

BIOLOGICAL TREATMENT OF WASTE WATER OF FOOD INDUSTRY ENTERPRISES

(In the case of Kokan bread factory)

Ismailkhodjaev B. Sh

National Research University "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers", Doctor of Biological Sciences, Professor, Department "Ecology and Water Resources Management", 100000, Tashkent, Qori Niyoziy. 39, Uzbekistan

Kholmirzaeva B. A.

Peoples' Friendship University named after academician A. Kuatbekov, Candidate of Biological Sciences, Associate Professor, Department of "Chemistry and Biology", 100067, Shymkent, Tole bi st. 32, Kazakhstan

Eskaraev N. M.

Central Asian Innovation University, Department of Chemistry, Biology-Ecology, Candidate of Biological Sciences, Associate Professor. Shymkent, Kazakhstan

Muminova Sh. S.

J. Tashenov University, Department Chemistry, Biology.
Phd Senior Lecturer. Shymkent, Kazakhstan

Abduraimova N. Sh

J. Tashenov University, Department Chemistry, Biology.
Senior Teacher, Shymkent, Kazakhstan

Turdaliyeva S. R.

National Research University "Tashkent Institute of Irrigation and Agricultural Mechanism Engineers"

Abstract:

In this article, we explore the world of industrial wastewater biological treatment and explore innovative strategies and emerging technologies to improve its efficiency. By addressing these challenges and implementing advanced solutions, the industry will not only meet stringent regulatory requirements, but also ensure a cleaner and more sustainable future for us. The treatment of wastewater from a bread production plant with the help of pistachio plant (*Pistia Stratiotes L*) was studied and the efficiency of biological treatment of wastewater was studied. The pistachio plant is used as an additional feed and fattening is observed in animals such as sheep and cows that are raised for consumption. The pistachio plant has been proven to be natural and harmless. Biological treatment is one of the most economically acceptable methods of wastewater treatment, and this method is proven in the article based on laboratory results, the

cultivation of aquatic plants, and the use of them. The daily average growth of pistachio biomass in the wastewater of Dangara bread production industry is 900-1300 g/m², in the diet of agricultural animals and poultry after thermal treatment of the biomass of high water plants grown in wastewater it is recommended to use it as a bio-additive.

Keywords: higher aquatic plants, microorganisms, wastewater treatment, microscopic algae, fouling, *Pistia Stratiotes L*, chemical composition of wastewater, physical composition of wastewater, treatment efficiency.

Introduction:

In a world increasingly conscious of environmental sustainability and resource conservation, the management of industrial wastewater has emerged as a critical challenge. As industries continue to grow and diversify, the volume and complexity of pollutants released into our waterways have surged, posing grave threats to aquatic ecosystems and human health. In this context, biological treatment methods have risen to prominence as a sustainable and effective solution for mitigating the adverse impacts of industrial effluents [1–3].

Biological treatment harnesses the power of nature's microorganisms to break down and remove contaminants from wastewater, transforming it into a less harmful or even reusable resource. This eco-friendly approach has gained traction in recent years for its potential to not only reduce the environmental footprint of industrial operations but also to minimize operational costs. However, the efficiency of biological treatment processes remains a pressing concern, with several challenges and limitations hindering their full potential [4–6].

Level of study of the problem: Biological processes comprising bacteria, fungi, yeast, and algae received increasing interest for dye degradation due to their cost-effectiveness and eco-friendly nature [7,8]. The batik industry is the heritage of Malaysia and some Southeast Asian countries; hence, maintaining this industry is essential to sustaining this valuable asset. However, from the process involved in this industry another environmental pollution issue has emerged that needs to be resolved. Conventional and existing treatments are unable to decrease contaminant levels in batik wastewater to the permitted level. A costly problem arises from the existing treatment [9].

When direct wastewater biological treatment is unfeasible, a cost- and resource-efficient alternative to direct chemical treatment consists of combining biological treatment with a chemical pre-treatment aiming to convert the hazardous pollutants into more biodegradable compounds. Whereas the principles and advantages of sequential treatment have been demonstrated for a broad range of pollutants and process configurations, recent progresses (2011–present) in the field provide the basis for refining assessment of feasibility, costs, and environmental impacts [10,11].

Biological wastewater treatment systems are often affected by shifts in influent quality, including the input of toxic chemicals. Yet the mechanisms underlying the adaptation of activated sludge process performance are rarely studied in a controlled and replicated experimental setting, particularly when challenged with a sustained toxin input. Three replicate bench-scale bioreactors were subjected to a chemical disturbance in the form of 3-chloroaniline (3-CA) over 132 days, after an acclimation period of 58 days, while three control reactors received no 3-CA input. Ammonia oxidation was initially affected by 3-CA. Within three weeks of the experiment, microbial communities in all three treatment reactors adapted to biologically degrade 3-CA resulting in partial ammonia oxidation recovery [12–16]. Wastewater treatment plants (WWTPs) are a major source of micropollutants to surface waters. Currently, their chemical or biological monitoring is realized by using grab or composite samples, which provides only snapshots of the current wastewater composition. Especially in WWTPs with industrial input, the wastewater composition can be highly variable and a continuous assessment would be advantageous, but very labor and cost intensive. A promising concept are automated real-time biological early warning systems (BEWS), where living organisms are constantly exposed to the water and an alarm is triggered if the organism's responses exceed a harmful threshold of acute toxicity. Currently, BEWS are established for drinking water and surface water but are seldom applied to monitor wastewater [17–20].

It is possible to establish a wide-scale cultivation of aquatic plants by monitoring the growing areas of these plants through remote sensing methods. In this case, the use of GIS technologies (ArcGIS, ENVI) is appropriate for monitoring plants [18,21–23].

Research objects: Bread manufacturers operating in Fergana region.

Research Methods:

Effluent samples were taken from specific areas of the biological pond in accordance with the calendar plan of research in 2021-2022. Temperature, color, smell of wastewater at a depth of 10-15 cm based on Stroganov, Buzinova methods; Ph, dissolved oxygen content, KBBT5, oxidation, KBKT, nitrates, chlorides were determined according to the methods of Y.Y. Lure.

Content of the method. The method is based on the boiling of substances in 0.01 normal potassium permanganate and sulfuric acid medium. Oxidation of up to 10 mg of oxygen can be determined in 1 l of water without impurities. The interfering effect of chloride, if their concentration has increased to 300 mg/l, is eliminated by adding 0.4 g of mercury (II) sulfate. Iron, hydrogen sulfide, sulfides and nitrites are determined separately, and the result obtained from the oxidation calculation is subtracted from the oxidation of the water found: 1 mg of hydrogen sulfide requires 0.47 mg of atomic oxygen, 1 mg of nitrite-0.35 mg, 1 mg of iron-0, Requires 14 mg of atomic oxygen.

Results and Discussions

The pistachio fruit is a dry, unopened fruit with many seeds. The seeds are long-cylindrical (1.5-3 mm) and the weight of 1000 seeds is 2.1-2.2 g.



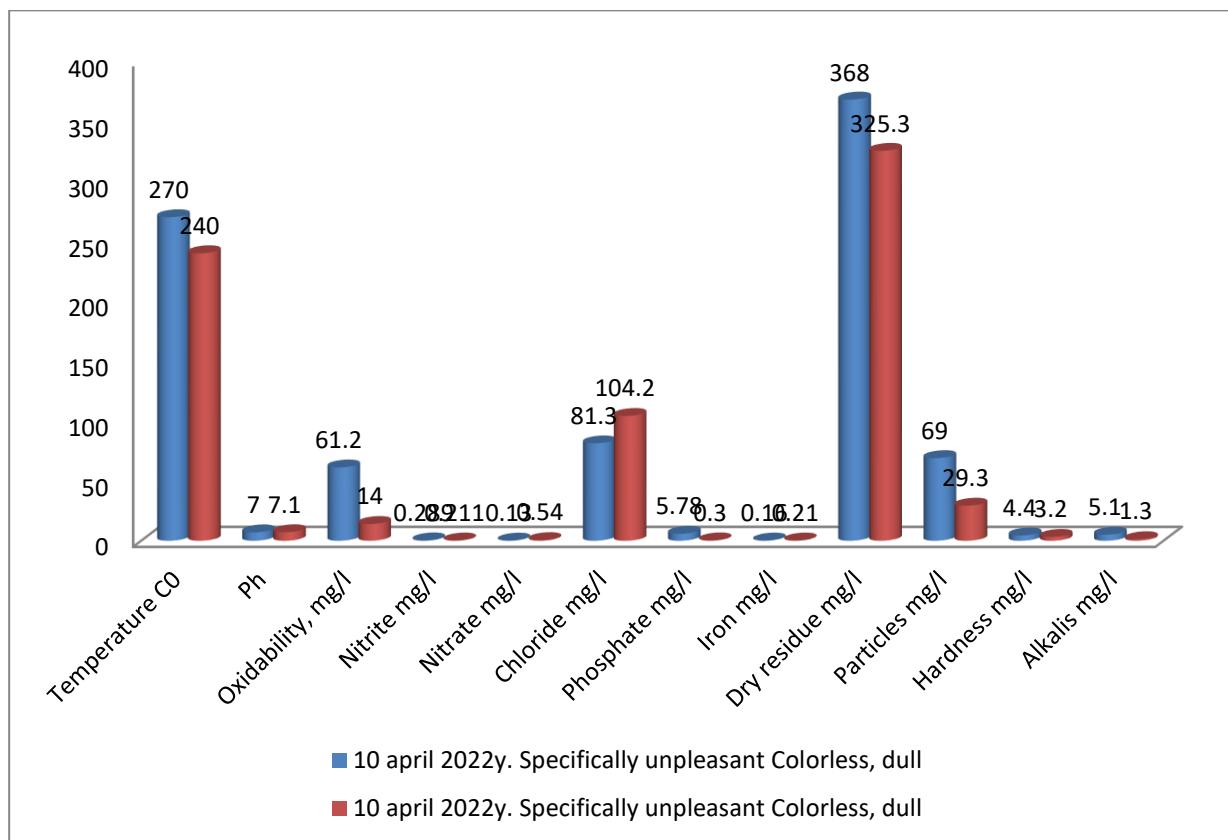
Picture 1. General view of pistachios grown in laboratory conditions.



Picture 2. Breeding of aquatic plants in greenhouse conditions in winter.

Pistia reproduces vegetatively with the help of a stolon, which is formed in the leaf axil. A new growth is formed at the edge of the stolons. A young plant usually has 4 leaves on the growth cone. During the growing season, 4-5 circles can be formed on one plant. Different substances are biochemically oxidized at different rates. Professor V.T. According to Caplin, easily oxidized—"biological softeners" include: formaldehyde, low aliphatic alcohols, phenol, furfural, and others. Their oxidation rate constant (K) is 1.4-0.30 min^{-1} . The middle place (K 0.30-0.05 min^{-1}) is occupied by cresol, naphthol, xylanol, resorcin, pyrocatechin, pyrogallol, anioactive PAV and others. Slow-degrading

- "biologically corrosive" substances (K 0.029-0.002 sut-1) are hydroquinone, sulfanol, NP-1, nonionic PAV, etc. Taking this into account, biochemical oxidation is short (2-3 days) and 15-20 the extension to the day may last longer in some cases. Therefore, it is necessary to monitor the CBT process until the depletion of dissolved oxygen in the sample stops, and this CBT is complete (only biochemically non-oxidizable bonds remain in the water).



1- Graph. Chemical composition of Dangara bakery wastewater before and after growth of aquatic plants (April 10, 2022).

Removal of excess active chlorine is required prior to analysis of river waters treated with chlorine scavenging reagents and contaminated with sewage. In this case, the water is dechlorinated for 1 hour. If there is a lot of active chlorine in the water, it is regenerated with sodium sulfite. The required amount of sodium sulfite is determined from the fraction of water extracted separately, to which 10 ml of 10% potassium iodide, a more acidic mixture, iodine separated by adding starch is determined by titration in 0.02 normal sodium sulfite. The temperature of the analyzed water should be 200C. The BOD (biological oxygen demand) indicator of water is found according to the

following formula:
$$X = \frac{(A1 - B1) - (A2 - B2)}{V} \cdot 1000 \quad (2.2)$$

end

$$X = (A1 - B1) - (A2 - B2) \cdot n \quad (2.3)$$

where: A1 is the concentration of dissolved oxygen in the sample at the beginning of incubation (day zero) in mg/l.

A2 - the concentration of dissolved oxygen in the solvent water added to the sample at the beginning of incubation (day zero) mg/l.

B1 - concentration of dissolved oxygen in the sample at the end of incubation mg/l.

B2 - at the end of incubation, the concentration of dissolved oxygen in the solvent water added to the sample is mg/l.

V - volume of the sample to be determined, ml when distributed to 1 l.

n - propagation duration.

Table 1. Chemical composition of the biomass of higher aquatic plants grown in the wastewater of the Dangara bread production industry (in % of absolute dry mass).

Plant type	Moisture %	Protein %	Fat %	Kletchatka %	Ash %	carotene, mg/kg
Pistia	8,0± 0,3	21,1± 0,71	2,65± 0,07	27,5± 0,94	5,43± 0,13	23,68± 0,74

According to these data, pistachio biomass grown in the wastewater of Dangara bakery has an average of 21.1% protein, 2.65% fat, 27.5% fiber, 8.0% moisture, 5.43 % ash, 23.68 mg/kg. It was found that carotene is present, one kilogram of pistachio biomass contains 0.40 nutrient units (exchangeable energy is 59.13 kcal).



Picture 3. Pistachio grown in bioponds of Dangara bread production industry.

Problems related to wastewater, polluting the environment is a big concern. This pollution is mainly caused by the high chemical oxygen demand present in dyes and wastewater. Here are some potential solutions and considerations for addressing this environmental issue:

Natural Adsorbents: Using natural adsorbents such as activated carbon, zeolites, or even agricultural waste products like coconut shells can help in adsorbing dyes and other pollutants from wastewater. These materials can be an eco-friendly and cost-effective way to reduce contaminant levels.

Constructed Wetlands: Constructed wetlands are an excellent option for biological treatment of wastewater. They are designed to mimic natural wetland ecosystems and can effectively remove pollutants through processes like microbial degradation and plant uptake. A two-stage constructed wetland system can provide enhanced treatment capabilities. **Monitoring and Regulation:** It's important for governments and environmental agencies to establish and enforce regulations regarding the discharge of wastewater from the batik industry. Regular monitoring of wastewater quality and compliance with regulations can help mitigate the pollution problem.

Research and Innovation: Continual research and innovation are essential to improving treatment methods for batik wastewater. This includes exploring new adsorbents, optimizing treatment processes, and developing eco-friendly dyes and dyeing processes that generate less pollution. **Public Awareness:** Raising awareness among producers and the general public about the environmental impact of the industry can encourage responsible practices. Sustainable and eco-friendly batik production methods can help reduce the pollution burden. **Collaboration:** Collaboration between government agencies, the industry, environmental experts, and researchers is crucial for finding sustainable solutions to the pollution issue. Funding and support for research and development in this field can lead to innovative and effective treatment methods.

In conclusion, addressing the environmental pollution associated with the industry is essential to preserve this cultural heritage while safeguarding the environment. An integrated approach that combines natural adsorbents and constructed wetlands, along with effective regulation and ongoing research, can contribute to resolving this issue and ensuring the sustainability of the batik industry.

Table 2. Productivity of aquatic plants grown in the wastewater of the Dangara bakery (field experiments, August, April 2021-2022)

Experience Options	Duration of experiments, day	Wet biomass,g/m ²				Biomass growth at the end of the experiment	
		at the beginning of the experiment	at the end of the experiment	Daily growth			
				gr	%	gr	%
Waste water + pistachio	10	4kg	10.5kg	71,2	8,9	712	89,0
Waste water + pistachio	10	8 kg	17 kg	87,1	97,2	871	97,2

A model scheme of the technology of accelerating the purification of wastewater of the bread production plant with the help of high-water plants has been developed.

Water purified with the help of aquatic plants in biological ponds.		
in fisheries	can be used for irrigation of agricultural crops and trees	can be used as technical water in industrial enterprises
Biomass of aquatic plants grown in biological ponds		
in fisheries Feeding herbivorous fish (carp, carp, etc.).	In poultry farming When feeding chickens, turkeys, etc	
Preparation of protein-vitamin and mineral feed from dried biomass (pistachio).	Wet biomass of pistachios can be used to produce biogas, biodiesel, and bioethanol, as well as greening ponds in parks.	
In industry it can be used to get paper, detergents.	In medicine pistia biomass is used to treat gonorrhea in Malaysian medicine, gonorrhea in India, and skin diseases in China.	

Conclusions:

Scientific and practical research on the comprehensive study of aquatic plants to determine their diversity in nature and the use of their biomass in various branches and sectors of the national economy through artificial reproduction it is necessary to carry out. Before using aquatic plants in the biological treatment of waste water, it is advisable to select a type of aquatic plants that is suitable for this water, resistant and actively absorbs harmful substances in this water.

Dangara receives wastewater from the bread factory and the volume of wastewater is 1900 m³ per day. In order to reduce the harmful effects of wastewater on nature, scientific researches were conducted using modern methods. This bakery has been accepted as an object, and further improvement of the technology of wastewater treatment from the bakery is one of the most important tasks to be fulfilled today. It is mentioned in the above literature that pistachio grows well in waters rich in organic substances, and it is also shown that these plants can be used as feed for animals. Physico-chemical parameters of wastewater were measured by known methods before and after cultivation of aquatic plants.

The chemical composition of the effluents of the Dangara bread production industry before and after the growth of pistachios was studied.

- The characteristics of growing aquatic plants in the wastewater of the Dangara bread production industry were determined.

- When growing aquatic plants in wastewater, it was found that the amount of dissolved oxygen in them increased, KBS5 and KKS decreased, the sanitary-biological condition improved, and the processes of purification from organic and mineral substances accelerated.
- The daily average growth of pistachio biomass in the wastewater of Dangara bread production industry is 900-1300 g/m², in the diet of agricultural animals and poultry after thermal treatment of the biomass of high water plants grown in wastewater it is recommended to use it as a bio-additive.
- For the first time, the biomass of aquatic plants grown in the wastewater of the Dangara bread production industry was chemically analyzed.
- A sample scheme of the technology of accelerating the purification of waste water of industrial and communal enterprises (as an example of the Dangara bread industry) using high-water plants has been developed.

REFERENCES

Gogate P R and Pandit A B 2004 A review of imperative technologies for [1] wastewater treatment I: Oxidation technologies at ambient conditions Advances in Environmental Research 8 501–51

Aksu Z 2005 Application of biosorption for the removal of organic pollutants: A [2] review Process Biochemistry 40 997–1026

Banat I M, Nigam P, Singh D and Marchant R 1996 Microbial decolorization of [3] textile-dye-containing effluents: A review Bioresource Technology 58 217–27

Appels L, Baeyens J, Degrève J and Dewil R 2008 Principles and potential of [4] the anaerobic digestion of waste-activated sludge Progress in Energy and Combustion Science 34 755–81

Ahmad A, Mohd-Setapar S H, Chuong C S, Khatoon A, Wani W A, Kumar R and [5] Rafatullah M 2015 Recent advances in new generation dye removal technologies: Novel search for approaches to reprocess wastewater RSC Advances 5 30801–18

Meng F, Zhang S, Oh Y, Zhou Z, Shin H-S and Chae S-R 2017 Fouling in [6] membrane bioreactors: An updated review Water Research 114 151–80

Li W, Zhao S, Yan Y, Biney B W, Zhang D, Al-shiaani Nabil H A, Chen K, Guo A [7] and Xia W 2023 High-efficiency desulfurization adsorbents loaded with uniformly dispersed nano-metal particles prepared from phytoremediation Journal of Environmental Chemical Engineering 11

Samuchiwal S, Naaz F, Kumar P, Ahammad S Z and Malik A 2023 Life cycle [8] assessment of sequential microbial-based anaerobic-aerobic reactor technology developed onsite for treating textile effluent Environmental Research 234

Egamberdiev N B, Sharipjonova Z, Nasibov B, Khomidov A O, Alimova M I and [9] Abdumalikov A A 2021 Biological treatment of industrial and domestic wastewater of a brewery in Uzbekistan E3S Web of Conferences 264

Ismailkhujaev B and Abdukodirova M 2020 Assessment of the effectiveness of [10] biological treatment wastewater at “binokor” aeration station located at Urta Chirchik district of Tashkent region IOP Conference Series: Materials Science and Engineering 883

Abduqodirova M and Ismoilkhodjayev B 2021 Treatment of polluted municipal [11] wastewater in Tashkent E3S Web of Conferences 264

Seshan H, Santillan E, Constancias F, Chandra Segaran U S, Williams R B H and [12] Wuertz S 2023 Metagenomics and metatranscriptomics suggest pathways of 3-chloroaniline degradation in wastewater reactors Science of the Total Environment 903

Aghazadeh M, Hassani A H and Borghei M 2023 Application of photocatalytic [13] proxone process for petrochemical wastewater treatment Scientific Reports 13

Cardozo J C, Barbosa Segundo I D, Galvão E R V P, da Silva D R, dos Santos E [14] V and Martínez-Huitle C A 2023 Decentralized environmental applications of a smartphone-based method for chemical oxygen demand and color analysis Scientific Reports 13

Aziz S and Abdel-Karim A 2023 Dual-functional ultrafiltration biocatalytic [15] membrane containing laccase/ nanoparticle for removal of pollutants: A review Environmental Nanotechnology, Monitoring and Management 20

Lasaki B A, Maurer P and Schönberger H 2023 Effect of coupling primary [16] sedimentation tank (PST) and microscreen (MS) to remove particulate organic carbon (POC): a study to mitigate energy demand in municipal wastewater treatment plants Sustainable Environment Research 33

Kizgin A, Schmidt D, Joss A, Hollender J, Morgenroth E, Kienle C and Langer [17] M 2023 Application of biological early warning systems in wastewater treatment plants: Introducing a promising approach to monitor changing wastewater composition Journal of Environmental Management 347

Muzafarov S M, Tursunov O, Kodirov D, Togaev B K, Balitskiy V E, Babayev A [18] G, Kilichov O G, Nasibov B R and Allenova I V 2020 Features of streamer form of corona discharge in respect to electric gas purification IOP Conference Series: Earth and Environmental Science 614

Joseph T M, Al-Hazmi H E, Śniatała B, Esmaeli A and Habibzadeh S 2023 [19] Nanoparticles and nanofiltration for wastewater treatment: From polluted to fresh water Environmental Research 238

Gualtieri M, Goglio A, Clagnan E and Adani F 2023 The importance of the [20] electron acceptor: Comparison between flooded and tidal bioelectrochemical systems for wastewater treatment and nutrients enriched solution production Bioresource Technology Reports 24

Abdullaev B D, Razzakov R I, Okhunov F A and Nasibov B R 2023 Modeling of [21] hydrogeological processes in irrigation areas based on modern programs E3S Web of Conferences 401

Nasibov B R, Polevshikova Yu A, Xomidov A O and Nasibova M R 2023 [22]
Monitoring of land cover using satellite images on the example of the Fergana Valley of

Uzbekistan AIP Conference Proceedings 2612

Abdukadirova M N, Ismailxo'jaev B Sh and Abdukadirova K B 2023 Study of [23]
biological treatment of domestic and municipal wastewater using microscopic algae E3S
Web of Conferences 401