

WATER QUALITY REGULATION AND STANDARDS

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Summary

The development of the world community, scientific and technical progress, continuous enlargement of international cooperation, ecological safety, and increasing the level of health of all inhabitants of Earth focus more and more attention from international, regional and national organizations to standardization problems in all countries of the world. It is difficult to indicate a field of human activity in which we would not meet standardization. In so doing, the scale of the work is increased, and the sphere of application of principles of standardization is enlarged with the enlarging and deepening knowledge and with the advance of science and technique.

Standardization made vigorous progress in the industrially developed countries in the second half of the twentieth century as applied to the scientific, technical, production and economic spheres. The world community accepted the necessity for development of international standardization.

Various international organizations carry out regulation of requirements for water quality, as applied to their spheres competence. These organizations and agencies include WHO, EEC, ONN, FAO, Codex Alimentarius, and ISO. Recently, the thematic priorities of ISO have shifted to the field of health protection, environment preservation, standard development, and testing methods. National standardization is represented by national standards DIN, AFNOR, BSI, ASTM, GOST, etc.

Natural water resources are a vital important component of the biosphere. These are economic and production resources possessing irreplaceable consumer properties. The pollution of water and degradation of water systems are growing planetary problems concerning all aspects of human activity and influencing human health, economics, and social conditions. Water consumption on Earth increased sevenfold in the twentieth century, while population growth only increased threefold. Agriculture is the world's largest water consumer. Up to 65% of the water utilized throughout the world is used for development of agriculture, including irrigation. Water quality is the most important factor of ecological safety and sustained development of agriculture.

Normalization of water quality is a basis for ecological safety and stability in agriculture, for the complex of practical measures and mechanisms (economic, legislative, legal, technological) for realization of sustainable use of water in the agriculture.

A large amount of water is necessary in addition to raw materials for almost all technological processes in industry. Water is used as a solvent, heat carrier, and transporting agent for different substances, etc. Polluted water is then discharged to rivers, lakes, seas, soils, and the upper layers of the Earth's crust.

One of the principal criteria of water quality for any application is the concentration of dissolved mineral substance. The maximum levels of concentration of various polluting substances in water are determined by standards and hygienic norms for water quality. The problem of prevention of pollution of water resources has a clearly expressed international character that is determined by the generality of interests of different states

in the use of water from rivers, seas, and oceans.

1. Introduction

The development of the world community, scientific and technical progress, continuous enlargement of international cooperation, ecological safety, increasing the level of health of all inhabitants of Earth focus increasing attention from international, regional and national organizations to standardization problems in all countries of the world. It is difficult to indicate a field of human activity in which we do not meet standardization. In so doing, the scale of the work is increased, and the sphere of application of the principles of standardization is enlarged with the enlarging and deepening knowledge and advance of science and technology.

“Standardization” in general understanding is determined as the activity including the search for solutions of repetitive problems in the fields of science, technology and economics directed to achieving an optimum degree of ordering in a particular field. The results of this activity are the development, publication, and application of “codes”, “norms”, “rules”, and “standards”.

This determination reflects the multiplicity of standardization and characterizes it as activity directed at order, not only in the purely technical sphere. Normalization and standardization are based on objective achievements of science, technology, economics, and advanced experience. These determine the basis not only for present but also future development. Thus, normalization and standardization should be carried out in harness with development of science and technology.

2. Water Quality Regulation and Standards

2.1. Principal concepts of standardization

It is necessary to distinguish international, regional and national standardization, depending on the level and scale of activity and form of participation, taking into account geographic, political, and economic characteristics. The norms, rules, requirements, and characteristics for each field of standardization need to be elaborated in each standardization process. These results are formulated in the form of a standardizing document. In accordance with the Guide 2 ISO/IES, 2004, the standard in the normal document is developed on a consensus basis and confirmed by the recognized organization. This document is intended for achievement of the optimum degree of ordering in the particular field of human activity. The general principles and rules concerning different kinds of activity or their results are established in the standard for common and multiple uses. This Guide specifies the following range of normalizing documents: standards, technical specifications, codes of established practice, and orders (technical orders).

Standards are subdivided in the following categories depending on their content and intention: basic standard (a standard with a wide field of application or containing general concepts for a particular field); standards on terms and definitions (terminology standard); standard on methods of control, testing, measurements, and analysis (testing

standard); standard on production (product standard). This standard establishes requirements that should be met in a particular product or group of products. There are also standards on work or process (process standard), on service (service standard), and on compatibility (interface standard). There are also standards with open values (standards on the data to be provided) containing list of characteristics, for which the values or other data should be indicated for concrete defining products, process or service.

Two notions should be clearly differentiated: “adoption of the standard” and “application of the standard”. The former implies the official publication of the regulating document by the authorized organization or agency, and the latter supposes the direct employing this regulating document in the corresponding field (production, testing, and certification) or introducing it into another regulating document.

The principal concepts concerning water and their definitions are set out in eight parts of international standards ISO 6107 “Water Quality: Glossary”, which contains a complete list of the terms used. For example, the following definitions of the types (sorts) of water are given among general terms: drinking water, water for potable water supply, surface water, rain water, ground water, boiler water, irrigation water, tidal water, industrial water, cooling water, relict water, storm water, mineral water, stagnant water, mesotrophic water, mesaprobic water, unpurified urban waste water, gray water, black water, saline water, etc. In particular, the term “surface water” is defined as “the water, which flows or is accumulated on the Earth surface”. The term “storm water” is “the surface water forming water streams as a result of strong showers“. The concept “irrigation water” is “the water that is brought into contact with soils or with plant roots for increasing soil humidity and providing water necessary for normal growth of plants and/or for preventing salt accumulation in the soil”.

The second group of standardized concepts is the terms and definitions concerning sampling. These include determination of such concepts as sample, bacteriological sample, composed sample, point sample, etc., plus other concepts connected with time factors and types of sampling (continuous sampling, periodical sampling, etc.). The third group of standardized concepts contains the terms and determinations relating to water quality and water analysis, as, for example, biomass, biota, alga, suspended matter, bacteria, viruses, diatoms, zooplankton, silt, coli-form organisms, acidity, carcinogen, turbidity, total chlorine, chemical oxygen demand (COD), photosynthesis, etc.

In Russian the concept complex is standardized by:

- GOST (State Standard) 27065-86 “Water Quality: Terms and Definitions”,
- GOST 19185-73 “Hydraulic engineering. Principal Concepts, Terms and Definitions”,
- GOST 17.1.1.01-77 “Nature preservation. Hydrosphere. Water utilizing and water protection. Principal terms and definitions”,
- GOST (Industry Branch Standard) 15282-83 “Water for ponds of trout and carp breeding farms: Terms and Definitions”,
- GOST 3470-657-84 “Nature preservation, Hydrosphere, Thermal treatment of

initial and wastewaters at thermal electric power plants. Terms and Definitions”.

The classification of water bodies and water use is regulated in Russia by:

- GOST 17.1.1.02-77 “Nature preservation. Hydrosphere. Classification of water bodies”,
- GOST 17.1.1.03-86 “Nature preservation. Hydrosphere. Classification of users of water”, and
- GOST 17.1.1.04-80 “Nature preservation. Hydrosphere. Classification of underground waters on the purposes of water usage”.

In general, water bodies as important elements of the biogeocenosis complex and as objects satisfying the needs of society are classified in the following groups: surface waters (their types are water flow, water reservoir, sea, glacier) and underground waters (their types are basin, water-bearing layer, deposit). The standards establish the types of water bodies in terms of its most important features (physical-geographic, regime, morphometrical) and characteristics (area, length, depth, discharge and volume of water, flow rate, water level and temperature, duration of periods unfavorable with regard to water volume and water exchange conditions, water exchange characteristics, filtration properties of soils and rock). Water bodies are also classified into categories demonstrating difference in the characteristics of dimensions or in the conditions of regime, water exchange, etc. that can be expressed as qualitative (comparative) or quantitative characteristics.

Classification of water users is carried out on the basis of the purposes of water use and the interaction of these uses, taking into account temporal aspects of water use including the objectives established for the water resources. For example, users of water are divided according to the purposes of water use into the following categories: potable and household water, municipal water, economic water, medical and curative water, water for agricultural needs, for industrial needs, water for needs of fishery, etc. The standard also establishes a classification of waters using types of water body (surface water, underground, internal and territorial sea water), on technical conditions of water utilization (either with or without constructions), on conditions of submitting and employment of water bodies (joint, separate), on the character of water usage (as a substance, as an energetic resource, as a habitat), on the method of its use (take-off and return, or without return), and on the effect of users on the water body (on its quantitative or qualitative characteristics). The classification of underground waters is interrelated with the classification of the purposes of water use.

The conceptual apparatus in the field of water problems received further development in international documents of various levels (for example, Directives 98/83/EC concerning water consumption by human). The following terms and definitions are using in discussing water purification problems: aeration, disinfection, dialysis, distillation, mineralization, infiltration (into the soil), ozonation, clarification, sterilization, flotation, fluorination, chlorination, etc.

The classification of water bodies, water users, and underground waters is carried out on the basis of the purposes of water use. Water bodies are considered to be both important

elements of the biogeocenosis complex and as assets satisfying the needs of human society. Thus, water bodies are classified in the following groups: surface waters (their types are water flow, water reservoir, sea, glacier) and underground waters (their types are basin, water-bearing layer, deposit). The standards establish types of water bodies with regard to their most important features (physico-geographic, regime, morphometrical) and characteristics (area, length, depth, discharge and volume of water, flow rate, water level, temperature, duration of periods unfavorable with regard to volume and water exchange conditions, water exchange characteristics, filtration properties of soils and rock). Water bodies are also classified into categories demonstrating difference in the characteristics of dimensions or in conditions of regime, water exchange, etc. that can be expressed as qualitative (comparative) or quantitative characteristics.

2.2. International standardization

Regulating the requirements for water quality is carried out at the international level by various international organizations, as related to the spheres of their competence, including WHO, EEC, UN, FAO, Codex Alimentarius, and ISO.

More than 10 000 international standards are currently employed in the world. From 500 to 600 standards are revised or adopted each year. The international standards are developed by the International Standardization Organization (ISO). Today, more than 120 national organizations on standardization are the constituents of ISO. English, French, and Russian are accepted as the official languages of ISO.

International standardization in the field of water problems began to develop in the year 1971, when the ISO Technical Committee ISO/TC-147 Water Quality was established. The activity of the Secretariat of ISO/TC-147 is executed by Germany as one of the most advanced European countries with considerable practical experience of national standardization in this field. The field of activity of ISO/TC-147 on standardization includes potable water, natural, and waste waters. At the present time ISO/TC-147 developed and adopted more than 170 standards, including the following: methods of control of inorganic components (37.4%), methods of control of organic components (9.4%), microbiological methods of control (9.4%), organoleptic and generalized characteristics (8.8%), biological test methods (12.3%), radiological methods of control (4%), estimation of measurement accuracy (1.2%), terms and definitions (6.4%), and sampling (11.1%).

ISO/TC-147 interacts in its work with other international organizations, in particular with World Health organization (WHO), UN Food and Agriculture Organization (FAO), and the United Nations Environment Programme (UNP), etc.

WHO, together with its European Regional Bureau (EURO), published in the years 1984 and 1985 the first edition of the Guide on Quality Control of Potable Water (in three volumes). This guide was revised in 1993, then – in 2004. The recommended values for various components of potable water are given in the first volume together with information necessary for the substantiation of these values. The second volume “Hygienic Criteria and other Relevant Information” contains the monographic materials for every pollutant or every type of the pollutants that formed the basis for the

recommended values. The third volume “Inspection and Control for Sources of Municipal Water Supply” has a completely different purpose. This volume contains information and recommendations required for small communities, especially in developing countries, for providing safe water supply. It is understood that the Guide on Quality Control of Potable Water should be revised continuously, and the series of substances or polluting agents and the values of their concentrations in the water should be estimated annually.

A new impetus for the development of activity in standardization in the field of environmental protection was given by the UN Environment Conference in 1992 in Rio de Janeiro, where representatives of 178 states and 30 international organizations participated. The program documents of the Conference, the most important of which was “Agenda 21”, declared the desire of the world community for adopting the model of so-called “sustained development”, in which the needs of humankind would be satisfied with maximum preservation of the environment. In 1996 in Helsinki, the “Convention on the preservation and exploitation of transborder water streams and international lakes” was adopted. This was aimed at establishing all necessary measures for preventing, limiting and decreasing the degree of propagation of diseases connected with water in the complex systems of control of hydro-economic activity. The target of these measures is in its turn the sustained use of water resources, provision of water quality that does not threaten human health, and water system preservation. The statements of this convention are applicable for surface fresh water, underground water, estuaries, coastal waters used for recreational purposes, for fishery production by aquaculture methods and for collecting mollusks and crustaceans. Also, these statements are applicable for closed waters available for public swimming, and for water in the processes of diversion, transportation, purification, and supply, as well as for waste waters in the processes of discharge, transportation, purification, and repeat use. A non-commercial organization for development of international standards and certification named National Sanitary Foundation (NSF) was established in the USA in 1944. The sphere of NSF activity includes development of international standards accepted on a consensus basis, production testing and certification. The products certified by NSF include all types of appliances for purification of potable and waste waters, columns for potable water wells, all types of filters for water purification appliances and constructions, materials and equipment applied in water supply systems, in the drink production industry, and in enterprises of public catering, sanitary technological equipment, and all other connected with the public health protection. The NSF international standards and corresponding certification system is applied in USA, Canada, and countries of the European Community.

2.3. Regional standardization

The regional standardization in the framework of the European Community promoted development of common European standards, i.e. Euro norms (EN). The national standards of the countries that comprise the Community are widely used as the basis for the development of Euro norms. In particular, the standards of Germany (DIN), France (AFNOR), and international standards (ISO) are employed. When the indicated documents correspond to the interest, purposes and requirements of the European countries as a whole, they are accepted as European norms (EN).

The basic practical tasks in regional standardization in Western Europe are assigned to the European Committee on Standard Coordination (CEN) which was set up in 1961.

In addition to Euro norms, CEN develops preliminary standards (ENV), Harmonization Documents (HD) that should explain the essentials of the administrative and legal norms in the CEN member countries.

Nowadays, the following technical committees are active in the field of hydrosphere protection in the framework of the CEN (the countries executing secretariat works are indicated in parentheses):

- CEN/TC 7 – sanitary technical equipment (Italy);
- CEN/TC 34 – fittings for sanitary technical equipment of water conducting lines and canalization systems;
- CEN/TC 48 – gas operating household water heaters (France);
- CEN/TC 164 – water supply (France);
- CEN/TC 165 – drainage and canalization (Germany).

The Technical Committee CEN/TC 230 “Water Analysis” is organized in the CEN for performing works in the field of water quality control. A series of agreements is concluded between this Committee and ISO/TC “Water Quality” on the interaction, mutual operations and reduction of duplication in work on standardization.

In addition, the Inter Scandinavian Standardization Organization (INSTA), International Association of the Countries of South-East Asia (ASEAN), Committee Pan-American of Standards (COPAN), and Interstate Council of Country Members of the Community of Independent States (on the territory of the former USSR), etc. carry out regional standardization.

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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.

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