WATER POLLUTION WITH NITRATES AND NITRITES

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ЗАГРЯЗНЕНИЕ ВОДЫ НИТРАТАМИ И НИТРИТАМИ

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Аннотация. *Данная статья посвящена рассмотрению проблемы загрязнения вод нитратами и нитритами. Представлено обзорное описание загрязнения вод в мире, описаны причины появления нитратов и нитритов в подземных водах, предложены пути решения очистки воды, путём использования активированного угля, цеолитов и других способов.*

Research objective. Water analysis on the content of nitrates and nitrites.

Only a small proportion (about 2.5%) of Earth's water is fresh and fit for human consumption. The rest (97%) is in the oceans and seas. About 13% of the fresh water is groundwater; it is an important source of drinking water as more than 50% of the world population depends on it [1]. For many villages and small cities, groundwater is the only source of drinking water [Fig.1].

Materials and methods. Nitrate pollution is a serious problem around the world, the level of water contamination is steadily increasing and, as a result, national and international organizations have to introduce laws on its level in the drinking water and wastewater. Despite these laws nitrate pollution still prevails in more than 85% of the water obtained from groundwater. Nitrate (NO_3^-)and nitrite (NO_2^-)are the most common pollutants in surface water in the world. Since most of the surface water containing a high concentration of nitrates is simply not used as a source of water, there is a significant loss of this valuable resource.

Nitrates are the end product of a biochemical oxidation of ammonia, and their high levels in water systems are usually a result of human activity, particularly, agriculture where nitrogen fertilizer is widely used [2, 3]. High concentrations of nitrate and nitrite can have significant consequences, which influence human health and the environment. As far as drinking water is concerned, increasing NO_3^- concentration has two negative consequences: methemoglobinemia(especially in young children) and carcinogenic nitrosamines, which can lead to the development of various types of human cancer and other diseases [4-7].

According to the sanitary rules of Rosh and norms for drinking water, nitrate concentration should not exceed 45 mg/L, while nitrite - 3 mg/L. [8]. The World Health Organization guideline for drinking water is less than 10 mg of NO_3^-/L, which is equivalent to approximately 50 mg NO_3^- /L [9].

The lowest average annual nitrate concentrations in fresh surface water were found in Finland and Sweden, followed by Lithuania, Portugal and the Netherlands, and the highest -in Malta, the United Kingdom and Belgium, where it exceeded 40 mg nitrate per liter.

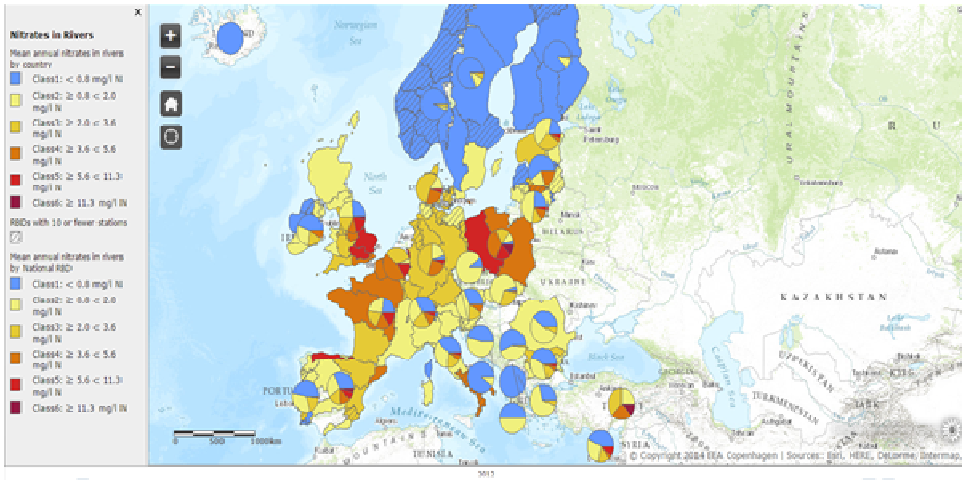

Fig. 1. The average annual concentration of nitrates (NO_3^-)measured in milligrams of NO_3^--N per liter of water, observed in the river monitoring stations and reported members of the European environment agency(EEA) (2012).

As for the Russian Federation, in the period from 2000 to 2009, 5577 cases of groundwater contamination were identified. The greatest number of the groundwater contamination locations is observed on the territory of the following federal districts: Volga - 1578 (28%), Siberia - 1550 (27%), Central - 904 (16%) and South - 628 (11%).

Methods of removing nitrates and nitrites. Removal of nitrate from water is a complex and expensive process involving catalysts, high temperature and pressure, because the nitrate ion is stable and highly soluble, so it cannot be removed by conventional water treatment processes. Potential treatment options include weak base anion exchange, strong base anion exchange, biological treatment and chemical reduction. However, in recent years other options have been proposed. For instance, granular activated carbon doped with nitrogen-containing functional groups that are well suited for removing oxyanions such as nitrate, sulfate and perchlorate.

Activated carbon (AC) is generally regarded as the universal sorbent for the removal of various types of water contaminants, especially organic. The widespread use of AC is due to the variety of structural and chemical properties that can be obtained from the carbon-containing precursors by means of physical and chemical processes. Traditionally AC have been produced from agricultural waste products such as coconut shells, hazelnuts, rice husks, cherry stones and apricot kernels which has reduced production costs to a minimum. Physical and chemical properties of AC in many respects determine its stability, porosity and surface composition, while the surface plays a major role. Therefore, an understanding of the physical and chemical nature of the AC is crucial for its use as an adsorbent in various applications.

Removal of nitrate from water by zeolite and clay adsorbents. Zeolites are widely known as adsorbents in the environmental cleanup of the pollutants. Zeolites are three-dimensional, microporous, crystalline solids with well-defined structures that contain aluminum, silicon, and oxygen. The silicon and

aluminum atoms are tetrahedral and coordinated with each other through the shared oxygen atoms. Zeolites have void space (cavities or channels) that can host cations, water, or other molecules.

Clays play an important role in the environment by acting as a natural scavenger of pollutants by taking up cations and anions either through ion exchange or adsorption, or both.

In Astrakhan Oblast (Russia) a set of sorbents for the chemical monitoring of the environment, as well as sorbents for the environment improvement were presented on the basis of natural clays (montmorillonites). They were also used for cleaning and purification of drinking water.

Conclusion. Nitrates and nitrites are serious pollutants of water. Their content in water affects the health of people, as in the body nitrates are converted into nitrites. Nitrites react with hemoglobin in red blood cells to form methemoglobin, which affects the ability of blood to supply the body's cells with a sufficient amount of oxygen. Thus, quality of water requires special consideration of the scientists.

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