



# URGANCH DAVLAT TIBBIYOT INSTITUTI JANUBIY OROLBO‘YI TIBBIYOT JURNALI

2 - TOM, 3 - SON. 2026

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## SCIENTIFIC BASES OF ECOLOGICAL AND HYGIENIC ASSESSMENT OF WASHING WATER FROM FILTERING PLANTS



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**Annotation:** The treatment of wash water generated during the operation of filtration facilities at water treatment plants is an important task. These waters contain a significant amount of pollutants, including suspended solids, organic matter, residual coagulants, and microorganisms. The purification of wash water from filtration facilities is an essential part of the technological cycle of water treatment at water supply stations.

**Keywords:** water treatment plants, wash water treatment, water supply

## НАУЧНЫЕ ОСНОВЫ ЭКОЛОГИЧЕСКОЙ И ГИГИЕНИЧНОЙ ОЦЕНКИ ПРОМЫТОЧНОЙ ВОДЫ С ФИЛЬТРУЮЩИХ УСТАНОВОК

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**Аннотация:** Очистка промывных вод, образующихся при эксплуатации фильтровальных сооружений водопроводных станций, является важной задачей. Эти воды содержат значительное количество загрязнений, включая взвешенные вещества, органику, остатки коагулянтов и микроорганизмы. Очистка промывных вод фильтровальных сооружений является важной частью технологического цикла водоподготовки на водопроводных станциях.

**Ключевые слова:** водопроводных станций, очистка промывных вод, водоснабжения



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## FILTRLASH QURILMALARIDAN OLINADIGAN YUVISH SUVINI EKOLOGIK VA GIGIYENIK BAHOLASHNING ILMIY ASOSLARI

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**Annotatsiya:** Suv ta‘minoti stansiyalarining filtrlash inshootlarini ishlatish jarayonida hosil bo‘ladigan yuvish suvlarini tozalash muhim vazifadir. Bu suvlarda katta miqdordagi ifloslantiruvchi moddalar, jumladan, muallaq moddalar, organik moddalar, koagulyant qoldiqlari va mikroorganizmlar mavjud. Filtrlash inshootlarining yuvish suvlarini tozalash suv ta‘minoti stansiyalarida suvni tozalashning texnologik jarayonining muhim qismidir.

**Kalit so‘zlar:** suv ta‘minoti stansiyalari, yuvish suvlarini tozalash, suv ta‘minoti

**INTRODUCTION.** The treatment of wash water generated during the operation of filtration facilities at water treatment plants is an important task faced by both designers and operational services. These waters contain a significant amount of pollutants, including suspended solids, organic matter, residual coagulants, and microorganisms [1,2,3,4]. Without proper treatment, such effluents cannot be reused or discharged into natural water bodies without causing environmental harm. The purification of wash water from filtration facilities is an essential part of the technological cycle of water treatment at water supply stations. During the filter backwashing process, accumulated contaminants are removed, resulting in the formation of large volumes of wastewater containing suspended solids, organic matter, colloids, and microorganisms [5,6,11]. Without adequate treatment, such water cannot be reused or discharged into water bodies. Therefore, the development and implementation of effective wash water treatment methods are of great importance for environmental protection, economic efficiency, and the sustainability of water supply systems [7,8,9,10,12].

*The aim of the study* is to examine the main methods of wash water treatment used in practice, as well as to emphasize their importance in the context of sustainable water supply.

As is well known, the filtration units at water treatment plants undergo regular backwashing, during which wash water is generated in an amount reaching up to 10% of the plant’s daily capacity. According to KMK 2.04.02–19 “Water Supply. External Networks and Facilities,” these waters should be returned to the headworks of the treatment facilities. However, in many cases, wash water is discharged without treatment into water bodies that serve as sources of domestic and drinking water supply [5]. At the same time, wash waters have not yet been sufficiently studied from a hygienic standpoint, and the degree of their potential hazard when discharged into water bodies or returned to the headworks of treatment facilities, as recommended by Sanitary Rules and Norms, remains unknown. Taking this into account, we conducted research focused on the toxicological and hygienic assessment of wash water

At the first stage of the research, the physicochemical properties of wash water were studied using the methods regulated by GOST 133.2024 “Drinking Water,” as well as by means of gas chromatography and atomic absorption flame spectrophotometry. The data obtained over a three-year observation period are presented in Table 1.

The results of our analytical studies indicate the specific composition of wash water. As shown in Table 1, these waters are characterized by a high content of suspended solids, elevated color, turbidity, and significant oxidizability. The concentrations of heavy metals did not exceed hygienic standards, with the exception of aluminum, whose levels were found to be tens of times higher than the maximum permissible concentration (MPC).



Table 1

Physicochemical and organoleptic indicators of wash water quality

Indicator	Value
Odor, score	2
Turbidity, mg/L	80.4
Color, degrees	55.6
Permanganate oxidizability, mg O <sub>2</sub> /L	76.5
Suspended solids, mg/L	500
Total hardness, mg-eq/L	8.0
Total dissolved solids (TDS), mg/L	200
Nitrates, mg/L	0.05
Chlorides, mg/L	9.0
Sulfates, mg/L	20.0
Aluminum, mg/L	17.0

The presence of residual chlorine and increased color suggested the possible formation of organochlorine compounds, particularly halomethanes. Indeed, halomethanes were detected in concentrations not exceeding the regulatory limits established by the Ministry of Health of the Republic of Uzbekistan for chemical substances.

Given the nature of wash water formation, their high oxidizability, turbidity, and color, as well as the possible presence of other chemical compounds—including transformation products (besides halomethanes) that cannot be detected by standard analytical methods—the only reliable way to assess the potential hazard of wash water is through experiments on warm-blooded animals [4,8]

When planning such an experiment, it was considered appropriate to focus on the aluminum content in the wash water — as a consistently present and measurable element on one hand, and as a toxic agent on the other. In practice, this was implemented by providing the animals in the experimental group (white rats) with wash water diluted with drinking tap water to reach the maximum permissible concentration (MPC) for aluminum (0.5 mg/L). The animals in the control group received only tap water under the same conditions. The background aluminum content in the tap water used for dilution was also taken into account. Additionally, attention was paid to the quality of the diluted wash water, including its organoleptic properties.

It was found that, despite achieving the regulatory aluminum concentration, the diluted wash water did not exceed the turbidity limits established by National Standart 133.2024 “Drinking Water”, with average values of 4–5 mg/L.

Throughout the eight-month chronic experiment, the daily water intake, behavior, and body weight gain of both experimental and control animals were monitored. After recording baseline parameters, the condition of peripheral blood (erythrocyte and leukocyte counts, hemoglobin level), enzyme activity (cholinesterase, alanine and aspartate aminotransferases, aldolase, peroxidase, and alkaline phosphatase), as well as the content of histamine, sulfhydryl groups, urea, and cholesterol in blood serum were studied monthly.

At the end of the chronic experiment, the animals were sacrificed. The functional state of spermatozoa was studied (motility duration, osmotic resistance, presence of pathological forms, and total count). The mass coefficients of internal organs (liver, kidneys, spleen, adrenal glands, and testes) were determined, as well as the activity of cholinesterase and the amount of histamine in the tissues of internal organs. Histological examinations of internal organ tissues were also carried out. The experimental data were processed using standard methods of parametric and non-parametric statistics.



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The results of the chronic experiment indicate that wash water, when diluted to the maximum permissible concentration (MPC) for aluminum, did not exhibit toxic effects on the organism of warm-blooded animals. No statistically significant differences were found compared to the control group for the majority (11) of the analyzed indicators. The minor changes observed at certain stages of the experiment were sporadic and generally remained within the physiological range characteristic of this animal species.

**DISCUSSION.** In parallel with the assessment of the general toxic effects of the wash water, special experiments were conducted to study the possible long-term consequences of exposure—namely, mutagenic (by the method of induction of dominant lethal mutations), embryotoxic, and gonadotoxic effects. It was established that the diluted wash water did not produce embryotoxic or gonadotoxic effects. There were no significant differences from the control group in terms of total, preimplantation, and postimplantation fetal mortality. Morphometric parameters of the testes in experimental animals (such as the number of normal spermatogonia, seminiferous tubules with exfoliated epithelium, or at the 12th stage of meiosis) did not differ from those of the control group. Likewise, indicators characterizing the functional state of spermatozoa (motility duration, osmotic resistance, and total count) showed no deviations from control values.

The absence of a gonadotoxic effect in the wash waters is direct evidence that aluminum — whose distinctive feature is its effect on the gonads — is present in the diluted wash waters at concentrations that do not cause a specific effect and therefore do not exceed the maximum permissible concentration (MPC), as established by analytical methods.

At the same time, the method of inducing dominant lethal mutations revealed that wash waters diluted to the MPC for aluminum exhibit a mutagenic effect (Table2).

It should be noted that there is a statistically significant difference from the control in such important indicators as embryonic mortality, the number of corpora lutea of pregnancy per female, implantations, and dead fetuses, which indicates a sufficiently pronounced mutagenic effect.

Thus, the analysis of the research results indicates that the wash waters from filtration facilities, when diluted to the maximum permissible concentration (MPC) for aluminum, fail to meet regulatory standards in only one parameter—turbidity. However, it has been established that these waters are capable of impairing reproductive function when chronically introduced into the bodies of warm-blooded animals. Therefore, turbidity, in relation to wash waters, should be considered not only as an organoleptic parameter but also as an indicator of potential hazard. This circumstance must be taken into account primarily when developing recommendations for the reuse of wash waters in water supply practice.

Table 2

Results of the study of the mutagenic effects of wash water (M±m)

Number of live fetuses per female Number of dead fetuses per female	Animal group	
	Control	experimental
Implantations	11,55±0,3	12,2±0,1
Corpora lutea	0,45±0,03	1,65±0,4
Preimplantation loss, %	11,77±0,4	13,01±0,55
Postimplantation loss, %	12,08±0,35	13,77±0,45
Total embryonic loss, %	7,01±1,08	7,10±2,55
Fetal weight, g	4,55±2,05	14,09±4,77
Fetal size, mm	9,90±3,44	20,06±3,44
Placental weight, g	5,67±0,44	5,54±0,33
Placental size, mm	40,6±2,05	40,7±0,87
Number of live fetuses per female	1,06±0,99	1,07±0,21
Number of dead fetuses per female	16,9±0,33	18,22±0,20



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On the other hand, when assessing the harmful effects of wash waters discharged into water bodies, one should be cautious in relying solely on their aluminum concentration, bearing in mind that achieving the regulatory level of aluminum in a water body does not necessarily ensure safe conditions for water use. Monitoring the potential harmful effects of wash waters discharged into water bodies based on turbidity is, for obvious reasons, not applicable. Considering all of the above, as well as the large volumes of wash waters generated at water treatment plants, the question arises as to the admissibility of discharging untreated wash waters from filtration facilities into water bodies that serve as sources of domestic and drinking water supply. It is therefore necessary to treat these waters both before their discharge into water bodies and prior to their subsequent reuse in domestic and drinking water supply systems

**CONCLUSION.** The problem of treating wash waters from filtration facilities is relevant from both ecological and technological perspectives. During the backwashing of filters at water treatment plants, wastewater is generated that contains a considerable amount of contaminants, including suspended solids, organic matter, residual reagents, and biological components. Without proper treatment, such waters cannot be discharged into natural water bodies or reused. Current practice demonstrates that the most effective approach to addressing this issue is the integrated application of various treatment methods, such as mechanical sedimentation, coagulation and flocculation, filtration, and, when necessary, membrane and biological technologies. The choice of a specific treatment scheme depends on the composition of the wash waters, the required purification level, the plant's capacity, and economic considerations.

At present, particular importance is attached to the possibility of reusing treated wash waters. This approach not only conserves resources by reducing the consumption of fresh water but also minimizes negative impacts on the environment. The most promising directions for reuse include returning the treated water to the initial stages of water treatment, reusing it for filter backwashing, and utilizing it for technical purposes within the plant itself.

Thus, the implementation of effective technologies for the treatment and recycling of wash waters contributes to:

- reducing operational costs;
- improving the environmental situation;
- extending the service life of equipment;
- enhancing the overall sustainability of water supply systems

Under the conditions of increasingly stringent environmental regulations, rising water use tariffs, and growing shortages of fresh water, the task of utilizing and reusing wash waters becomes not merely desirable but essential. Therefore, the further development and implementation of innovative solutions in this field will play a crucial role in the advancement of water supply systems at both local and global levels

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