

PERSPECTIVES ON WATER QUALITY

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Summary

As part of almost every technological process in industrial production, a large amount of water is necessary in addition to the raw materials. Water is used as a solvent, heat carrier, transporting medium for substances, etc. Polluted water is then discharged to rivers, lakes, seas, soils, and the upper layers of the Earth's core. At present, all the countries of the world use, for industry and energy production, more than 600 cubic kilometers of water per annum. Irrigated agriculture consumes 5 to 6 times more water annually.

Pollutants can be categorized according to geographic scale, as follows:

- local pollutants confined to not very large territories of a single state (causing pollution of small creeks, lakes, vegetation, soil);
- regional pollution confined to one or several states (pollution of rivers, large lakes, vegetation, soils, underground waters);
- global pollution occurring on the scale of the whole planet (e.g. pollution of the World Ocean).

Depending on their origin or chemical structures pollutants are classified as follows:

- pathogenic microorganisms and viruses;
- materials that can be destroyed by oxidation (organic substances);
- inorganic compounds of phosphorus and nitrogen;

- organic synthetic substances (e.g. pesticides and detergents);
- heat pollution

One of the principal criteria of water quality for any purpose is concentration of dissolved mineral substances. Limit levels of concentration of various pollutants in water are determined by standards and hygienic norms for water quality.

Prevention of pollution of water resources is an international issue because of the community of interests of different states in using water from rivers, seas, and oceans. In this connection, countries share the following problems:

- water system protection;
- water purification;
- improvement of production processes;
- control of water bodies;
- monitoring and control of water quality;
- water quality regulation;
- standardization and certification of water bodies;
- improvement of information systems;
- formation of the legal basis

The fundamental strategic goal of the world community is undertaking all necessary measures for preventing, limiting and reducing the spread of water-borne diseases.

1. Introduction

Humanity entered a new era when the power of its chemical, biological, and physical activity became commensurable with the forces of nature. The economic activities of humanity have become a power to alter the world.

Any processes connected with production are characterized not only by resource transformation and creation of the required substances, but also by the formation of by-products. These are generally alien to the environment and so are xenobiotic agents. On entering plant or animal cells, the xenobiotics causes negative changes in the organism; these manifest themselves at various levels, e.g. somatic, gene and chromosome, etc. This disturbs metabolism, and mineralization of wastes may be disrupted. In soil, microbiological activity can be inhibited by various toxic compounds. Human activity produces a large number of substances that cannot be destroyed by normal biological degradation and these accumulate in the atmosphere, hydrosphere, and soil.

Humankind currently synthesizes more than seven million different chemical substances. Up to 70 000 chemical products are now used in human activity.

Two types of pollution can be distinguished:

- natural pollution—cyclic changes in water quality induced by natural factors, that are harmful for aquatic fauna and flora (e.g. pollution of rivers and forest

water basins by leaves and needles of coniferous plants; ferrous salts of humic acids affecting seasonal changes of oxygen levels in water; siltation after heavy rainfall);

- pollution caused directly by human activity as a result of discharge of harmful substances and waste waters.

Among the latter the following types of pollution can be distinguished:

- Chemical pollution resulting from discharge of appreciable amount of water contaminated with wastes containing acids, alkalis, cyanides, phenols, heavy metals, and other mineral and organic toxic substances; the total background pollution of the global aquatic environment by chemical substances has increased as a result of translocation by water streams, air masses, and living organisms.
- Non-obvious latent slow-acting pollutants (oil hydrocarbons, Freon manufacturing products, halogen containing insecticides, herbicides, synthetic detergents.
- Pollution with organic substances capable of enzymatic transformation or biological pollution; this type of pollution can be caused by discharge of urban wastes without purification, or without adequate purification. It can also be caused by discharge of industrial waste water (from pulp and paper, food, and textile industries). Biological pollution is connected automatically with pollution by detergents and diverse microchemical contaminations. The same occurs with industrial pollution by the substances capable of enzymatic transformations. Often the combination of organic contamination and toxic (chemical) industrial pollution creates an extremely dangerous form of pollution.
- Radioactive contamination caused by a number of natural and artificial sources; the influence of potable water on total radiation dose is very small. This is caused by natural presence of radionuclides as a result of fission of uranium and thorium. The level of natural radionuclides in potable water can rise as a result of different kinds of human activity. Radionuclides formed from nuclear fuel or used in medicine or other applications of radioactive materials can penetrate systems of potable water supply. However, the entrance fraction of these sources is conventionally limited.
- Mechanical pollutants that are the result of discharge into the water of solid inert substances (clay, sand, silt, slag, coal dust); the water becomes permanently turbid and not suitable for any life;
- Heat pollution that is the warming of the waters by discharges of the thermal and nuclear power plants;
- Microbiological contamination that is connected mostly with the excretions of human beings, animals and birds; the fecal pollution of the water sources results in the occurrence of pathogenic microorganisms in the water

Recently the danger of “water hunger” has become a major issue in many countries. In some cases, it is connected with the limited availability of water resources and with special features of its geographic distribution, and in other cases it is caused by water pollution. This in turn is connected with irrational water utilization and with absence of proper measures for water protection. This phenomenon is clearly seen in some

developed countries (e.g. USA, Germany, France, and Great Britain), in which the proportion of polluted and repeatedly used waters grows continuously. Irrational and predatory exploitation of natural resources sometimes causes degradation of natural systems. Low rates of payments for natural resources and in many cases complete absence of charges favor unlimited exploitation of the natural wealth and disruption of natural renewal of resources.

The problem of pollution of water resources crossed national borders and even continents a very long time ago. Water pollution has an international character due to the common interests of various states, when waters of rivers, seas, and oceans are exploited. In this connection, the problems are uniform for many countries.

2. Protection of water systems

The problem of water protection is a vitally important one. All lakes, rivers and coastal water in the territory of industrially developed countries are polluted to some degree. Highly polluted areas are normally of limited extent and associated with discharge of urban and industrial waste water. Protection of water sources is therefore of prime importance for providing safe potable water supply. It is always better to protect water from pollution than to purify it after pollution. Groundwater sources and, in particular, springs and wells should be chosen so that they are protected from surface drainage and floods, and also from access of people and livestock.

Catchments areas should be protected from unfavorable effects of human activity. The protective measures include isolation of water accumulation area and control of the sorts of human activity that might cause pollution (e.g. discharge of dangerous wastes, mine engineering and open-cut mining of mineral resources, fertilizers and pesticides used in agriculture. Recreational activity should also be limited in water catchments.

Preservation of wilderness areas is no less urgent and important. Setting up of preserved territories and national and regional parks, and also protection of natural systems, might be the best way to reach this goal. Special attention should be paid to protection and recovery of small rivers because they perform a leading role in formation of water resources.

Another serious problem is protection of open water surface. It is possible to protect water basins from most forms of human activity, but protection for rivers is possible only on a limited part of it, if at all. It is often therefore necessary to accept existing and historically ways of exploitation of rivers and lakes, and to organize water purification in correspondence with them.

3. Water purification

One of the most important problems in the protection of water basins from pollution is purification of urban and industrial waste water. Discharges of metal wastes into water basins have increased with the development of industry. Biological methods or combinations of biological, physico-chemical and other methods are employed for purification of such wastes. A decisive factor in the controlling the entry of

contaminating substances into water bodies is improvement of technological processes (non-waste, low waste producing, closed cycles of water supply, etc.), and also increased scale of recycling of water supplies and cooling water. Observance of maximum permissible norms of composition of waste water entering the treatment plants, as well as their emissions, can provide a solution to this problem. The permissible characteristics of waste water include some general parameters, and also concentrations of petroleum products, detergents, phenols, pesticides, compounds of heavy metals, nitrogen, phosphorus, and sulfur, and also content of microorganisms.

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Biographical Sketch

Vadim A. Taktashov was the Head of Department All-Russian Research Institute on standardization, Gosstandart of Russia.

Vadim A. Taktashov - Doctor Science(tech.), associate professor (reader) of a metrology, certification and diagnostic, Vice-Director of Central Body of a national system certification of drinking water quality.

Dr. Taktashov research and teaching interests are focused in a number of areas.

First - standardization and quality management of development, production, servicing, maintenance, quality control and tests of different industries products.

A second area is standardization, metrology, management, test and audit drinking water quality.

A third focus is design (projection) quality engineering system (quality management and quality assurance standards).

Vadim A. Taktashov organized and headed activity of technical committees on national standardization in these areas, participated series of national systems of certification (space-rocket engineering, special equipment and methods of a guard, job safety, braits, drinking water, services in a scientific and technological orb etc.).

Dr. Taktashov – is the author more than 130 monographies and tutorials, publications, articles, national state standards, recommendations and normative documents.

Now Dr. Taktashov is General director of State Department inspection and quality assurance surveillance in Central Federal locale of Russia.