicator parameter to be measured if the water originated or is influenced by surface water*
Source: According to EU Drinking Water Directive: COUNCIL DIRECTIVE 98/83/EC

Volume of water distributed or produced each day within a supply zone [m3/d]	Check monitoring number of samples per year	Audit monitoring number of samples per year
< 100	The frequency is to be decided by the Member State concerned.	The frequency is to be decided by the Member State concerned.
>100 - < 1 000	4 / year	1 / year
> 1 000 - < 10 000	4 / year + 3 for each 1 000 m^3/d and part thereof of the total volume	1 / year + 1 for each 3 300 m^3/d and part thereof of the total volume

Table 4: Frequency of sampling and analysing the drinking water quality within the supply zone.
Source: EU Drinking Water Directive: COUNCIL DIRECTIVE 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, Official Journal of the European Communities

2. Chemical contaminants in drinking water

The quality of drinking water can be influenced by several sources:

- Depending on the original source of drinking water, the water may contain various natural inorganic substances, partly wholesome for human health and partly even with health concerns. It may contain particles or natural organic substances (decomposing products) originating from forest or marsh areas.
- Due to human activities, agriculture, industry or traffic, the water may contain impurities.
- Drinking water can be contaminated by the contact of the materials within the network, e.g. metal from pipes.

In the following section, the most common chemical contaminants, which can occur in drinking water and originate from the above three mentioned sources, are presented. In addition, the maximal allowed concentration for the respective chemical in drinking water (according the EU drinking water directive) are given.

2.1. Nitrate (NO_3)

Nitrate (NO_3) is a naturally occurring form of nitrogen found in soil. Nitrogen is essential to all life. Most crop plants require large quantities to sustain high yields. The formation of nitrates is an integral part of the nitrogen cycle in our environment. In moderate amounts, nitrate is a harmless constituent of food and water. Plants use nitrates from the soil to satisfy nutrient requirements and may accumulate nitrate in their leaves and stems. Usually plants take up these nitrates, but rain or irrigation water can leach them out due to its high mobility into groundwater. Although nitrate occurs naturally in some groundwater, in most cases, higher levels are thought to result from human activities (see also module 10)

Common sources of nitrate include:
- Fertilisers and manure
- Animal feedlots
- Municipal wastewater and sludge
- Septic systems and pit latrines

Nitrate is a natural substance that all plants need for growing

Nitrate in drinking water can aggravate “Blue Baby Disease” (Methaemoglobinaemia) as it is converted to nitrite in the body. Nitrite reacts with haemoglobin of the red blood cells to Methaemoglobin, affecting the blood’s ability to carry oxygen to the cells of the body. Infants less than three months of age are particularly at risk. The intake of tea or other baby food prepared with nitrate-rich water can cause the baby to not get enough oxygen and to turn blue. This disease can be lethal, or it can damage the brain or nerves of the child. Older people may also be at risk because of decreased gastric acid secretion. In areas where natural iodine intake by the inhabitants is low, high nitrate concentrations in drinking water can increase the frequency of thyroid problems.

- The maximal allowed concentration of nitrate in drinking water is 50 mg/l.
- The nitrate concentration in most natural water sources is less than 10 mg/l.
- Nitrate levels with more than 25 mg/l, indicate a human-made pollution of the water source.

Chemical	**Source**	**Health concerns**
Nitrate	Agriculture/ wastewater	Harmful for new-born babies (Blue baby diseases or Methaemoglobinaemia)
Pesticides	Agriculture	Carcinogenic, mutagenic, effects nervous system
Mineral oil	Landfills, leakages	Carcinogenic
Arsenic	Geogenic	Skin diseases, carcinogenic
Fluorine*	Geogenic	Dental and bone fluorosis
Iron and Manganese*	Geogenic	Suspected relation with nervous diseases
Uranium	Geogenic/mining	Kidney diseases, cancer
Copper*	Copper pipes	Liver damage
Lead	Lead pipes	Effects nervous system
Cadmium	Galvanic pipes	Kidney diseases
Asbestos	Asbestos-cement pipes	Increased risk of developing benign intestinal polyps

Table 5: Overview of the most common chemical contaminants in drinking water, the related health concerns and its possible sources.

**These chemicals are essential for human health, but harmful in case of increased intake.*

2.2. Pesticides

Pesticides represent a risk factor in all intensive agricultural areas where drinking water is extracted from underground sources or surface waters. Many European rivers are affected by pesticides and with a seasonal variability. In countries with intensive agriculture, like the Netherlands, river water samples show an average of at least 10 different active pesticide substances. Many of these chemicals are proven or are suspected to be carcinogenic, mutagenic and/or a hormone-disruptor. Some types of pesticides can accumulate in fatty areas of the body; e.g. the breast is composed mainly of fatty tissue. Many of the artificial (synthetic) chemicals are long lasting in the environment and are found in the whole food cycle, for example DDT or Lindan.

Depending on the chemical structure, pesticides can be water-soluble or fat-soluble. Water-soluble pesticides, such as substances of the chemical groups of urea or Triazin herbicides, should not be applied in water sensitive regions, and in particular, not in water protection zones. Some pesticides such as atrazine (a Triazin herbicide), which were used decades ago and caused a widespread contamination of groundwater, are forbidden in many countries since the early nineties. However, they are still present as active substances or as decomposing products in groundwater, thus still being risk factors for human health.

The maximal allowed concentration of pesticides in drinking water for one active substance is 0,1 μg/l.
The maximal allowed concentration of the total amount of active substances is 0,5 μg/l.

Source:http://www.ourbreathingplanet.com/pesticides-and-food-safety/

Source: www.CartoonStock.com

2.3. Fluoride (F)

The appearance of fluoride in the groundwater is mostly of geogenic origin, but can also be caused by mining or industrial pollution. In Central Europe, groundwater resources that exceed the fluoride guideline value of 1.5 mg/l are widespread, and effects on health have been reported in areas with high fluoride amounts in the water. Known regions with increased levels of fluoride in groundwater are found, e.g., in Ukraine, Moldova, Hungary or Slovenia. On one hand, fluoride is to some extension essential for the development of healthy bones and teeth, but on the other hand, long-term and increased intake of fluoride via water or other sources can cause severe problems with teeth and bones.

The concentration of fluoride should not exceed 1.5 mg/l.

Dental fluorosis is the appearance of spots on teeth that can range from white to brown spots with destruction of tooth enamel.
Source Photo; Oral Health Tips.
http://www.oralhealthtips.co.uk/tag/dental-fluorosis-2

2.4. Metals

Metals are substances that occur naturally in geological formations. Some metals are essential for life and are available naturally in our food and water. On the other hand, drinking water may contain metals, in certain concentrations, which cause health risks. Several heavy metals, such as Plutonium or Lead, are not essential for life and can cause severe diseases. Those metals are undesired in drinking water. Copper is another heavy metal essential for life, but it is toxic in high concentrations. Other light (alkali) metals, like Calcium and Magnesium, are essential for life and are desired in drinking water for technical reasons. In the following, some metals that are most known in drinking water, are presented.

Arsenic (As)

Arsenic contamination of groundwater is found in many counties. It is mostly a natural occurring contamination in deeper levels of groundwater. One of the most known cases of large-scale poisoning by the consumption of arsenic contaminated water is found in India. Besides the natural occurrence of arsenic in groundwater, groundwater nearby mines can also be contaminated with *As*.
In Europe, in e.g. Hungary, Romania and Slovakia, exposure of *As* in drinking water has been identified. Arsenic and its compounds have carcinogenic properties. Skin diseases and increased cases of cancer endanger the population in regions with too high of an arsenic level in their drinking water.

The maximal allowed concentration of arsenic in drinking water is 10 μg/l.

Cadmium (Cd)

Sources of cadmium could be corrosion of galvanised pipes, erosion of natural deposits, discharge from metal refineries, runoff from waste batteries and paints. The release of *Cd* in drinking water due to galvanised pipes depends on the composition of the pipes. Many countries have a limited percentage of *Cd* allowed in constructing galvanised pipes.

With the introduction of chemical fertilisers, cadmium has been accumulating in agricultural land and therefore in almost all foods (only a very small amount leaches into the groundwater). For example, many natural sources of phosphates are contaminated with *Cd* and other metals. Several developed countries have a regulated limit introduced for the concentration of cadmium in fertilisers. Cadmium can cause kidney, liver, bone and blood damage.

The maximal allowed concentration of cadmium in drinking water is 5μg/l.

Copper (Cu)

Copper is a common, malleable metal that occurs naturally in rock, soil, water, sediment and air. It is used to make products such as coins, electrical wiring and water pipes for household plumbing. The primary sources of copper in drinking water are corroding pipes and brass components of household piping systems. The amount of copper in drinking water also depends on the hardness and pH of the water, how long the water remains in the pipes, the condition of the pipes, the water's acidity and its temperature (see also module 6)

Signs that drinking water may have elevated levels of copper include a metallic taste or blue to blue-green stains around sinks and plumbing fixtures. The corrosion leads to the release of copper ions and their deposit of by-products on the pipe wall. The solubility of these by-products ultimately determines the level of copper at our taps. The only way to accurately determine the level of copper in drinking water is to have the water tested by a certified laboratory.

Healthy water should not be corrosive and contain sufficient calcium (hardness) in order to develop a protective layer of lime scale within the pipes. In the beginning, newly installed copper pipes or other copper equipment release some copper into the water. Therefore, water that was left hours in new copper pipes should not be used for consumption.

Although copper is an essential element for human beings, long-term exposure and increased amounts of copper causes liver or kidney damage. In particular, babies and children are affected.

The maximal allowed concentration of copper in drinking water is 2 mg/l.

Lead (Pb)

Lead is a heavy, soft, and malleable metal found in natural deposits (such as ores containing other elements), and has no characteristic taste or smell. It is used to make pipes, cable sheaths, batteries, solder, paints, and glazes. Where drinking water is concerned, lead has been used to produce service lines and solder (both banned since 1988), and a variety of brass pipes and plumbing devices (see also module 6).

Most lead enters our drinking water through the interaction of the water and plumbing materials containing lead, i.e. through corrosion and the solubilisation of lead-based corrosion by-products. Water chemistry, the age of the piping, and the amount of exposed lead at the surface of the material in contact with the water are the most important factors contributing to lead leaching into our drinking water. Furthermore, corrosion deposits within distribution systems can adsorb trace amounts of certain soluble contaminants, including lead.

Lead is for humans, and in particular for foetuses and children, a toxic metal. Lead can affect delays in physical or mental development in children and infants. Children can show slight deficits in attention and learning activities. Adults can experience kidney problems and high blood pressure.

Taking the recognised health risks of lead into consideration, the EU changed the regulations in 1998.

The maximal allowed concentration of lead in drinking water was reduced from 50 µg/l to 10 µg/l.
A transition period of 15 years was defined to allow replacing of lead distribution pipes.

Lead is a heavy and malleable metal and has been used in previous time to produce service lines and solder. Lead is for human a toxic metal.

3. Elements with technical impacts

3.1. Calcium (Ca) and Magnesium (Mg) / hardness

The hardness of groundwater is very much influenced by the composition of the minerals in soils. Dissolved natural (carbonate) salts of calcium and magnesium cause water hardness, which can cause deposits of hard layers on the surfaces of water pipes or water heaters.
As aforementioned, metal pipes can be a source of drinking water contamination. Therefore one of the requirements of the Drinking Water Directive is that drinking water should not have any corrosive properties in contact with metals. That means water should have certain hardness, although the EU Drinking Water Directive does not specify standards for hardness, composed of calcium or magnesium.

However, too much hardness is unwanted, particularly within households. Heating apparatuses are damaged and the diameter of pipes can get smaller. The EU Drinking Water Directive does not advise a minimum or maximum concentration (indicator parameter) for calcium and magnesium, but several countries do so. Water with a very high hardness level may be a problem considering heating installations and household equipment. *Ca-* and/or *Mg*-salts precipitate, in particular, on materials in contact with heated water (water cookers, heating systems). Furthermore, hard water requires more detergents/soaps for cleaning purposes.

Calcium and magnesium are essential elements for human beings. Drinking water with high hardness levels is not considered to be harmful.

Corrosion can cause severe leakages in the distribution system

3.2. Iron (Fe) and Manganese (Mn)

The primary sources of iron in drinking water are natural geologic sources, as well as ageing and corroding distribution systems (household pipes). Iron-based materials, such as cast iron and galvanised steel, have been widely used in our water distribution systems and household plumbing.

Undesirable effects are tastes or odours. Iron in quantities greater than 0,3 mg/l in drinking water can cause an unpleasant metallic taste and rusty colour. Iron and manganese are both known to stain the water supply. They can make water appear red or yellow, create brown or black stains in the sink, and give off an easily detectable metallic taste. Even laundry can get brown spots by washing with *Fe-* and *Mn*-rich water. Although these can all be aesthetically displeasing, iron and manganese are not considered to be unhealthy. Fortunately, they can be removed from the water easily. Furthermore, increased levels of iron can appear in the drinking water of galvanised pipes that are corroding and release iron. Because galvanised pipes consist of a mixture of metals, zinc or cadmium levels in the drinking water could also increase. Like iron, zinc is not considered to cause health risks. Please see above for cadmium.

4. General remarks

Most substances that pose health risks are not visible and do not have a colour or a smell. Therefore, only extended water analyses of the water source and the final drinking water consumed by the people can give information about the quality. If any health-concerned substances exceed maximum levels, the consumer should be informed and advised on taking appropriate precautionary measures.
The EU Directive indicates that the analyses results have to be made accessible to the public. The water supplier is responsible for the water quality of the entire supply system-up to the water meter of the connected household. Water should be free of pathogens, and the parameter values of the Drinking Water Directive should be fulfilled and the delivered water should have no corrosive properties.
The water quality has to be monitored on a regular basis and according to the delivered quantity of drinking water. But within the house, it is the owner or consumer who is responsible for maintaining the quality of water, the pipes and other equipment in contact with the drinking water. The following Table (Table 6) shows parameters, which are substances that cause health concerns. The concentration should not exceed the set parametric values.

Parameter	Parametric value	Unit
Acrylamide	0,10	µg/l
Antimony	5,0	µg/l
Arsenic	10	µg/l
Benzene	1,0	µg/l
Benzo(a)pyrene	0,010	µg/l
Boron	1,0	mg/l
Bromate	10	µg/l
Cadmium	5,0	µg/l
Chromium	50	µg/l
Copper	2,0	mg/l
Cyanide	50	µg/l
1,2-dichloroethane	3,0	µg/l
Epichlorohydrin	0,10	µg/l
Fluoride	1,5	mg/l
Lead	10	µg/l
Mercury	1,0	µg/l
Nickel	20	µg/l
Nitrate	50	mg/l
Nitrite	0,50	mg/l
Pesticides	0,10	µg/l
Pesticides-total	0,50	µg/l
Polycyclic aromatic hydrocarbons	0,10	µg/l
Selenium	10	µg/l
Tetrachloroethene and Trichloroethene	10	µg/l
Trihalomethanes — total	100	µg/l
Vinyl chloride	0,50	µg/l

Table 6: Chemical parameters and parametric values for the quality of drinking water
Source: EUROPEAN COUNCIL DIRECTIVE 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, Values of Annex 1, Part B

5. Exercises and Questions

- What is the importance of clean drinking water?
- What are the risks related to drinking water quality?
- What are the types of contaminants and their impact on human health?
- How can one recognize when water is contaminated and what are the sources of contamination?
- What is hard water?
- Can water have a chemical reaction with the pipes?
- What is corrosion?

WSP related activities

Review the national drinking water directive.

Cooperation with the water supplier or other responsible authorities:

- Find out the water quality of your environment – which parameters are analysed in which frequency?
- Where are the samples taken?
- Are there leakages within the public network?
- Are all households connected to the central water supply?
- Do all citizens consume water of the centralised water supply network?
- If not, what are their alternative water sources and what is the quality of that water?
- If needed, initiate additional water analyses and discuss the results.
- Are the results accessible and understandable to the wider public?
- Are there parameters exceeding the limits indicated by the EU Drinking Water Directive?
- If yes, what are the measures for a better water quality?
- Are there any health risks linked to the water quality?
- Did outbreaks of water related diseases occur in previous time?

Household level: Make observations on the quality of the water pipes by interviews including following information:

- Is there a presence of lead or copper pipes?
- Are there complaints about turbidity or particles in the drinking water (corrosion or other visible particles)?

6. Text sources and further reading

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