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THE ROLE AND IMPORTANCE OF MECHANICAL WASTEWATER TREATMENT DEVICES TODAY

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ABSTRACT

This article delves into the pivotal role and the enduring importance of mechanical wastewater treatment devices in the contemporary context of environmental preservation. We will explore the diverse array of devices that fall under this category, their specific functions, and the pivotal role they play in preparing wastewater for subsequent biological and chemical treatment processes. Moreover, we will illuminate how advancements in technology have elevated the efficiency, reliability, and eco-friendliness of these devices, making them indispensable tools in the pursuit of a cleaner, healthier, and more sustainable environment.

Introduction: In an age where environmental concerns have taken center stage, the management of wastewater has never been more critical. Rapid urbanization, industrialization, and population growth have led to an alarming increase in the volume of wastewater generated worldwide. Consequently, the demand for effective and sustainable wastewater treatment solutions has reached unprecedented levels [1-4]. Among the arsenal of tools available to combat water pollution and protect our precious aquatic ecosystems, mechanical wastewater treatment devices stand as stalwart guardians at the forefront of this vital mission[1;3-7].

Mechanical wastewater treatment devices, often the unsung heroes in the wastewater treatment process, play an indispensable role in safeguarding our water resources. They are the initial sentinels in a multi-stage treatment process, responsible for the removal of physical impurities and solids that lurk in the effluents from households, industries, and agricultural activities [8-13]. These devices are not merely the "first responders" in the wastewater treatment realm; they are the essential foundation upon which the edifice of sustainable water management is constructed [14-18].

Methods. The article examines the mechanical devices of wastewater treatment in Uzbekistan and compares them with the mechanical devices of wastewater treatment in foreign countries. System data analysis has been performed.

Results and discussions. Mechanical wastewater treatment plants are designed to remove solid particles and waste from wastewater through physical processes. These devices are usually the first step in wastewater treatment, helping to prepare the wastewater for subsequent treatment processes. Today, common mechanical wastewater treatment devices:

Screens: Screens are one of the main mechanical devices used in wastewater treatment plants. They consist of fine mesh or perforated plates through which wastewater flows. Screens remove large objects such as sticks, leaves, plastics and other debris from the wastewater. Grit Chambers: Grit chambers are designed to remove heavy particles such as sand, gravel, and sand from wastewater. These materials settle to the bottom of the chamber due to their weight, and then the clean water is directed to the next stage of treatment.

Clarifiers: Large, circular or rectangular tanks that allow solid particles in wastewater to settle to the bottom. The settled solids, called sludge, are periodically removed, and the treated water is directed to further treatment. Settling ponds: Similar to clarifiers, settling ponds are used to settle solid particles from wastewater. They are usually used in municipal and industrial wastewater treatment.

Rotating Biological Contactors (RBCs): RBCs are mechanical devices that use rotating discs to provide a large surface area for biological treatment processes. They promote the growth of microorganisms that help break down organic matter in wastewater. Dissolved Air Flotation (DAF) Units: DAF units are designed to remove small, floating particles such as oils and greases from wastewater. They introduce tiny air bubbles into the water, which attach to the particles and float to the surface to remove them.

1 picture. DISSOLVED AIR FLOTATION

Screw Presses: Screw presses are used to dewater sludge produced during the treatment process. They mechanically press the sludge to remove excess water, reducing its volume and weight to facilitate its disposal or subsequent cleaning.

2 picture. Screw Press

In simple terms, a dewatering screw press separates liquids from solids. It is a device that moves slowly, dewatering sludge through a gravitational process. A screw press is used for material that is hard to dewater, including materials that pack together. The screw press uses a filter system to separate the liquid from the solid material. Liquid collects as it flows through a screen or filter and can then be reused.

Centrifuges: Centrifuges use centrifugal force to separate the solids in the wastewater from the liquid. They are particularly effective in dewatering sludge and can achieve high solids removal rates. Drum Filters: Drum filters are rotating filter drums covered with filter cloth or mesh. They are used to separate the solids from the liquid in the wastewater by mechanically scraping or vacuuming the trapped solids. Belt Filters: Belt filters are used to dewater sludge and are similar to drum filters, but use a moving belt instead of a rotating drum to capture and remove solids from the liquid.

Based on world experience, we studied the cleaning technologies of several countries. Japan has a well-developed and advanced mechanical cleaning technology sector. Japan is known for its innovation and technological advancements in various industries, including cleaning and sanitation. Japan is a leader in robotics and automation technology. Robotic cleaning systems, such as autonomous vacuum cleaners and floor scrubbers, were widely used in commercial spaces, offices, and even households. These robots can perform tasks like vacuuming, mopping, and sweeping without human intervention. Ultrasonic cleaning technology is used in precision cleaning applications. It relies on high-frequency sound waves to create tiny bubbles in a cleaning solution, which implode upon contact with the surface, effectively removing contaminants. This technology is often used in electronics manufacturing and medical device cleaning. Japan's manufacturing sector relies on industrial vacuum systems for cleaning and maintaining production equipment and facilities [19-22]. These systems are designed to handle large volumes of dust, debris, and waste. Japan is known for its semiconductor and electronics manufacturing industry, which requires extremely clean environments. Cleanroom technology, including high-efficiency particulate air (HEPA) filtration systems and air showers, is used to maintain sterile and dust-free environments.

Japan has advanced automated car wash systems that provide thorough cleaning and polishing for vehicles. These systems often incorporate brushes, high-pressure water jets, and specialized cleaning agents. Japan has faced environmental challenges, such as nuclear disasters and industrial pollution. Mechanical cleaning technologies are utilized for environmental cleanup efforts, including soil remediation and contaminated water treatment. Japanese cities have implemented smart waste management systems that incorporate mechanical technology for waste collection and sorting. These systems use sensors and automation to optimize waste collection routes and reduce environmental impact.

Germany is known for its advanced mechanical cleaning technology sector. The country places a strong emphasis on engineering, innovation, and sustainability, which has led to the development of cutting-edge cleaning technologies. Keep in mind that there may have been further developments and innovations since then. Germany is a hub for manufacturing and industrial production. Therefore, the country has a strong presence in the development of industrial cleaning systems. These systems include high-pressure water jets, industrial vacuum cleaners, and automated cleaning machines used in factories and production facilities. German companies have been at the forefront of robotic cleaning solutions. These include autonomous vacuum cleaners for homes, robotic floor scrubbers for commercial spaces, and specialized robots for cleaning hard-to-reach areas in industrial environments. Germany is known for its precision engineering, and ultrasonic cleaning technology is widely used in industries like automotive, aerospace, and electronics manufacturing. Ultrasonic baths and tanks are used for parts cleaning and degreasing. Sustainability is a key focus in Germany. Eco-friendly and sustainable cleaning technologies have gained popularity. This includes the use of environmentally friendly cleaning agents and equipment designed for low energy consumption and reduced waste generation. Germany has a strong semiconductor and pharmaceutical industry that relies on cleanroom technology. German companies produce cleanroom equipment such as high-efficiency particulate air (HEPA) filters, laminar flow cabinets, and cleanroom monitoring systems. Germany is known for its efficient waste management systems. Mechanical technologies such as automated waste sorting and recycling equipment are used to separate and process waste materials for recycling and disposal. German-made automated car wash systems are known for their quality and efficiency. These systems often include advanced brushes, high-pressure water jets, and specialized cleaning agents for vehicles. High-pressure water jet cleaning technology is widely used in various applications, including graffiti removal, building cleaning, and industrial equipment maintenance. Germany is known for producing high-quality industrial vacuum cleaners for various industries, including manufacturing, construction, and healthcare. Germany has expertise in environmental cleanup and soil remediation technologies. Mechanical cleaning systems are used to address pollution and contamination issues.

These mechanical wastewater treatment plants play a crucial role in the initial stages of wastewater treatment by removing physical impurities and solids, making the water suitable for further biological and chemical treatment processes. The choice of specific devices depends on the type and characteristics of the wastewater to be treated and the desired treatment results. Imagine a river flowing with plastic waste, debris and other unsightly

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materials. Without an effective system to remove these contaminants, downstream treatment processes can become clogged, causing equipment failure and water quality degradation.

Conclusion: In summary, Uzbekistan, Germany, and Japan each have distinct approaches to water treatment technologies based on their specific challenges and priorities. Uzbekistan is focused on modernization and addressing water scarcity, while Germany emphasizes advanced treatment methods and sustainability. Japan, known for its technological innovation, places strong emphasis on resilient infrastructure and cutting-edge filtration technologies. All three countries are actively working to improve water treatment and address their unique water-related challenges. In wastewater treatment, it is necessary to re-inspect the treatment facilities. The paving units in the treatment plant are outdated, and these problems can be solved by bringing in foreign technologies and using them. It would be appropriate to use mechanical cleaning devices while paying attention to their service life, to establish continuous monitoring of cleaning performance.

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