European Journal of Emerging Technology and Discoveries
ISSN (E): 2938-3617
Volume 2, Issue 4, April - 2024

THE PROCESS OF WASTEWATER TREATMENT BY PHYSICAL-CHEMICAL METHODS

Salohiddinov Fayzulloh Fazliddin o'g'li
Assistant, Andijan Machine-building Institute
E-mail: salohiddinovfayzulloh60@gmai.com,
Phone: +99 8(99)326-09-88

Abstract
Wastewater treatment through physical-chemical methods stands as a cornerstone in the preservation of environmental integrity and public health. This abstract provides a concise overview of the process, elucidating its key components and objectives. Beginning with coagulation and flocculation, wherein chemical agents induce the aggregation of contaminants, the process progresses to sedimentation, filtration, and adsorption, each stage targeting specific pollutants for removal. Finally, disinfection ensures the elimination of harmful microorganisms, rendering the treated water safe for discharge or reuse. Through a synergistic combination of physical and chemical mechanisms, wastewater treatment embodies a vital nexus of science, engineering, and environmental stewardship, safeguarding water resources for present and future generations.

Keywords: Wastewater treatment, Physical-chemical methods, coagulation, sedimentation, adsorption, disinfection, coagulation, extraction, distillation, concentration, ion exchange, flocculation, flotation.

Introduction

Wastewater treatment through physical-chemical methods stands as a pivotal solution in addressing the burgeoning challenges of water pollution. This process harnesses a combination of physical processes, such as coagulation and sedimentation, alongside chemical techniques like adsorption and disinfection, to effectively remove contaminants from wastewater. By targeting suspended solids, dissolved pollutants, and harmful microorganisms, physical-chemical methods ensure the production of treated water that meets stringent quality standards. This introduction sets the stage for a comprehensive exploration of the intricate yet indispensable process of wastewater treatment, underscoring its significance in safeguarding both environmental health and human well-being. Contaminated water contains particles of different sizes which can be classified as dissolved (< 0.08 μm), colloidal (0.08 - 1 μm), supracolloidal (> 100 - 100 mm) and settleable (> 100 μm) (1 and 2). The type of treatment selected depends on the size of particles present in the wastewater. In practice, treatment efficiency also depends on particle size. Solids of the size that are visible to the naked eye can be separated either by settling under the influence of gravity or by flotation, depending on the relative densities of solids and water. They may also be easily separated by filtration. However, very fine particles of a colloidal nature (called colloids, size < 1 μm) which have high stability are significant pollutants. The reason for this stability is that these particles have electrostatic surface charges of the same sign (usually negative). This means that repulsive forces are created between them, preventing their aggregation and subsequent settling. It has therefore proved

impossible to separate them by settling or flotation. It is not possible to separate these solids by filtration because they pass through any filter. However, separation by physico-chemical treatments is possible. Physico-chemical treatment of wastewater focuses primarily on the separation of colloidal particles. This is achieved through the addition of chemicals (called coagulants and flocculants). These change the physical state of the colloids allowing them to remain in an indefinitely stable form and therefore form into particles or flocs with settling properties.

Methodologies

Basic Cleaning Methods:

1. Coagulation is the process of increasing pollutant particles and combining them into aggregates. Most often used for cleansing emulsions and suspensions. For industrial waters, coagulants such as aluminum salts, iron salts, magnesium salts, lime, zinc, calcium sulfate and much more are used;
2. Extraction is based on the dissolution of the pollutant using extractants. In the process, beneficial substances (fatty acids and phenols) can be extracted. Typically, extractants are organic solvents that do not mix with water (benzene, mineral oils, carbon tetrachloride);
3. Distillation - the natural process of evaporation of water is accelerated by heating to the boiling point, leading to the formation of steam. Mechanical particles are too heavy to be picked up by steam. Dissolved chemicals precipitate. Volatile organic compounds rise along with the steam, so distillers can often have a post-purification filter based on activated carbon;
4. Concentration - wastewater is neutralized, mineral salts are separated and conditionally pure water is obtained, which is suitable for a recycling water supply system. The method is carried out in several stages:

- concentration stage;
- stage of separation of dry substances.

5. **Adsorption** is the process of removing impurities concentrated on the surface or in the pores of solid particles. Adsorbents are natural and artificial porous materials: active clay, peat, irlites, dolomites, activated carbon, ash, aluminum gels, silica gels, sawdust. Using the physico-chemical adsorption method for wastewater treatment, it is possible to perform high-quality wastewater treatment, the efficiency is 95%. This method is used if it is necessary to carry out deep purification of wastewater from dissolved organic matter after biochemical treatment. The advantages of the method include cost-effectiveness and the ability to purify from several types of impurities;

6. **Ion exchange** is the process of interaction of solutions with a solid medium, which can exchange its own ions for others located in a particular solution. This method is especially effective for isolating heavy metals: copper, zinc, nickel, chromium, lead, cadmium, mercury, vanadium, manganese, arsenic compounds, phosphorus and others. The purification process is as follows: collectors (surfactants) are added to the wastewater, providing the floated metals with water repellence and binding to bubbles, which remove contaminants and carry them into a layer of foam into the flotation chamber, from where they are removed and removed.

7. **Flocculation** is a method based on the aggregation of suspended elements. The purification process begins after the introduction of high-molecular compounds into wastewater. Aggregation occurs both during direct contact of particles and during the interaction of molecules of the adsorbed flocculant. By combining the processes of flocculation and coagulation, the costs of coagulants are significantly reduced. In addition to improving treatment efficiency, flocculation also increases the performance and life of the system. Flocculants are divided into several groups:

- inorganic (active silicic acid);
- natural polymers (guar gum, starch, sodium alginate, cellulose);
- synthetic polymers (nonionic, anionic, cationic).

8. **Flotation** is the adhesion of dirt particles together with air bubbles that carry them to the surface. Foam is easily removed with foam collection equipment. The effectiveness of cleaning depends on how tightly the particles are attached to the air bubble. Since air is hydrophobic (wettable surface), the same substances can attach to the bubbles: oils, fats, surfactants, petroleum products.

The advantages of this method are a wide range of use, high quality of purification, continuous operation, high speed of implementation, as well as the possibility of recovering removed impurities. Also, there are several types of flotation depending on the technology for the formation of air bubbles:

- mechanical;
- jet;
- vacuum, pressure, airlift;
- chemical;
- biological;
- electroflotation;
- flotation with air supply through porous materials;
- gravity flotation.

Results:

The article examines the intricacies of the physico-chemical treatment of wastewater and provides a complete overview of this important process. Physico-chemical treatment is the primary solution to the various contaminants present in wastewater, from suspended solids to dissolved contaminants and harmful pathogens. Through a synergistic combination of physical and chemical mechanisms, this treatment method effectively removes impurities and makes wastewater suitable for safe discharge or reuse. The article covers the basic principles of physico-chemical treatment by studying the main processes such as coagulation, flocculation, sedimentation, filtration, adsorption and disinfection. Coagulation and flocculation involve the addition of chemicals that promote the aggregation of suspended particles, making them easier to remove by settling. Filtration further purifies treated water by passing it through a porous medium, while adsorption targets dissolved contaminants through the use of adsorbent materials. In addition, the article highlights the importance of disinfection in ensuring the microbiological safety of treated water using methods such as chlorination, ultraviolet

irradiation, and ozonation. The article highlights the mechanisms and application of physico-chemical cleaning methods and emphasizes their crucial role in the preservation of water resources and protection of public health. It highlights the continued need for research, innovation and investment in wastewater treatment infrastructure to address the evolving challenges of water pollution in an increasingly urbanized world.

Conclusion

The journey of wastewater through physical-chemical treatment methods represents a triumph of science and engineering in combating water pollution. From the initial coagulation of suspended particles to the final disinfection of pathogens, each stage plays a pivotal role in transforming contaminated water into a valuable resource. However, challenges persist, ranging from the optimization of treatment processes to the management of byproducts and residues. As we navigate the depths of wastewater treatment, continued research, innovation, and collective effort are essential to safeguarding our precious water resources for future generations.

REFERENCES

1. Seidel, M., & Niessner, R. (2014). Ammonia Sensors and Their Applications—A Review. Sensors, 14(3), 4448-4467.
2. Lu, L., & Kimmel, W. G. (2016). Ammonia removal from wastewater by ion exchange in fixed-bed columns. Journal of Environmental Chemical Engineering, 4(2), 2131-2140.
3. Zhang, Y., Zhang, B., & Li, G. (2018). Review on the Treatment and Valorization of Ammonia Wastewater. Molecules, 23(6), 1417.
4. Azamat, Y., & Fayzulloh, S. (2022). DEVELOPMENT OF A WIRELESS WATER QUALITY MONITORING SYSTEM FOR WATER TREATMENT FACILITIES. *Universum: технические науки*, (5-10 (98)), 23-26.
Url: https://cyberleninka.ru/article/n/development-of-a-wireless-water-quality-monitoring-system-for-water-treatment-facilities
5. ALIJONOVICH, Y. A. (2022). DEVELOPMENT OF A WIRELESS WATER QUALITY MONITORING SYSTEM FOR WATER TREATMENT FACILITIES. *Unversum: технические науки*.
Url: https://scienceweb.uz/publication/11271
6. ALIJONOVICH, Y. A. (2022). DESIGN OF WIRELESS WATER QUALITY MONITORING SYSTEM FOR WATER TREATMENT FACILITIES. *EPRA International Journal of Research and Development (IJRD)*.
Url: https://scienceweb.uz/publication/11262
7. Fazliddin o‘g‘li, S. F. (2023). IOT (INTERNET OF THINGS) GA ASOSLANGAN OQAVA VA CHIQINDI SUVLARI SIFATI MONITORINGI TIZIMINI LOYIHALASH. *Mexatronika va robototexnika: muammolar va rivojlantirish istiqbollari*, *1*(1), 414-417.
Url: https://michascience.com/index.php/mrmri/article/view/140

8. Fayzulloh, S., & Salohiddin, G. U. (2023). REAKTIV QUVVAT NAZORATINI BOSHQARISH JARAYONINI MATLAB DASTURIDA MODELLASHTIRISH. *FAN, JAMIYAT VA INNOVATSIYALAR*, *1*(1), 147-153.
Url: https://michascience.com/index.php/fji/article/view/26
9. Fayzulloh, S., & Islombek, S. (2023). THE USE OF RADAR SENSORS IN MEASURING SATURATION. *FAN, JAMIYAT VA INNOVATSIYALAR*, *1*(1), 126-131.
Url: https://michascience.com/index.php/fji/article/view/23
10. Fayzulloh, S., & Sanjarbek, A. (2023). REACTIVE POWER COMPENSATION: ENHANCING POWER SYSTEM EFFICIENCY AND STABILITY. *FAN, JAMIYAT VA INNOVATSIYALAR*, *1*(1), 132-137.
Url: https://michascience.com/index.php/fji/article/view/24
11. Tokhirov, A. I. (2021). USING THE GRAPHICAL EDITOR" КОМПАС 3D" in teaching computer engineering graphics. Universum: технические науки: электрон. научн. журн, 7(88), 8-3.
12. Tokhirov, A. (2021). Application procedure CAD/CAM/CAE-systems in scientific research. Universum: технические науки, (6-5), 16-19.
13. Tokhirov, A. (2021). Writing control programs for computer numeral control machines. Universum: технические науки, (5-6), 15-17.
14. Tokhirov, A. (2021). WRITING CONTROL PROGRAMS FOR COMPUTER NUMERAL CONTROL MACHINES. Universum: технические науки, (5-6), 15-17.
15. ugli Tokhirov, A. I. (2021). Technological process development using CAD-CAM programs. Science and Education, 2(6), 288-291.
16. Tokhirov, A. I. U. (2021). Technological process development using CAD-CAM programs. Science and Education, 2(6), 288-291.
17. TOKHIROV, A., & MARASULOV, I. (2021). Control models and information system of cotton storage in the claster system. UNIVERSUM, 12-18.
18. Ogli, I. M. R., & Ogli, T. A. I. (2021). A Role of Mechanical Engineering in Mechatronics. JournalNX, 824-828.
19. Djurayev, A. D., Tokhirov, A. I., & Marasulov, I. R. (2022). CLEANING COTTON FROM SMALL DIRTY. Universum: технические науки: электрон. научн. журн, 3, 96.
20. A'zamjon, T. (2022). ROBOTOTEXNIKA MAJMUALARINING AVTOMATLASHTIRILGAN ELEKTR YURITMALARINI QO'LLANILISH SOHALARI. Involta Scientific Journal, 1(6), 3-9.
21. A'zamjon, T. (2022). ROBOTOTEXNIKA MAJMUALARINING AVTOMATLASHTIRILGAN ELEKTR YURITMALARINI QO'LLANILISH SOHALARI. Involta Scientific Journal, 1(6), 3-9.
22. Marasulov, I. R., & Toxirov, A. I. (2021). A role of mechanical engineering in mechatronics. Journal NX–A Multidisciplinary Peer Reviewed Journal, 824-828.
23. Tokhirov, A. I. Methodology of teaching three-dimen modeling using the program «KOMPAS 3D». Eurasian Journal of Academic research Innovative Academy Research Support Center/[Электронный ресурс].–Режим доступа: https://doi. org/10.5281/zenodo, 4718298.

24. Tokhirov, A. (2021). APPLICATION PROCEDURE CAD (No. 6, p. 87). CAM/CAE–SYSTEMS IN SCIENTIFIC RESEARCH//Universum: technical sciences: a scientific journal.
25. Ibrohim o'g, T. A. Z. (2022). Robototechnics And Technical Sets Application Of Automatic Electric Power Supplies Fields. Open Access Repository, 8(6), 92-96.
26. Джураев, А. Д., Далиев, Ш. Л., & Тохиров, А. И. У. (2022). РАЗРАБОТКА ЭФФЕКТИВНОЙ КОНСТРУКТИВНОЙ СХЕМЫ ОЧИСТИТЕЛЯ ХЛОПКА-СЫРЦА ОТ МЕЛКОГО СОРА. Universum: технические науки, (9-2 (102)), 26-28.
27. Anvar, D., Azamjon, T., & Islombek, M. (2022). CLEANING COTTON FROM SMALL DIRTY. Universum: технические науки, (3-7 (96)), 9-14.
28. Azamjon, T., & Islombek, M. (2021). CONTROL MODELS AND INFORMATION SYSTEM OF COTTON STORAGE IN THE CLASTER SYSTEM. Universum: технические науки, (11-6 (92)), 12-18.
29. Azamjon, T. (2021). WRITING CONTROL PROGRAMS FOR COMPUTER NUMERAL CONTROL MACHINES. Universum: технические науки, (5-6 (86)), 15-17.
30. Ugli, T. A. I. (2021). USING THE GRAPHICAL EDITOR" КОМПАС 3D" IN TEACHING COMPUTER ENGINEERING GRAPHICS. Universum: технические науки, (7-3 (88)), 38-43.
31. Azamjon, T. (2021). APPLICATION PROCEDURE CAD/CAM/CAE-SYSTEMS IN SCIENTIFIC RESEARCH. Universum: технические науки, (6-5 (87)), 16-19.
32. IR, D. A. T. A. M. CLEANING COTTON FROM SMALL DIRTY.
33. A'zamjon Ibrohim o'g'li Toxirov, Robototexnika majmualarining avtomatlashtirilgan elektr yuritmalarini qo'llanilish sohalari, "Science and Education" Scientific Journal, May 2022 Vol. 3 No. 5 (2022): Science and Education
URL: https://openscience.uz/index.php/sciedu/article/view/3425
34. Toxirov A'zamjon. ROBOTOTEXNIKA MAJMUALARINING AVTOMATLASHTIRILGAN ELEKTR YURITMALARINI QO'LLANILISH SOHALARI. Involta Scientific Journal, 1(6), 3–9.
URL: https://involta.uz/index.php/iv/article/view/159
DOI - 10.5281/zenodo.6519792
35. Djurayev A.D., Tokhirov A.I., Marasulov I.R. CLEANING COTTON FROM SMALL DIRTY // Universum: технические науки : электрон. научн. журн. 2022. 3(96).
URL: https://7universum.com/ru/tech/archive/item/13196
DOI - 10.32743/UniTech.2022.96.3.13196
36. Tokhirov A.I. Writing control programs for computer numeral control machines // Universum: технические науки : электрон. научн. журн. 2021. 5(86).
URL: https://7universum.com/ru/tech/archive/item/11810
DOI - 10.32743/UniTech.2021.86.5.11810
37. Tokhirov A.I. Application procedure CAD/CAM/CAE - systems in scientific research // Universum: технические науки : электрон. научн. журн. 2021. 6(87).
URL: https://7universum.com/ru/tech/archive/item/11836
DOI - 10.32743/UniTech.2021.87.6.11836
38. Tokhirov A.I. Using the graphical editor "Компас 3D" in teaching computer engineering graphics // Universum: технические науки : электрон. научн. журн. 2021. 7(88).

URL: https://7universum.com/ru/tech/archive/item/12076
DOI: 10.32743/UniTech.2021.78.8-3.12076
39. Tokhirov A.I., Marasulov I.R. CONTROL MODELS AND INFORMATION SYSTEM OF COTTON STORAGE IN THE CLASTER SYSTEM // Universum: технические науки : электрон. научн. журн. 2021. 11(92).
URL: https://7universum.com/ru/tech/archive/item/12486
40. Azamjon Ibrohim ugli Tokhirov, “TECHNOLOGICAL PROCESS DEVELOPMENT USING CAD-CAM PROGRAMS”, "Science and Education" Scientific Journal, June 2021
URL: https://openscience.uz/index.php/sciedu/article/view/1561
41. Toxirov A’zamjon Ibrohim o’g’li, “METHODOLOGY OF TEACHING THREE-DIMEN MODELING USING THE PROGRAM “KOMPAS-3D””, EURASIAN JOURNAL OF ACADEMIC RESEARCH Innovative Academy Research Support Center,
URL: https://doi.org/10.5281/zenodo.4718298
42. Marasulov Islombek Ravsjanbek o’g’li,Tohirov A’zamjon Ibrohim o’g’li, “THE IMPORTANCE OF AUTOMATION OF COTTON RECEIVING SYSTEM”, EURASIAN JOURNAL OF ACADEMIC RESEARCH Innovative Academy Research Support Center,
URL: https://doi.org/10.5281/zenodo.4898919
43. Toxirov A’zamjon Ibrohim o’g’li, “QUALITY IN MODERN MANUFACTURING ENTERPRISES THE ROLE OF ROBOTOTECHNICS AND AUTOMATED ELECTRICAL INSTRUMENTS IN PRODUCTION”, EURASIAN JOURNAL OF ACADEMIC RESEARCH Innovative Academy Research Support Center,
URL: https://doi.org/10.5281/zenodo.4968770
44. Islombek Marasulov Ravshanbek Ogli, & Toxirov Azamjon Ibrohim Ogli. (2021). A ROLE OF MECHANICAL ENGINEERING IN MECHATRONICS. JournalNX - A Multidisciplinary Peer Reviewed Journal, 824–828.
URL: https://repo.journalnx.com/index.php/nx/article/view/1690.