Experience of the Republic of Kazakhstan in standardizing requirements for the quality of wastewater treatment and regulating wastewater discharges from settlements with a centralized drainage system

Historical data on wastewater discharge regulation

The maximum permissible discharge (MAD) is the mass of a substance in wastewater, the maximum permissible for discharge with the established regime at a given point of a water body per unit of time in order to ensure water quality standards at the control point.

The MAD is established taking into account the maximum permissible concentration in places of water use, the assimilative capacity of the water body and the optimal distribution of the mass of discharged substances between water users discharging wastewater (GOST 17.1.1.01-77 "Nature conservation. Hydrosphere. Use and protection of water. Basic terms and definitions").

In Kazakhstan, and in other countries of the former USSR, the basis for standardizing the maximum permissible value is laid down in the "Instructions for standardizing emissions (discharges) of pollutants into the atmosphere and water bodies" (Approved by the Deputy Chairman of the USSR State Committee for Nature Protection V.F. Kostin on September 11, 1989 G.).

More than 30 years have passed since the approval of this instruction, but the principles of standardization have not changed.

Existing methodology for regulating wastewater discharges

According to the existing Methodology for determining emission standards into the environment (Order of the Minister of Ecology, Geology and Natural Resources of the Republic of Kazakhstan dated March 10, 2021 No. 63. Registered with the Ministry of Justice of the Republic of Kazakhstan on March 11, 2021 No. 22317), the values of permissible discharge standards are determined as the product of the maximum hourly wastewater flow water to the permissible concentration of pollutant for discharge.

When calculating the conditions for wastewater discharge, the value of the permissible discharge concentration (PDC) is first determined, ensuring the standard water quality at the control site, and then the permissible discharge (PD) is determined in the form of grams per hour (g/h) according to the formula:

$$PD=q \times SDS, \text{ g/h}$$

where q is the maximum hourly wastewater flow rate, cubic meter per hour (m3/h);

Questions regarding the regulation of wastewater discharges

Contradictions and shortcomings in the old MAD rationing system:

- **lack of consistency in the legislative framework and by-laws,**
- **lack of practice of a differentiated approach to standardization of the content of substances of natural origin in water bodies of various physical and geographical regions,**
- **the practical lack of connection between the standardization of MAD and the real economic and technological possibilities for their implementation,**
- **insufficiently substantiated MPC standards and, as a consequence, imperfection of existing MAD methods,**
- **departmental disunity in establishing, applying and monitoring standardized water quality indicators,**
- **a tendency towards expanding the lists of chemical indicators and, accordingly, increasing the cost of control for a more complete assessment of pollution in accordance with the accepted payment system.**

For example, when diverting part of a storage tank's effluent into rivers or for irrigation, the MPC for fishery water use (MPCfisheries) and the quality standards for irrigation water are taken as the MPC, respectively.

Questions regarding the regulation of wastewater discharges

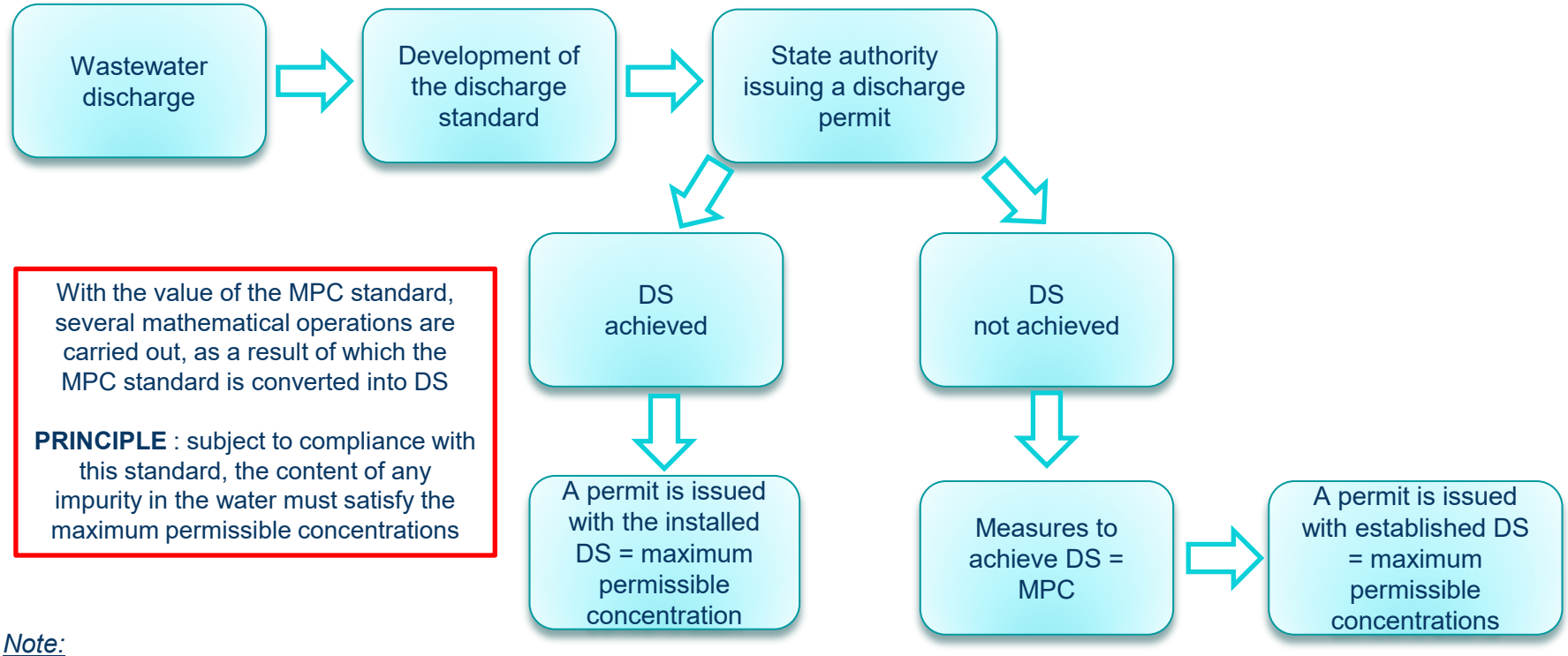
MPC of fishery reservoirs is based on a regulatory document from the times of the USSR - “Generalized list of maximum permissible concentrations (MPC) and approximately safe exposure levels (SAEL) of harmful substances for the water of fishery reservoirs / Fish stock. households of the USSR. Ch. ex. on the protection and reproduction of fish. stocks and regulation of fisheries (Glavrybvod). - M.: VNIRO, 1990.”

The document “Hygienic Standards for Safety Indicators of Household, Drinking and Cultural and Domestic Water Use” (Order of the Minister of Health of the Republic of Kazakhstan dated November 24, 2022 No. KR DSM-138. Registered with the Ministry of Justice of the Republic of Kazakhstan on November 25, 2022 No. 30713) provides the relevant MPCs for economic -drinking and cultural and domestic water use.

Irrigation water quality standards are given in the Technicla Standard of KAZ ISO 16075-2-2017 “Guidelines related to projects using treated wastewater for irrigation.”

All of the listed regulatory documents regulate the quality of water discharged after treatment facilities, and certainly influence the regulation of wastewater discharges.

Actual block diagram of the approval of discharge standards (DS) into water bodies



Note:

- The calculated DS is most often ignored by the government agency issuing a discharge permit, and DS = MPC is set;
- Environmental taxes are levied on the basis of discharges at and above the DS , with three types of payments: taxes on permitted discharges, fines for non-compliance, and a pollution damage fee of 10 times the amount.
- At the design and operation stage, the authorized state body can designate “special” requirements for the quality of normatively treated wastewater, requiring a level of treatment up to the MPC, while the level of pollutants specified by the MPC is unattainable even taking into account the best available technologies.
- DS are calculated on the basis of maximum permissible concentrations and do not take into account the environmental capabilities of self-purification of water basins.

Regulatory requirements for the transition to BAT and technological standardization

Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) – ratified by KAZ in 2000. Over the course of 20 years, a number of works have been carried out to meet the requirements of the Convention.

To comply with the requirements of the Water Convention, the Environmental and Water Code of the Republic of Kazakhstan, as well as from other legal acts developed as part of the harmonization of water legislation in Kazakhstan, a transition to standardization principles corresponding to the best available technologies for wastewater treatment in populated areas is necessary.

Additional documents:

- **Rules for the development of target indicators of environmental quality, including the minimum list of indicators for which target indicators of environmental quality are established**
- **Methodology for developing target indicators of water quality in surface water bodies and measures to achieve them**

In 2024, the BAT Handbook "Wastewater treatment of centralized drainage systems in populated areas" is being developed.

Regulatory requirements for the transition to BAT and technological standardization

The current Environmental Code of the Republic of Kazakhstan was adopted on January 2, 2021 No. 400-VI ZRK, according to the code regarding BAT and technological standardization there are the following articles:

Article 111. General provisions on integrated environmental permits

The presence of a comprehensive environmental permit is mandatory for objects of category I.

Operators of other facilities not specified in paragraph 1 of this article have the right to voluntarily obtain a comprehensive environmental permit if they have opinions approved by the Government of the Republic of Kazakhstan on the best available techniques for the relevant technological process or industry.

Article 217. Technological standards for discharges

For Category I objects, a comprehensive environmental permit, in addition to permissible discharge standards, establishes technological discharge standards.

Concept of the new Technical Standard of KAZ

NATIONAL STANDARD for standardizing the quality of wastewater discharges from treatment facilities in settlements with a centralized wastewater disposal system provides for:

I. Compliance:

the International Water Convention, the Environmental and Water Code of the Republic of Kazakhstan, as well as from other normative legal acts developed as part of the harmonization of the water legislation of the Republic of Kazakhstan on the transition to standardization principles corresponding to the best available technologies (BAT) for wastewater treatment in populated areas.

II. Transition to technological standardization:

The technological standard for permissible discharge is calculated based on the use of BAT and will lead to the fact that it will be possible to carry out all possible improvements in the quality of wastewater due to adequate requirements for its composition.

III. Incentivizing water users to switch to BAT

Apply coefficient 0 - for the volume of pollutant discharges within the limits of technological standards after the implementation of BAT at WWTP (coefficients subject to compliance: With MPC = 1; temporarily permitted discharges = 25; exceeding C MPC and technological standards = 100)

IV. Selection of BAT technology

Determination of technological processes, equipment, technical methods, methods as BAT for wastewater treatment at WWTPs carried out according to any official directories of near and far abroad (according to the Environmental Code of the Republic of Kazakhstan, 2007).

Concept of the new ST RK

BASIC PRINCIPLES OF BEST AVAILABLE TECHNOLOGY (BAT)

Generally recognized and most developed in relation to BAT is system environmental legislation adopted European union

NTD

the best	• lowest level of impact on the environment, resource and energy saving
available	• cost-effective, implemented at two or more WWTPs, technology available for delivery
technologies	• technological processes, technological methods, methods and equipment

BAT is a compromise, a search for a balance between the interests of environmental protection and the development of economic indicators at WWTPs. It represents the transition from over-regulation to realistic standards. Transition from fines to economic incentives for the development of wastewater treatment plants

Economic stimulation

Reset fee adjustment

- payment offset against investments 100%

Refusal to charge fees for negative impacts on water bodies after the implementation of BAT

- application of a reduction factor equal to zero

Accelerated depreciation of NDT equipment

- application of additional coefficient 2 when calculating depreciation on NDT equipment

Investment tax credit

- reimbursement of the interest rate on the loan through income tax

Concept of the new ST RK

RATING OF DISCHARGES under **BAT application conditions** :

For discharge from WWTP (biological treatment), the following indicators are established: suspended solids, COD, BOD, ammonium nitrogen, nitrate nitrogen, nitrite nitrogen, phosphate phosphorus.

- For specific substances, standards are established for subscribers (industrial enterprises).
- Biological treatment plants are not designed to treat specific pollutants.
- The construction of universal WWTPs requires expensive investments - preliminary local treatment of specific pollutants by subscribers is necessary.

II. Technological standards:

are installed based on technological indicators not exceeding technological indicators BAT (*Appendix B of the draft Standard*) or values of average annual concentrations determined on the basis of industrial environmental monitoring data in wastewater samples upon release into a water body .

III. Pollutants not related to technological standards:

are established by calculation based on MPC standards, taking into account the background state of the water body and in accordance with the current methodology for developing maximum permissible discharges (MPD).

IV. Water bodies covered by international treaties (agreements):

are applied in cases where the standards are stricter than the requirements of the Standard for similar substances (indicators), as well as in terms of requirements for other substances (indicators).

Concept of the new ST RK

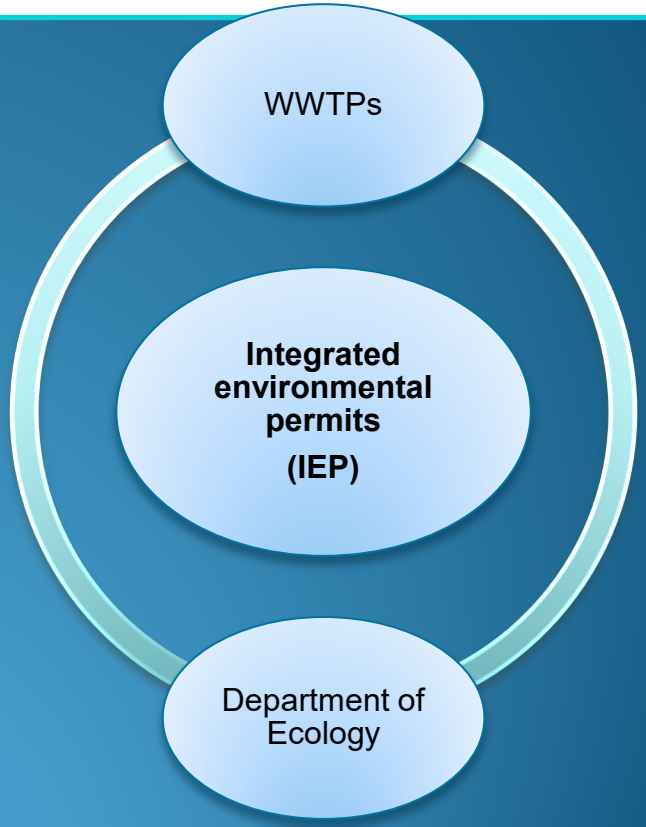
SYSTEM OF TECHNOLOGICAL STANDARDING OF EMISSIONS ACCORDING TO THE PRINCIPLE OF BAT

Technological standardization – determination of technological indicators and technological standards to reduce the impact on the environment based on the use of BAT.

The technological indicator of the technology used must be less than or equal to the technological indicator of BAT.

Technological standards

- BAT technologies included in the BAT Reference Document of the European Union and other countries
- Technological parameters of treatment facilities
- Marker substances characteristic of cleaning technology



Increase in payment coefficients: for temporarily permitted discharges K=25
for discharge exceeding permitted K=100

Conditions for the transition to technological standardization (BAT)

To determine BAT, it is necessary to select those technologies (technical measures, management decisions) that are the most effective in terms of achieving an overall high level of discharge of treated wastewater and environmental protection.

In practice, situations may arise in which it is not clear which technology will provide the highest level of environmental protection. Therefore, there is a need to conduct a preliminary assessment of technologies to select the technology that is the best.

Conditions for the transition to technological standardization (BAT)

For example, to select the best technology and equipment for treating contaminated wastewater with a complex chemical composition, the following requirements may be established:

Required wastewater treatment effect:

- **suspended solids – 95–98%;**
- **BOD_5 – 35–40%;**
- **COD – 70–75%;**
- **phenols – 35–40%.**

Basic (mandatory) subprocesses of the traditional full-cycle WWTP scheme:

- **mechanical cleaning;**
- **biological treatment;**
- **disinfection of purified water;**
- **sludge dewatering.**

Any technology that does not contain the above mandatory subprocesses is incomplete and insufficient.

At the vast majority of WWTPs, the main wastewater treatment process is biological treatment in aeration tanks, where technological levels of purification can be achieved.

An example of a methodology for calculating BAT technological standards

The main factor in calculating BAT for a particular release is the dilution factor of wastewater with the water of a water body, determined by the ratios of the flow rates of the water body and discharged wastewater, and the concentrations of substances in the water of the water body and in the wastewater discharged into it.

The value of BAT is determined by the formula:

$$TN_{NDTi} = q \times C_{TNNDT\,i} \quad (1)$$

where q is the estimated maximum hourly flow rate of wastewater at the outlet into the water body, m^3 / h (accepted based on actual or design materials);

S_{TNNDTI} - the value of the concentration of a pollutant in wastewater, ensuring the standard quality of water in a water body at the control site, mg/ dm^3 .

S_{TNNDTi} is determined by the balance equation:

$$C_{ТННДТi} = \frac{Q+q}{q}\left(ТП_{НДТi} - C_{Фi}\right) + C_{Фi} \quad (2)$$

where Q is the estimated water flow of the water body, m^3 / h

TPi - BAT technological indicator for pollutant discharges, mg/dm^3

$C_{Фi}$ - background concentration of the same substance in a water body before wastewater is released into it, mg/dm^3

An example of a methodology for calculating BAT technological standards

From (2) the ratio of flow rates or concentrations:

$$\frac{Q+q}{\mathrm{q}} = \frac{\mathrm{C_{ТННДТ}}i - \mathrm{C_{Ф}}i}{\mathrm{ТП_{НДТ}}i - \mathrm{C_{Ф}}i} = n \quad (3)$$

Formulas for determining C_{TNNDTI} taking into account dilution will take the form:

for conservative substances:

$$\mathrm{C_{ТННДТ}}i = \mathrm{C_{Ф}}i + n\left(\mathrm{ТП_{НДТ}}i - \mathrm{C_{Ф}}i\right) \quad (4)$$

for non-conservative substances:

$$\mathrm{C_{ТННДТ}}i = \mathrm{C_{Ф}}i + n\left(\mathrm{ТП_{НДТ}}i - \mathrm{C_{Ф}}i\right) \times e^{-kt} \quad (5)$$

where *n* is the total dilution factor.

***k* - coefficient of non-conservativeness , 1/sec;**

t is the time it takes for the flow to reach the control point, sec.

When calculating BAT technological standards for wastewater discharged to filtration fields and irrigation fields:

$$\mathrm{TN_{NDTi}} = n \times \mathrm{C_{Фi}} \quad (6)$$

where n is the dilution factor of filtered water in the groundwater flow.

Calculation of BAT technological standards for wastewater discharge into storage ponds, evaporation ponds, biological ponds is carried out according to the formula:

$$\mathrm{TN_{NDTi}} = \mathrm{C_{Фi}} + (\mathrm{ТПi} - \mathrm{C_{Фi}}) \times \mathrm{K_a} \quad (7)$$

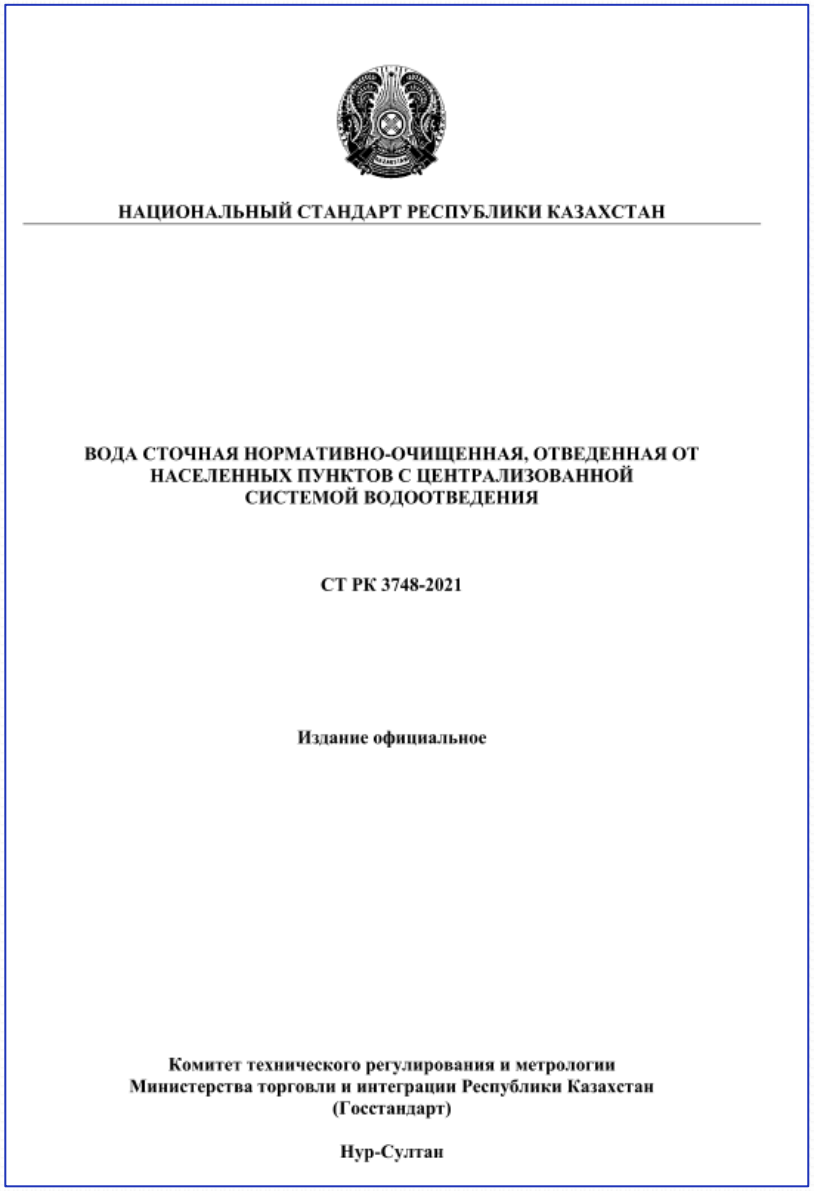
where K_a is a coefficient that takes into account the assimilating, evaporation, and filtering abilities of the storage tank.

BAT based on the traditional scheme of biological wastewater treatment

An example of the implementation of the best available technologies (BAT) at a WWTP on a traditional scheme of biological wastewater treatment to remove nitrogen and phosphorus can be:

- ***BNDBF technology*** **– biological nitri -denitrification with biological phosphorus removal. Removal of organic matter and suspended solids, nitrogen, phosphorus and nitrification process are achieved. Phosphorus removal efficiency may vary depending on the composition of the source water and a number of other factors . P allows you to remove organic contaminants with an efficiency of up to 96–98% - up to 5–8 mg/l, nitrogen compounds - up to 90%, total phosphorus - up to 90%, phosphorus phosphates - up to 95%.**
- ***BNDBF-A technology*** **is biological nitri-denitrification with biological phosphorus removal, additionally stabilized by acidification . Removal of organic matter, suspended solids, nitrogen, phosphorus and nitrification process are achieved. Phosphorus removal efficiency is stable and below 1 mg/L concentration.**
- ***BNDBHF technology*** **is biological nitri-denitrification with biological phosphorus removal, additionally stabilized by dosing reagents. Removal of organic matter, suspended solids, nitrogen, phosphorus and nitrification process are achieved. Phosphorus removal efficiency is stable and below 1 mg/L concentration.**

Composition and content of ST RK



НАЦИОНАЛЬНЫЙ СТАНДАРТ РЕСПУБЛИКИ КАЗАХСТАН

ВОДА СТОЧНАЯ НОРМАТИВНО-ОЧИЩЕННАЯ, ОТВЕДЕННАЯ ОТ НАСЕЛЕННЫХ ПУНКТОВ С ЦЕНТРАЛИЗОВАННОЙ СИСТЕМОЙ ВОДООТВЕДЕНИЯ

СТ РК 3748-2021

Издание официальное

Комитет технического регулирования и метрологии
Министерства торговли и интеграции Республики Казахстан
(Госстандарт)

Нур-Султан

The composition and content of the ST RK is as follows:

Preface

1 area of use

2 Normative references

3 Terms and definitions

4 Symbols and abbreviations

5 General provisions

6 Methodology for technological regulation of discharges

7 Discharge of wastewater from subscribers into centralized water disposal (sewage) systems

Appendix A (informational) Achievable technological indicators of marker substances at wastewater treatment stages

Appendix B (informational)

Appendix B (informational)

Appendix D (informational)

Bibliography

Ways of implementation

Based on the experience of the Republic of Kazakhstan, in order to solve problems related to the standardization of requirements for the quality of wastewater treatment and the regulation of wastewater discharges, the following steps must be taken:

1. Introducing changes to existing legislation in the field of wastewater disposal, specifically in terms of requirements for the quality of wastewater treatment and the regulation of wastewater discharges.
2. Development of the BAT reference book “Treatment of urban wastewater”.
3. Development of a standard for the transition to technological regulation using BAT.

BAT is the most effective and advanced stage in the development of wastewater treatment plants and wastewater treatment plants of industrial enterprises, which indicate the practical suitability of certain technologies in order to provide a basis for determining wastewater discharge limits intended to reduce impacts on the environment as a whole (Council Directive 96/61 / EC of 24 September 1996 concerning integrated pollution prevention and control).

The term " best" available technologies " (“best available technologies”) was defined in Article 2(11) of the Directive European Council dated 24.09.1996 96/61/EC “On integrated control and prevention pollution »

When developing a BAT Guide for urban wastewater treatment, reference books from the EU or other leading countries in the world can be taken as a basis.

Author: Ph.D. Amangeldy Dzhumagulov

- **Expert on regulation of pollutant discharges into water bodies**
- **International expert on water resources management International Visitors Leadership Programme (IVLP) USA**
- **Expert on water supply and sanitation issues at the Association of Environmental Organizations of Kazakhstan**
- **Expert of the Technical Committee 81 on standardization in the field of housing and communal services of the RSE "Kazakhstan Institute of Standardization and Metrology"**
- **Expert of the Scientific and Technical Council of the Committee for Construction and Housing and Communal Services of the Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan**

THANK YOU FOR YOUR ATTENTION!