ASSESSMENT OF WASTE WATER QUALITY OF SEWAGE TREATMENT PLANT

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A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering

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Section: (13A)
Semester :(Spring-2022)

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It is stated that the project work on, " Assessment of wastewater quality of sewage treatment plant " has been performed under the supervision of Md. Abu Saleh Sagor, Lecturer, Department of Civil Engineering, SU has been accepted for satisfactory submission in partial fulfillment of the requirements for the degree of Bachelor of Science in civil engineering. Any portion of this has not been submitted elsewhere for any degree or diploma.

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Dedicated

to

“Our Beloved Parents and Teachers”

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ABSTRACT

The present study was conducted to evaluate the efficiency and performance of the wastewater Sewage treatment plant at Gazipur City Corporation. The performance of this plant is an essential parameter to monitor because the treated effluent is discharged for irrigation purposes. Wastewater samples were collected from different unit operations of the plant. The main untreated outlet, primary treated outlet and the final outlet. These samples were analyzed for various physio-chemical characteristics such as pH, TDS, TSS, TS, hardness, alkalinity, DO, BOD. The results obtained have concluded that the waste water treatment plant is efficient in the treatment of waste water. After the final treatment, it is found that the treated water is satisfactory for irrigation. Dissolved oxygen was increased from zero (waste water) to 7.8 mg /liter after secondary treatment. Total alkalinity and biochemical oxygen demand to tend to decreased with secondary treatment. Total suspended solids and hardness decreased in treated water.

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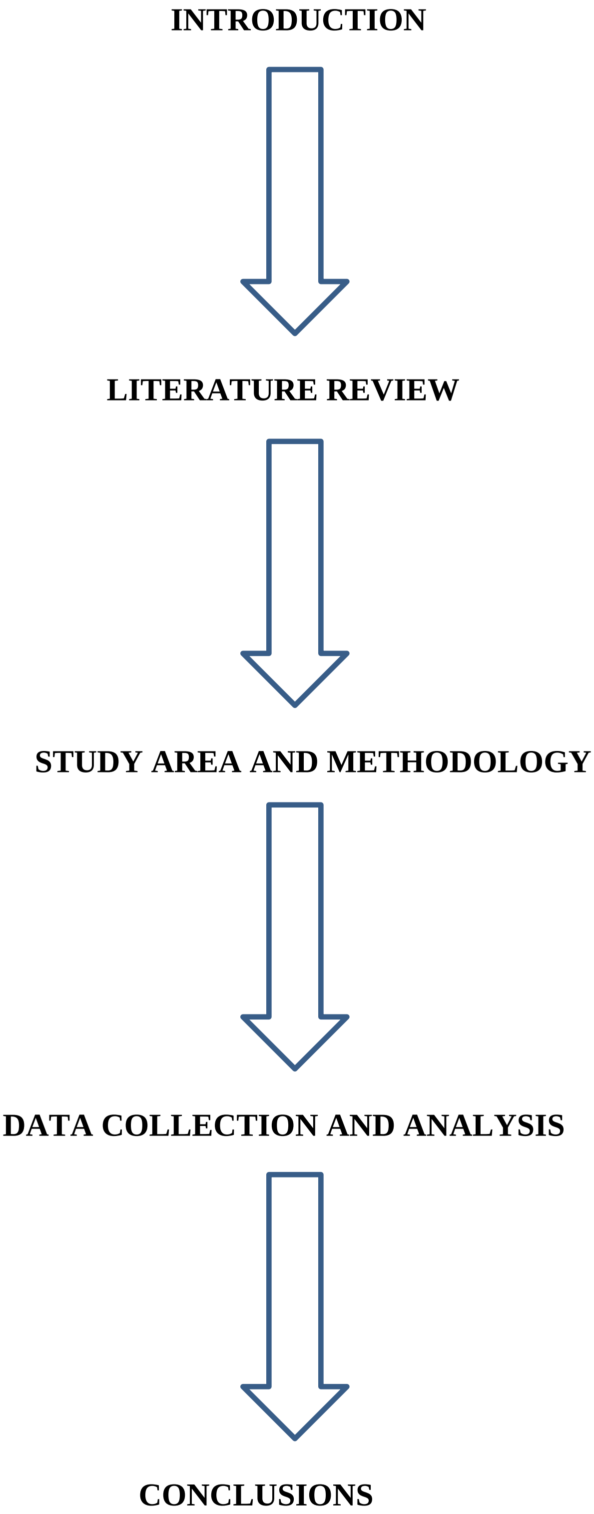
THESIS ORGANIZATION OF THESIS

The research consists of five chapters. The first chapter contains the introduction of the thesis, background of the study, objective of the study, outline of the methodology, and organization of the thesis. Chapter two incorporates a literature review related to the Sewage treatment plant. Chapter three describes the methodology and study area, and the procedures applied for the execution of the study. Chapter four deals with the data collection, and analysis in Sewage treatment plant. Chapter five includes the conclusion of the entire study.

STRUCTURE OF THE THESIS



CHAPTER 1
INTRODIUTION

1.0.Introduction

Water is one of the most vital and extensive compounds in the ecosystem. All living organisms on earth need water for their existence and growth. Water is increasingly contaminated by various toxic pollutants due to the increase in the human population, industrial development, the use of fertilizers in agriculture and many other man made activities. It is difficult to fully understand the biological phenomenon because the chemistry of water feeds much of the metabolism of the ecosystem and explains the general hydro-biological relationship (Basavaraja et al, 2011). Sewage makes up almost 99% of the wastewater characterized by the volume or flow velocity, the physical conditions, the chemical components and the bacteriological organisms it contains. Waste water consists essentially of substances such as human waste, food waste, oils, soaps, chemicals and household waste. The assessment of wastewater quality is very crucial to provide safeguards for public health and the environment (Sarawak et al. 2015). To minimize risks to health and the environment, these harmful pollutants should be reduced to the allowable limits for safe disposal of waste water. As the availability of fresh water is gradually reduced, the use of wastewater and other industrial waste to irrigate agricultural land increases. For farmers, there are opportunities.

1.2. OBJECTIVE OF THE STUDY

To determine Parameters of water before and after treatment

CHAPTER 2

LITERATURE REVIEW

2.0 Waste water collection

The collection and conveyance of wastewater (sewage) from the various sources at the point of generation is the first step in the effective management of a community's wastewater. The pipes that collect and transport the wastewater away from its point of generation are called sewers, and the network of sewer pipes in a community is known as sewerage system. There are three types of collection sewerage systems have been developed: (i) Sanitary, (ii) Storm-sewers, and (iii) Combined sewers. Sanitary sewers, which are often called separate sewers/conventional sewer, originally were intended solely for the collection of wastewater from residential district as a mean of improving the general sanitation of the community. Sewage is a liability to the community. Therefore, it must be collected and transported from the point of production to the treatment plant or final disposal as quickly as possible to prevent development of septic conditions so that it cannot endanger public health. The Milwaukee, Wisconsin epidemic of domestic water supply waterborne disease caused by Cryptosporidium in the spring of 1993 in which over 400,000 people became ill and over 80 people died has stimulated renewed attention to the potential significance of pathogenic organisms in domestic water supplies. It has been recently reviewed that the significance of domestic water supply waterborne pathogens as a cause of disease in the US. Adeyeye EI, (1994)Population. It has been recently estimated that the lifetime risk of death for the US population from waterborne enterovirus pathogens is 1 in 20. Therefore, the lifetime risk of disease and death from waterborne pathogens in domestic water supplies is far greater than the risks associated with the chemical contaminants (Priority Pollutants), individually or all of them combined, that are the focus of current regulatory attention. In general, from about 1900 to the early 1970s treatment objectives were concerned with (i) the removal of suspended and floatable materials, (ii) the treatment of biodegradable organics, and (iii) the elimination of pathogenic organisms step of sewage treatment is usually the removal of large floating objects and heavy mineral particles. Coarse solids are removed by a series of closely spaced mild steel bars placed across the flow. For large flows mechanically raked screens are preferred since they can be cleaned more frequently and are considerably smaller than the corresponding first hand raked screen. Grit is the heavy inorganic fraction of sewage solids. It includes road grit, sand, eggshells, ashes, charcoal, glass and pieces of metal etc. There are two basic types of grit removal plant; constant velocity grit channels and the various proprietary tanks or taps available commercially. A comminatory is a self-cleansings shredding machine. Comminutes avoid the problems with the handling and disposal of screenings. The activated sludge process involved the production of an activated mass of micro-organisms capable of stabilizing of a waste aerobically. Many versions of the original processes are in use today, but fundamentally they are all similar. The concept of a trickling filter grew from the use of contact filters, which were watertight basins filled with broken stones. In operation, the contact bed was filled with wastewater from the top, and the wastewater was allowed to contact the media for a short time. The bed was then drained and allowed to rest before the cycle was repeated. A trickling filter is a packed bed of media covered with slime growth over which wastewater is passed. As the wastewater passes through the filter, organic matter present in the wastewater is removed by the biological film. This process is similar to the conventional Activated Sludge Process except that Primary Sedimentation Tank does not use here. In this process, sludge wasting is minimized. This results in low growth rates, low sludge yields, and relatively high oxygen requirements by comparison with the

Conventional Sludge Processes. Aerated lagoons are activate sludge units operated without sludge return. They are developed from waste stabilization ponds in temperature climates where mechanical aeration was used to supplement the algal oxygen supply in winter. Aerated lagoons are now usually designed as completely mixed non-return activated sludge unit.[6] The rotating biological contractor consists of large-diameter plastic media mounted on a horizontal shaft in a tank. The contractor is slowly rotated with approximately 40% of the surface area submerged. mm layer of slime biomass is developed on the media. Shearing forces cause excessive biomass to be stepped from the media in a manner similar to a trickling filter. In the US and Canada, 70% of RBC systems installed are used carbonaceous removal only, 25% for combined carbonaceous BOD removal and nitrification, and 5% for nitrification of secondary effluent. Waste stabilization ponds are large shallow basins enclosed by earthen embankments in which raw sewage is treated by entirely natural processes involving both algae and bacteria. They are without doubt the most important method of sewage treatment in hot climates where sufficient land is normally available. Ponds systems can be classified as (i) Aerobic, (ii) facultative, (iii) maturation, and (iv)anaerobic with respect to the presence of oxygen. Maturation ponds are used as a second stage to facultative ponds. Their main function is the destruction of .Maturation ponds are wholly aerobic and are able to maintain aerobic conditions at depths up to 3 m. But normally depth is taken as that of facultative ponds (1-1.5 m), since the destruction of viruses is better in shallow ponds than in deep ones. Ins the UASB process the following units are normally used for wastewater treatment. Adeyeye EI, (1994*)*

2.1 Waste water process

- Flow restriction and measurement
- Coarse and fine screens
- Grit chamber
- UASB reactor
- Facultative pond

The constituents removed in wastewater treatment plants screenings, grit, scum, and sludge. The sludge resulting from wastewater treatment operations and processes is usually in the form of a liquid or semisolid liquid that typically

fro .25-12% solids by weight. Digestion, composting, incineration, wet-air oxidation, and vertical tube reactors are used primarily to treat or stabilize the organic material in the sludge. Characteristics of sludge that affect its suitability for land application and beneficial use include organic content, nutrients, pathogens, metals, and toxic organics. The term heavy metal is used to denote several of the trace elements present in sludge For land application of sludge, concentrations of heavy metals may limit the sludge application rate and the useful life of the application site. Adeyeye EI, (1994) .

2.2 Oxygen Depleting Parameter Following are the oxygen depleting parameters:

- Biochemical Oxygen Demand (BOD) which is also divided in to (a) Nitrogenous Biochemical Oxygen Demand (NBOD), and (b) Carbonaceous Biochemical Oxygen Demand (CBOD).
- Chemical Oxygen Demand (COD).

The most widely used parameter of organic pollution applied to both wastewater and surface water is the 5-day BOD BOD5).The BOD5 by the definition is the quantity of oxygen required for the stabilization of oxidizable organic matter present after 5 days of incubation at 20º c. Non carbonaceous matter, such as ammonia, is produced during hydrolysis of proteins. The interference caused by the presence of nitrifying bacteria can be eliminated by pretreatment of the sample or by the use of inhibitory agents. The CBOD test is now being used as substitute for the BOD test in discharge permits, especially where nitrification is known to occur. The COD test measures the total organic carbon with the exception of certain aromatics, which are not completely oxidized in reaction. The COD is an oxidation-reduction reaction, so other reduced substances, such as sulfides, sulfites, and ferrous iron, will also be oxidize.

2.3 Waste water uses different

1. worked on heavy metal uptake by three types of algae Chlorella sp., Spirulina sp., and other algae found in wastewaters of industries. They used untreated and autoclaved effluents as a substrate and observed that microalgae removed up to 81.7% of copper and 94.1 % of zinc and also found that higher heavy metal removal is obtained in autoclaved effluents because the presence of microbes in untreated effluents put negative impact on the removal efficiency. (Chan et al in 2013)

2used the microbial mats for the study using different species of algae such as Ulva sp., Cladophora sp. and Chlorella sp. and observed COD and BOD in three different types of process free cell process, batch process and continuous process and found that better results water developed in continuous process with 52.1(COD) and 50.8(BOD) along with changes in dissolved oxygen (DO) and ph. .

3. studied the capability of Chlorella vulgaris to remove nitrogen in the form of ammonia and ammonium ion from local wastewater. The wastewater effluent leaving the plant was found to include high concentrations of nitrogen (7.7± 0.19 mg/L) (ammonia (NH_3) and ammonium ion (NH_4^+)) and total inorganic carbon (58.6±0.28 mg/L) at pH 7, and to be suitable for growing Chlorella vulgaris. When Chlorella vulgaris was cultivated in a batch mode under a closed system, half of the nitrogen concentration was dramatically removed in 48 h after a 24h lag-phase period. Kim et al. in 2010

4. Studied the physical and chemical parameters of dairy wastewater quality such as nitrates, sulphides, phosphates, chlorides and hardness. They founded that nitrogen and phosphate removal is achieved to be 49 % and 83 % respectively. Kothari et al in 2012

5. investigated the treatment efficiency of wastewater by using single or mixed cultures of cyanobacteria and they found that single culture was better than mixed culture. The lower efficiency of mixed culture is due to competition between cultures for nutrients and also found that organic matter removal (COD) is between 20 – 57.1 % Sheikh et al in 2012.

6. performed the wastewater treatment process in inverse fluidization unit using biomass and observed the changes in COD value with time in hour for various ratios of settled bed volume to the reactor volume (Vb/VR) and air velocity Ugo. Sogol et al in 2009

7. highlighted a review on the current scenario in the cultivation of microalgae in wastewater for nutrient removal Srirampur et al in 2012

8. studied the removal of organic content and nutrients from dairy effluents by chlorella sp., and euglena sp. In both open and closed systems and found that NH4, +N was reduced to 96% by Chlorella sp. Than Euglena sp. Yadavalli et al. in 2013

9. studied the effect of light emitting diode's wavelength and intensities on the microalgae biological wastewater treatment system .They founded that the optimum light intensity is 2000 mmol /m2*s and experimental illumination time is 120 h. And the species was successfully able to purify under this optimum condition Hegang et al in 2013

2.4 WASTE WATER CHARACTERISTICS

The selection and design of treatment plants for industrial effluent is based on the study of the physical, chemical and biological characteristics of wastewater, the quality that is to be maintained in the environment to which the wastewater is to be discharged or quality that is to be maintained for its reuse and standards for its discharge. The important and principal physical characteristics of wastewater are its color, solid contents, its odor and temperature and chemical properties include electro compounds, inorganic compounds, pH, alkalinity, hardness, and temperature.

Color

Color is a qualitative characteristic that can be used to assess general condition of Wastewater. Wastewater that is light brown in color is less than 6 h old, while a light-to-medium grey color is characteristic of wastewaters that have undergone some degree of decomposition or that have been in the collection system for some time. If the color is dark grey or black, the wastewater is typically septic, having undergone extensive bacterial decomposition under anaerobic conditions.

Total Solids

The total solids in a wastewater consist of the insoluble or suspended solids and the soluble compounds dissolved in water. Between 40 and 65 % of the solids in an average wastewater are suspended. Settle-able solids, expressed as milliliters per liter, are those that can be removed by sedimentation. Usually about 60 % of the suspended solids in a municipal wastewater are settle-able.

Temperature

Temperature is not a critical issue below 37 °C if waste water is to receive a biological treatment. Most industries waste tends to be on the warmer side. It is possible to operate thermophilic biological wastewater treatment systems up to 65 °C with acclimated microbes. Low temperature operations in northern climates can result in very low temperatures and slow reaction rates for both biological treatment systems and chemical treatment system. Increased viscosity of waste waters at low temperatures makes solid separation more difficult. Efforts are generally made to keep operating temperatures between 10 °C and 30 °C.

Organic Compounds

Organic compounds create most of the pollution problems as a result of their effect on oxygen resources in the environment. The low-molecular weight water soluble organics tend to be biodegraded by bacteria and fungi with utilization of oxygen. Solubility and biodegradability decrease with the complexity of organic molecules. The total COD (Chemical Oxygen Demand) of organic compounds in waste water is measured by dichromate Cod test. A 2- hour reflux with concentrated sulphuric acid and potassium dichromate with silver sulphate and mercuric sulphate catalyst is adequate for complete oxidation of all but a few aromatic organic compounds.

Inorganic Compounds

The inorganic compounds in most industrial wastes are the direct result of inorganic compounds in the carriage water. Soft water sources will have lower inorganic compounds than hard water or salt water sources. In a few instances, industrial processes add inorganic compounds to the waste water. While domestic waste water has a balance industrial processes add inorganic compounds to the waste water. While domestic waste waters have balance in organic compounds and inorganic compounds, many process waste waters from industry are deficient in specific inorganic compounds. Biodegradation of organic compounds requires adequate nitrogen, phosphorus, iron and trace salts. Ammonium salts or nitrate salts can provide the nitrogen, while phosphate supplies the phosphorus. Either ferrous or ferric salts or even normal steel corrosion can supply the needed iron. Other trace elements needed for biodegradation are potassium, calcium magnesium, cobalt, molybdenum, chloride and Sulphur. Carriage water or demineralized waste waters or corrosion products can supply the needed trace elements for good metabolism. Occasionally, it is necessary to add specific trace elements or nutrient elements. International Journal of Science and Technology (IJST) – March, 2017 1IJST © 2017– IJST Publications UK. All rights reserved. 735pH and Alkalinity. Waste water less than pH less than 6 are corrosive in nature and those having pH more than 9 will cause some of the metal ions to precipitate as carbonates or hydroxides.

Total Hardness

Total hardness is determined by the multivalent cations concentrations present in water. These cations have a positive charge that is higher than 1+. Typically, cations have a charge of 2+. The most common cations present in hard water are Mg2+ and Ca2+. Recommendations have been made for the maximum and minimum levels of calcium (40–80 mgL-1) and magnesium (20–30 mgL-1) in drinking water, and a total hardness expressed as the sum of the calcium and magnesium concentrations of 2–4 mmol.

Dissolved Oxygen

Dissolved Oxygen is present in water which is an essential element for the working of aerobic bacteria in the biological treatment systems. It is important that the waste water have maximum DO level, when these are discharged. Oxygen is a poorly soluble gas in water, having a solubility of 9.1 mgL-1 at 20°C. DO is minimum when the BOD rates are maximum. Chlorides, sulphates, pH and alkalinity are determined to assess the suitability of reusing treated wastewater and in controlling the various treatment processes. Trace elements, which include some heavy metals, are not determined routinely, but trace elements may be a factor in the biological treatment of wastewater. All living organisms require varying amounts of some trace elements, such as iron, copper, zinc and cobalt, for proper growth. Heavy metals can also produce toxic effects; therefore, determination of the amounts of heavy metals is especially important where the further use of treated effluent or sludge is to be evaluated. Many of the metals are also classified as priority pollutants

Industrialization is an inevitable feature of economic intensification in a developing country. In the way of employment-intensive industrialization, textile industries are playing an utmost important role offering tremendous opportunities for the economy of Bangladesh. But, hasty and unplanned clustered growth of industries leads to adverse environmental consequence in an alarming way. Large quantity of water associated with the production of a number of dyeing and textile industries, releases toxic wastewater rich in dye and chemicals to the environment that result in severe water-body pollution. These un- treated industrial effluents not only deteriorate surface water quality, ground water, soil, vegetation, but also cause many water borne diseases that is threatening to public health. Therefore, treatment facility for such wastewater is strictly recommended within the industry. But, in developing countries like Bangladesh, where less attention is paid to environmental protection, environ- mental regulations are not effectively implemented and pollution control techniques are not yet fully developed.

In this situation, pollution and the public health problem caused by the textile/ dyeing along with other industries in Bangladesh has been the focus recently and the gravity of installation of Effluent Treatment Plant (ETP) has drawn attention. Amid huge public criticism against tex- tile dyeing and processing units for polluting waterbodies and farmland by releasing toxic chemical wastes, the government is trying to deal with the matter by setting deadlines to pressure the industries to set up ETPs. Thus, industries have to continue to progress in meeting environmental obligations by undertaking anti-pollution measures. As, a large number of factories are operating without the ETPs, violating the existing laws, it has be- come a challenge for Government and private sector to work together to promote ETP installation with clear understanding the gravity of the problem and to take necessary steps by giving proper attention to all aspects. APHA. (1998).

2.5 PRIMARY TREATMENT

Primary treatment removes material that will either float or readily settle out gravity It includes the physical processes of screening, comminution, grit removal, and sedimentation. Screens are made of long, closely spaced, narrow metal bars. They block floating debris such as wood, rags, and other bulky objects that could clog pipes or pumps. In modern plants the screens are cleaned mechanically, and the material is promptly disposed of by burial on the plant grounds. A comminatory may be used to grind and shred debris that passes through the screens. The shredded material is removed later by sedimentation or flotation processes.

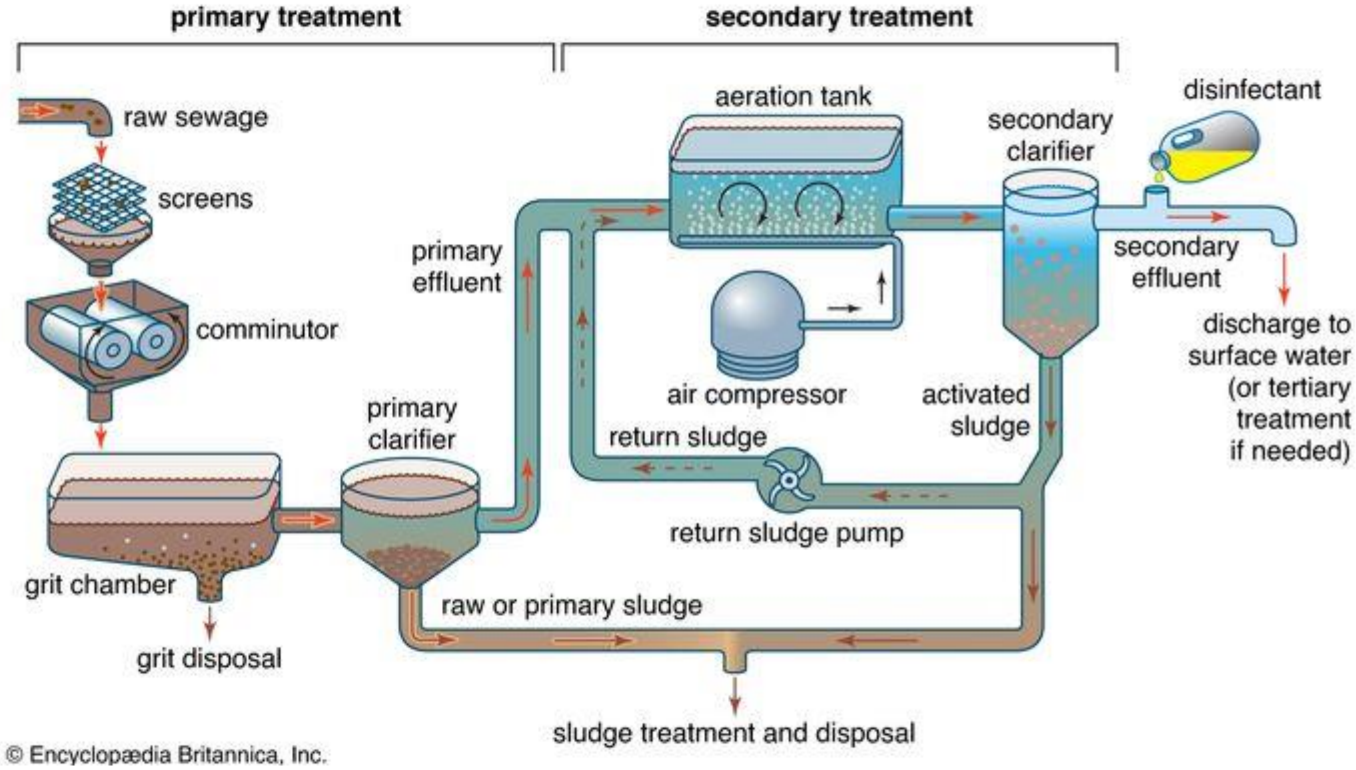


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Figure 1: Primary and secondary treatment.

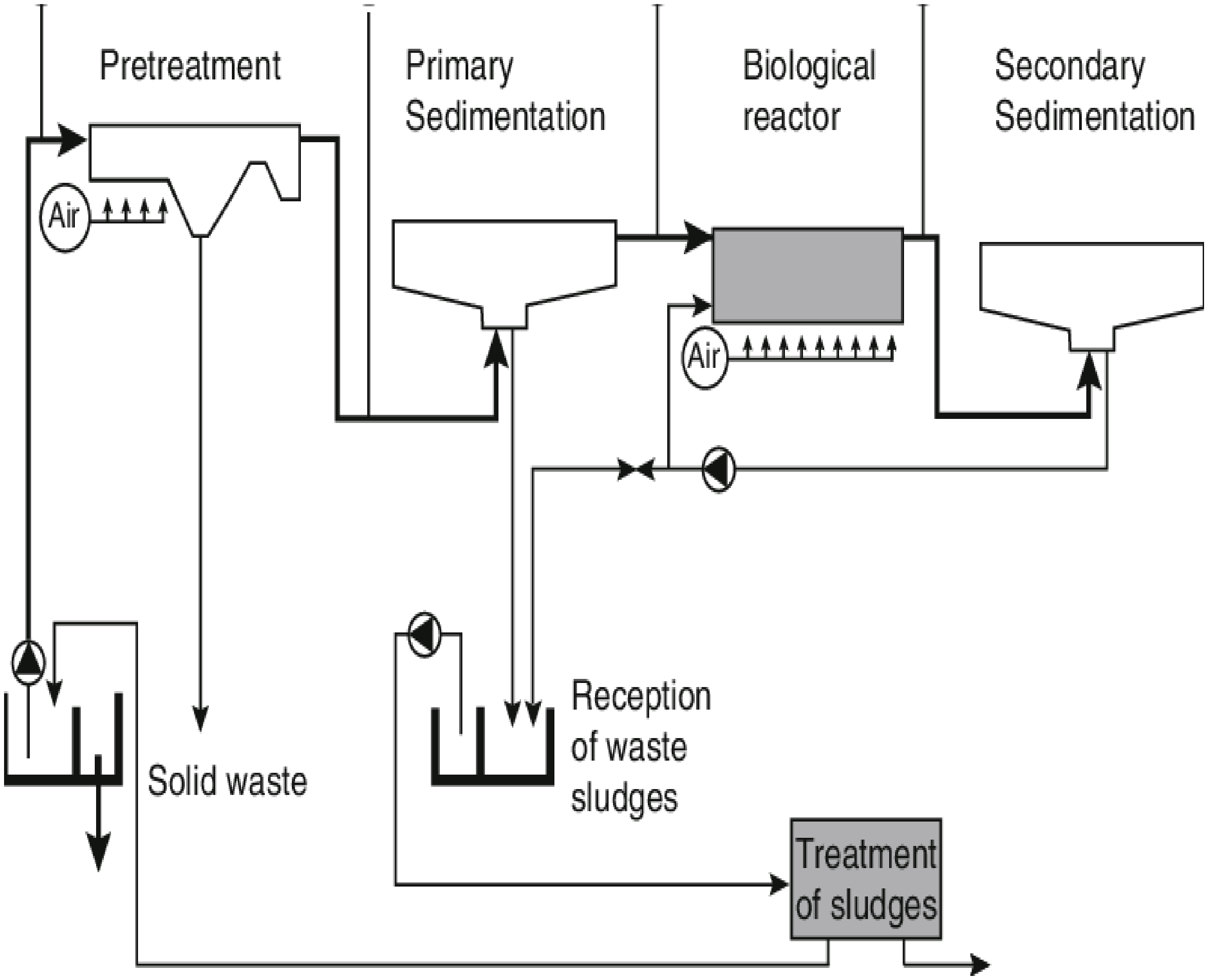


Figure 2: Sewage treatment process.

Secondary treatment

Secondary treatment removes the soluble organic matter that escapes primary treatment. It also removes more of the suspended solids. Removal is usually accomplished by biological processes in which microbes consume the organic impurities as food, converting them into water, and energy for their own growth and reproduction. The sewage treatment plant provides a suitable environment, albeit of steel and concrete, for this natural biological process. Removal of soluble organic matter at the treatment plant helps to protect the dissolved oxygen balance of a receiving stream, river or lake.

There are three basic biological treatment methods: the trickling filter, the activated sludge process, and the oxidation pond. A fourth, less common method is the rotating biological contacter.

Trickling filter

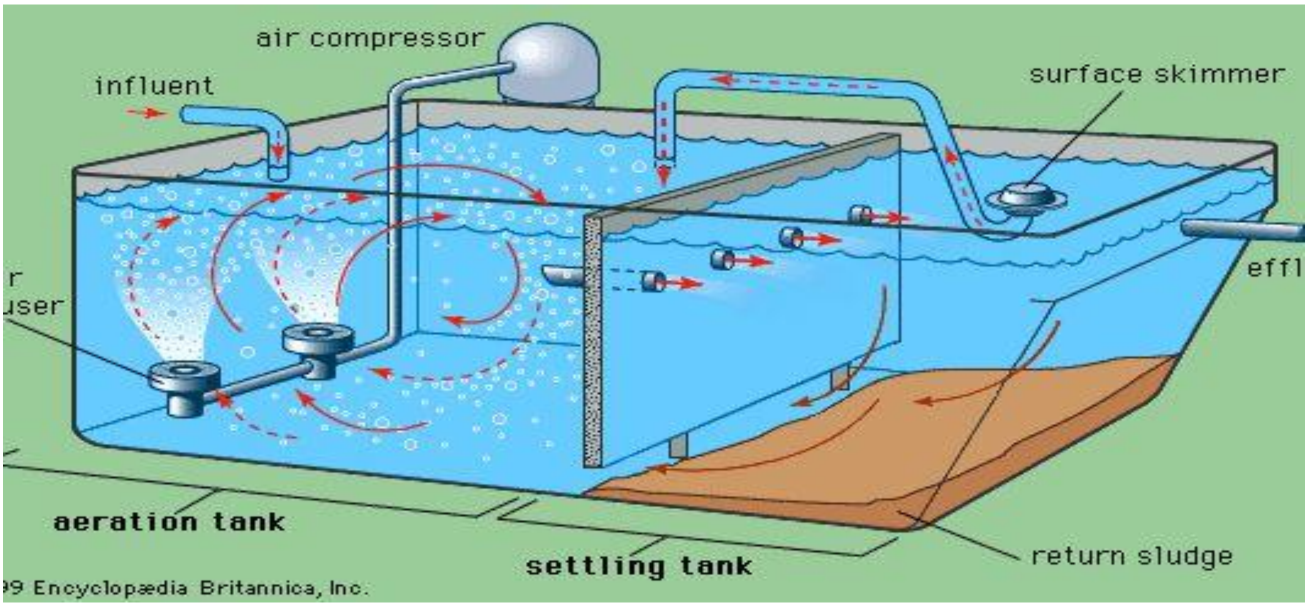
A trickling filter is simply a tank filled with a deep bed of stones. Settled sewage is sprayed continuously over the top of the stones and trickles to the bottom, where it is collected for further treatment. As the wastewater trickles down, bacteria gather and multiply on the stones. The steady flow of sewage over these growths allows the microbes to absorb the dissolved organics, thus lowering the biochemical oxygen demand (BOD) of the sewage. Air circulating upward through the spaces among the stones provides sufficient oxygen for the metabolic processes. Settling tanks, called secondary clarifiers, follow the trickling filters. These clarifiers remove microbes that are washed off the rocks by the flow of wastewater. Two or more trickling filters may be connected in series, and sewage can be recirculated in order to increase treatment.

Activated sludge

The activated sludge treatment system consists of an aeration tank followed by a secondary clarifier. Settled sewage, mixed with fresh sludge that is recirculated from the secondary clarifier, is introduced into the aeration tank. Compressed air is then injected into the mixture through porous diffusers located at the bottom of the tank. As it bubbles to the surface, the diffused air provides oxygen and a rapid mixing action. Air can also be added by the churning action of mechanical propeller-like mixers located at the tank surface.

Under such oxygenated conditions, microorganisms thrive, forming an active, healthy suspension of biological solids—mostly bacteria—called activated sludge. About six hours of detention is provided in the aeration tank. This gives the microbes enough time to absorb dissolved organics from the sewage, reducing the BOD. The mixture then flows from the aeration tank into the secondary clarifier, where activated sludge settles out by gravity. Clear water is skimmed from the surface of the clarifier, disinfected, and discharged as secondary effluent. The sludge is pumped out from a hopper at the bottom of the tank. About 30 percent of the sludge is recirculated back into the aeration tank, where it is mixed with the primary effluent. This recirculation is a key feature of the activated sludge process. The recycled microbes are well acclimated to the sewage environment and readily metabolize the organic materials in the primary effluent. The remaining 70 percent of the secondary sludge must be treated and disposed of in an acceptable manner (*see* Sludge treatment and disposal).

Variations of the activated sludge process include extended aeration, contact stabilization, and high-purity oxygen aeration. Extended aeration and contact stabilization systems omit the primary settling step. They are efficient for treating small sewage flows from motels, schools, and other relatively isolated wastewater sources. Both of these treatments are usually provided in prefabricated steel tanks called package plants. Oxygen aeration systems mix pure oxygen with activated sludge. A richer concentration of oxygen allows the aeration time to be shortened from six to two hours, reducing the required tank volume.



Aeration treatment

Schematic diagram of a prefabricated package plant for the aeration treatment of small sewage flows.

Encyclopedia Britannica, Inc.

Oxidation pond

Oxidation ponds, also called lagoons or stabilization ponds, are large, shallow ponds designed to treat wastewater through the interaction of sunlight, bacteria, and algae. Algae grow using energy from the sun and carbon dioxide and inorganic compounds released by bacteria in water. During the process of photosynthesis, the algae release oxygen needed by aerobic bacteria. Mechanical aerators are sometimes installed to supply yet more oxygen, thereby reducing the required size of the pond. Sludge deposits in the pond must eventually be removed by dredging. Algae remaining in the pond effluent can be removed by filtration or by a combination of chemical treatment and settling.

Rotating biological contacted

In this treatment system a series of large plastic disks mounted on a horizontal shaft are partially submerged in primary effluent. As the shaft rotates, the disks are exposed alternately to air and wastewater, allowing a layer of bacteria to grow on the disks and to metabolize the organics in the wastewater.

Tertiary treatment

When the intended receiving water is very vulnerable to the effects of pollution secondary effluent may be treated further by several tertiary processes.

Effluent polishing

For the removal of additional suspended solids and BOD from secondary effluent, effluent polishing is an effective treatment. It is most often accomplished using granular media filters, much like the filters used to purify drinking water. Polishing filters are usually built as prefabricated units, with tanks placed directly above the filters for storing backwash water. Effluent polishing of wastewater may also be achieved using micro strainers of the type used in treating municipal water supplies.

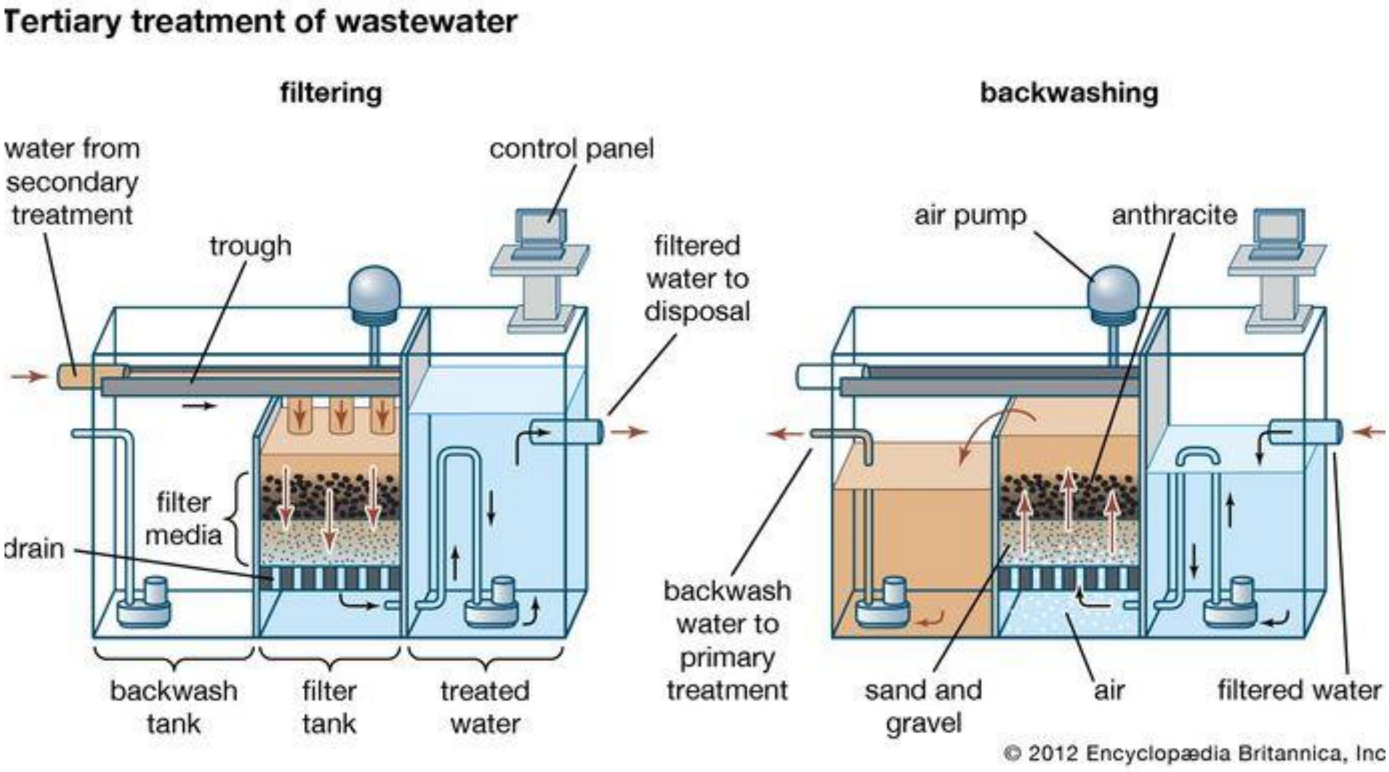


Figure 3: Tertiary treatment and disposal

Tertiary treatment of wastewater

(Left) During the filtering step, wastewater from secondary treatment, still containing suspended solids, pours from a trough and percolates through a filter bed made of porous media such as sand, gravel, and anthracite. The filtered water is then piped away for disposal. (Right) In the backwashing step, entrained solids are periodically flushed from the filter media by pumping filtered water back through the assembly. The backwash water, carrying suspended solids, is returned to the beginning of the wastewater treatment process.

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Removal of plant nutrients

When treatment standards require the removal of plant nutrients from the sewage, it is often done as a tertiary step. Phosphorus in wastewater is usually present in the form of organic compounds and phosphates that can easily be removed by chemical precipitation. This process, however, increases the volume and weight of sludge. Nitrogen, another important plant nutrient, is present in sewage in the form of ammonia and nitratas. Ammonia is toxic to fish, and it also exerts an oxygen demand in receiving waters as it is converted to nitrates. Nitrates, like phosphates, promote the growth of algae and the of lakes. A method called nitrification-denitrification can be used to remove the nitrates. It is a two-step biological process in which ammonia nitrogen is first converted into nitrates by microorganisms The nitrates are further metabolized by another species of bacteria, forming nitrogen gas that escapes into the air. This process requires the construction of more aeration and settling tanks and significantly increases the cost of treatment.A physicochemical process called ammonia stripping may be used to remove ammonia from sewage. Chemicals are added to convert ammonium ions into ammonia gas. The sewage is then cascaded down through a tower, allowing the gas to come out of solution and escape into the air. Stripping is less expensive than nitrification-denitrification, but it does not work very efficiently in cold weather.

Land treatment

In some locations, secondary effluent can be applied directly to the ground and a polished effluent obtained by natural processes as the wastewater flows over vegetation and percolates through the soil. There are three types of land treatment: slow-rate, rapid infiltration, and overland flow.

In the slow-rate, or irrigation, method, effluent is applied onto the land by ridge-and-furrow spreading (in ditches) or by sprinkler systems. Most of the water and nutrients are absorbed by the roots of growing vegetation. In the rapid infiltration method, the wastewater is stored in large ponds called recharge basins. Most of it percolates to the groundwater, and very little is absorbed by vegetation. For this method to work, soils must be highly permeable. In overland flow, wastewater is sprayed onto an inclined vegetated terrace and slowly flows to a collection ditch. Purification is achieved by physical, chemical, and biological processes, and the collected water is usually discharged into a nearby stream.

Land treatment of sewage can provide moisture and nutrients for the growth of vegetation, such as corn or grain for animal feed. It also can recharge, or replenish, groundwater aquifers. Land treatment, in effect, allows sewage to be recycled for beneficial use. Large land areas are required, however, and the feasibility of this kind of treatment may be limited further by soil texture and climate.

2.6 Clustered wastewater treatment systems

In certain instances when it is not feasible to connect residences or units to public sewer systems, communities may opt for a clustered wastewater treatment system. Such facilities are smaller versions of centralized treatment plants and serve only a limited number of connections. The technologies used for clustered wastewater treatment may be the same as those used for centralized systems or for individual on-site systems, depending upon the specific applications and degree of treatment required. Upon treatment, effluent from clustered wastewater systems can be discharged via surface or subsurface disposal methods.

On-site septic tanks and leaching fields

In sparsely populated suburban or rural areas, it is usually not economical to build sewage collection systems and a centrally located treatment plant. Instead, a separate treatment and disposal system is provided for each home. On-site systems provide effective, low-cost, long-term solutions for wastewater disposal as long as they are properly designed, installed, and maintained. In the United States, about one-third of private homes make use of an on-site subsurface disposal system.

The most common type of on-site system includes a buried, watertight septic tank and a subsurface absorption field (also called a drain field or leaching field). The septic tank serves as a primary sedimentation and sludge storage chamber, removing most of the settle able and floating material from the influent wastewater. Although the sludge decomposes anaerobically, it eventually accumulates at the tank bottom and must be pumped out periodically (every two to four years). Floating solids and grease are trapped by a baffle at the tank outlet, and settled sewage flows out into the absorption field, through which it percolates downward into the ground. As it flows slowly through layers of soil, the settled wastewater is further treated and purified by both physical and biological processes before it reaches the water table.

Septic Tank

A septic tank before installation.

An absorption field includes several perforated pipelines placed in long, shallow trenches filled with gravel. The pipes distribute the effluent over a sizable area as it seeps through the gravel and into the underlying layers of soil. If the disposal site is too small for a conventional leaching field, deeper seepage pits may be used instead of shallow trenches; seepage pits require less land area than leaching fields. Both leaching field trenches and seepage pits must be placed above seasonally high groundwater levels.For subsurface on-site wastewater disposal to succeed, the permeability, or hydraulic conductivity, of the soil must be within an acceptable range. If it is too low, the effluent will not be able to flow effectively through the soil, and it may seep out onto the surface of the absorption field, thereby endangering public health. If permeability is too high, there may not be sufficient purification before the effluent reaches the water table, thereby contaminating the groundwater. The capacity of the ground to absorb settled wastewater depends largely on the texture of the soil (i.e., relative amounts of gravel, sand, silt, and clay). Permeability can be evaluated by direct observation of the soil in excavated test pits and also by conducting a percolation test, or “per test.” The perk test measures the rate at which water seeps into the soil in small test holes dug on the disposal site. The measured perk rate can be used to determine the total required area of the absorption field or the number of seepage pits.Where unfavorable site or soil conditions prohibit the use of both absorption fields and seepage pits, mound systems may be utilized for on-site sewage disposal. A mound is an absorption field built above the natural ground surface in order to provide suitable material for percolation and to separate the drain field from the water table. Septic tank effluent is intermittently pumped from a chamber and applied to the mound. Other alternative on-site disposal methods include use of intermittent sand filters or of small, prefabricated aerobic treatment units. Disinfection (usually by chlorination) of the effluent from these systems is required when the effluent is discharged into a nearby stream.

2.7 Wastewater reuse

Wastewater can be a valuable resource in cities or towns where population is growing and water supplies are limited. In addition to easing the strain on limited freshwater supplies, the reuse of wastewater can improve the quality of streams and lakes by reducing the effluent discharges that they receive. Wastewater may be reclaimed and reused for crop and landscape irrigation, groundwater recharge, or recreational purposes. Reclamation for drinking is technically possible, but this reuse faces significant public resistance.

There are two types of wastewater reuse: direct and indirect. In direct reuse, treated wastewater is piped into some type of water system without first being diluted in a natural stream or lake or in groundwater. One example is the irrigation of a golf course with effluent from a municipal wastewater treatment plant. Indirect reuse involves the mixing of reclaimed wastewater with another body of water before reuse. In effect, any community that uses a surface water supply downstream from the treatment plant discharge pipe of another community is indirectly reusing wastewater. Indirect reuse is also accomplished by discharging reclaimed wastewater into a groundwater aquifer and later withdrawing the water for use. Discharge into an aquifer (called artificial recharge) is done by either deep-well injection or shallow surface spreading.

Quality and treatment requirements for reclaimed wastewater become more stringent as the chances for direct human contact and ingestion increase. The impurities that must be removed depend on the intended use of the water. For example, removal of phosphates or nitrates is not necessary if the intended use is landscape irrigation. If direct reuse as a potable supply is intended, tertiary treatment with multiple barriers against contaminants is required. This may include secondary treatment followed by granular media filtration, ultraviolet radiation, granular activated carbon adsorption, reverse osmosis, air stripping, zonation, and chlorination.

The use of gray-water recycling systems in new commercial buildings offers a method of saving water and reducing total sewage volumes. These systems filter and chlorinate drainage from tubs and sinks and reuse the water for no potable purposes (e.g., flushing toilets and urinals). Recycled water can be marked with a blue dye to ensure that it is not used for potable purposes. The residue that accumulates in sewage treatment plants is called sludge (or bio solids). Sewage sludge is the solid, semisolid, or slurry residual material that is produced.

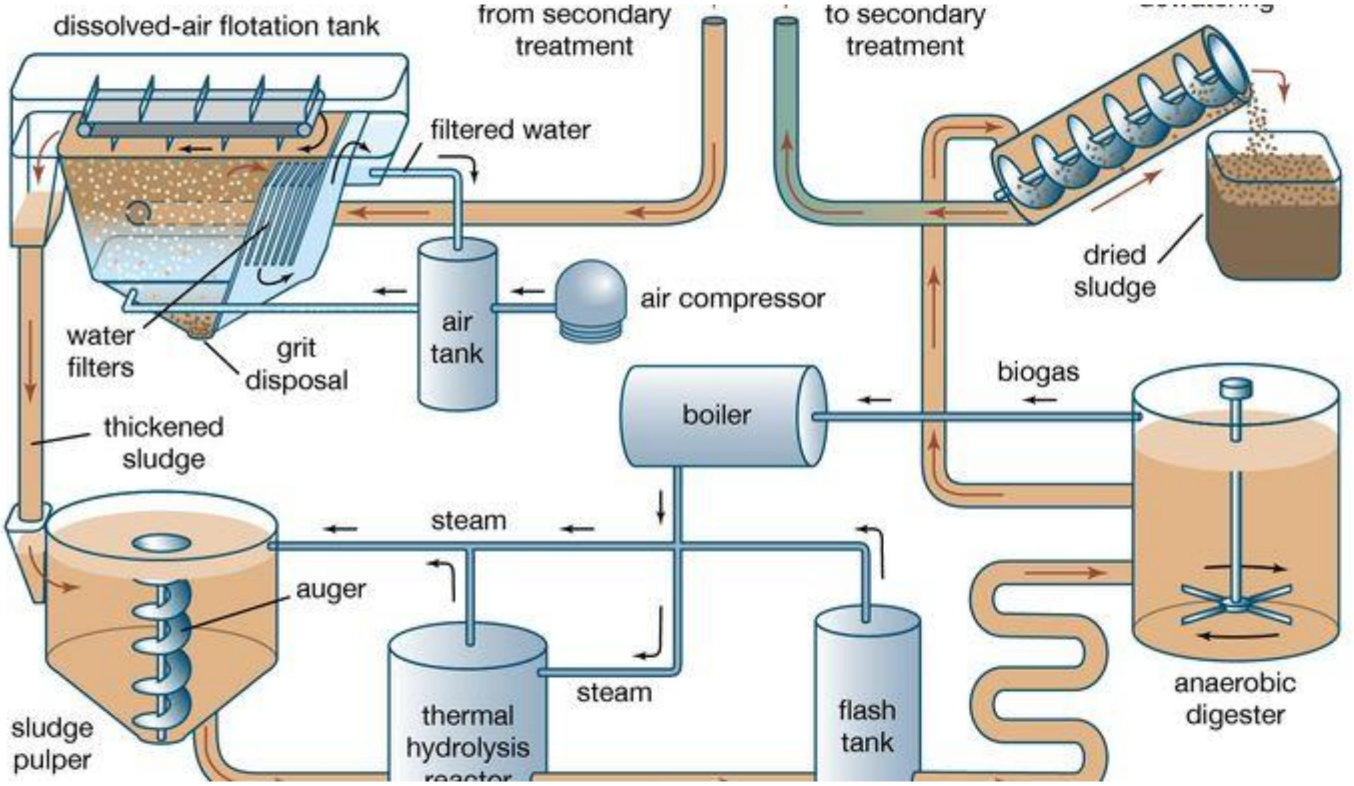

Figure: 4

Thickening

Thickening is usually the first step in sludge treatment because it is impractical to handle thin sludge, a slurry of solids suspended in water. Thickening is usually accomplished in a tank called a gravity thickener. A thickener can reduce the total volume of sludge to less than half the original volume. An alternative to gravity thickening is dissolved-air flotation. In this method, air bubbles carry the solids to the surface, where a layer of thickened sludge forms.

Digestion

Sludge digestion is a biological process in which organic solids are decomposed into stable substances. Digestion reduces the total mass of solids, destroys pathogens, and makes it easier to dewater or dry the sludge. Digested sludge is inoffensive, having the appearance and characteristics of a rich potting soil.

Most large sewage treatment plants use a two-stage digestion system in which organics are metabolized by bacteria anaerobically (in the absence of oxygen). In the first stage, the sludge, thickened to a dry solids (DS) content of about 5 percent, is heated and mixed in a closed tank for several days. Acid-forming bacteria hydrolyze large molecules such as proteins and lipids breaking them into smaller water-soluble molecules, and then ferment those smaller molecules into various fatty acids. The sludge then flows into a second tank, where the dissolved matter is converted by other bacteria into biogas, a mixture of carbon dioxide and methane. Methane is combustible and is used as a fuel to heat the first digestion tank as well as to generate electricity for the plant.

Anaerobic digestion is very sensitive to temperature acidity, and other factors. It requires careful monitoring and control. In some cases, the sludge is inoculated with extra hydrolytic enzymes at the beginning of the first digestion stage in order to supplement the action of the bacteria. It has been found that this enzymatic treatment can destroy more unwanted pathogens in the sludge and also can result in the generation of more biogas in the second stage of digestion.

Another enhancement of the traditional two-stage anaerobic digestion process is thermal hydrolysis, or the breaking down of the large molecules by heat. This is done in a separate step before digestion. In a typical case, the process begins with a sludge that has been dewatered to a DS content of some 15 percent. The sludge is mixed with steam in a pulper, and this hot homogenized mixture is fed to a reactor, where it is held under pressure at approximately 165 °C (about 330 °F) for about 30 minutes. At that point, with the hydrolytic reactions complete, some of the steam is bled off (to be fed to the pulper), and the sludge, still under some pressure, is released suddenly into a “flash tank,” where the sudded drop in pressure bursts the cell walls of much of the solid matter. The hydrolyzed sludge is cooled, diluted slightly with water, and then sent directly to the second stage of anaerobic digestion.

Sludge digestion may also take place aerobically—that is, in the presence of oxygen. The sludge is vigorously aerated in an open tank for about 20 days. Methane gas is not formed in this process. Although aerobic systems are easier to operate than anaerobic systems, they usually cost more to operate because of the power needed for aeration. Aerobic digestion is often combined with small extended aeration or contact stabilization systems.

Aerobic and conventional anaerobic digestion convert about half of the organic sludge solids to liquids and gases. Thermal hydrolysis followed by anaerobic digestion can convert some 60 to 70 percent of the solid matter to liquids and gases. Not only is the volume of solids produced smaller than in conventional digestion, but the greater production of biogas can make some wastewater treatment plants self-sufficient in energy.

Dewatering

Digested sewage sludge is usually dewatered before disposal. Dewatered sludge still contains a significant amount of water—often as much as 70 percent—but, even with that moisture content, sludge no longer behaves as a liquid and can be handled as a solid material. Sludge-drying beds provide the simplest method of dewatering. A digested sludge slurry is spread on an open bed of sand and allowed to remain until dry. Drying takes place by a combination of evaporation and gravity drainage through the sand. A piping network built under the sand collects the water, which is pumped back to the head of the plant. After about six weeks of drying, the sludge cake, as it is called, may have a solids content of about 40 percent. It can then be removed from the sand with a pitchfork or a front-end loader. In order to reduce drying time in wet or cold weather, a glass enclosure may be built over the sand beds. Since a good deal of land area is needed for drying beds, this method of dewatering is commonly used in rural or suburban towns rather than in densely populated cities.

Alternatives to sludge-drying beds include the rotary drum vacuum filter, the centrifuge, and the belt filter press. These mechanical systems require less space than do sludge-drying beds, and they offer a greater degree of operational control. However, they usually have to be preceded by a step called sludge conditioning, in which chemicals are added to the liquid sludge to coagulate solids and improve drain ability.

Disposal

The final destination of treated sewage sludge usually is the land. Dewatered sludge can be buried underground in a sanitary landfill It also may be spread on agricultural land in order to make use of its value as a soil conditioner and fertilizer. Since sludge may contain toxic industrial chemicals, it is not spread on land where crops are grown for human consumption.

Where a suitable site for land disposal is not available, as in urban areas, sludge may be incinerated. Incineration completely evaporates the moisture and converts the organic solids into inert ash. The ash must be disposed of, but the reduced volume makes disposal more economical. Air pollution control is a very important consideration when sewage sludge is incinerated. Appropriate air-cleaning devices such as scrubbers and filters must be used.

Dumping sludge in the ocean, once an economical disposal method for many coastal communities, is no longer considered a viable option. It is now prohibited in the United States and many other coastal countries.

Emerging technologies

Experts in the wastewater treatment sector have been working to implement established technologies and to improve environmental rules and regulations to meet water quality goals and human health protection. At the same time, the industry has also been transitioning to prepare for future challenges, such as climate changing populations, and aging infrastructure.

2.8 Improved treatment methods

Many older wastewater treatment facilities require upgrading because of increasingly strict water quality standards, but this is often difficult because of limited space for expansion. In order to allow improvement of treatment efficiencies without requiring more land area, new treatment methods have been developed. These include the membrane bioreactor process, the ballasted floc reactor, and the integrated fixed-film activated sludge (IFAS) process.

In the membrane bioreactor process, hollow-fiber microfiltration membrane modules are submerged in a single tank in which aeration, secondary clarification, and filtration can occur, thereby providing both secondary and tertiary treatment in a small land area.

In a ballasted floc reactor, the settling rate of suspended solids is increased by using sand and a polymer to help coagulate the suspended solids and form larger masses called flocs. The sand is separated from the sludge in a hydro clone, a relatively simple apparatus into which the water is introduced near the top of a cylinder at a tangent so that heavy materials such as sand are “spun” by force the outside wall. The sand collects by gravity at the bottom of the hydro clone and is recycled back to the reactor.

Biological aerated filters use a basin with submerged media that serves as both a contact surface for biological treatment and a filter to separate solids from the wastewater. Fine-bubble aeration is applied to facilitate the process, and routine backwashing is used to clean the media. The land area required for a biological aerated filter is only about 15 percent of the area required for a conventional activated sludge system.

Automation

Advanced wastewater purification processes involve biological treatments that are sensitive to processing parameters and to the environment. To ensure stable and reliable operations of physical, chemical, and biological processes, treatment plants quite often need to implement sophisticated technologies involving complex instrumentation and process control systems. Use of online analytical instruments, programmable logic controllers (PLC), supervisory control and data acquisition (SCADA) systems, human machine interface (HMI), and various process control software allow for the automation and computerization of treatment processes with the provision for remote operations. Such innovations improve system operations significantly, thus minimizing supervision needs.

Environmental considerations

Natural treatments, energy conservation, and carbon footprint reduction are some of the key considerations for communities facing energy and electricity challenges. Green technologies and the use of renewable energy sources, including solar and wind power, for wastewater treatment are evolving and will help minimize the environmental impacts of human activities. Ecological and economical natural wastewater treatment and disposal systems have already gained importance in many places, especially in smaller communities. These include constructed wetlands, lagoons, stabilization ponds, soil filters, drip irrigation, groundwater recharge, and other similar systems. The simplicity, cost-effectiveness, efficiency and reliability of these systems have provided potential applications for such environmentally friendly technologies.

Given that wastewater is rich in nutrients and other chemicals, sewage treatment facilities have gained recognition as resource recovery facilities, overcoming their former reputation as mere pollution mitigation entities. Newer technologies and approaches have continued to improve the efficiency by which energy, nutrients, and other chemicals are recovered from treatment plants, helping create a sustainable market and becoming a revenue generation source for wastewater processing Concepts such as nutrient trading have also emerged. The intention of such initiatives is to control and meet overall pollution load targets for a given watershed by trading nutrient reduction credits between point and non-point source dischargers. Such programs can help to minimize nutrient pollution effects as well as reduce financial burdens on societies for costly treatment plant upgrades.

CHAPTER 3

STUDY AREA AND METHODOLOGY

3.0 General

During this research, Gazipur City Corporation Sewage treatment plant And different industries sewage were collected. And tested their physiochemical parameters, namely at Industry, pulp and paper Industry collection: Water samples were collected from gazipur city corporation in the months of February 2022, and tested physical qualities and chemical contents. The samples were well-kept in 1.5 L polyethylene plastic bottles, which had been formerly cleaned with metal-free detergents, washed continually with distilled water, saturated in 10 % nitric acid for 24 h and finally rinsed with deionized water. The sample bottles were labeled with date and sampling location. All samples were kept at 4 °C for further processing and analysis. Analytical methods: Standard procedures were used to analyze the physio-chemical parameters of the water sample. Gravimetric method for TSS and TS, single electrode pH meter (Microprocessor-based pH meter, HANNA pH 211) for pH, Portable Conductivity and TDS Meters (HANNA instruments: HI 98130) for conductivity and total dissolved solid (TDS); turbidity meter (HANNA instruments: HI 93703) for turbidity, 5-Day BOD test for BOD by Fixed control dilution method, closed reflux titrimetric method for the determination of COD, In the laboratory, the water samples were filtered using fine filter paper (Whitman filter paper 41, diameter 125 mm) to remove the suspended materials and flame emission atomic absorption spectrophotometer (FL-AAS model: Shimadzu, Japan, AA6800) were used for the determination of metal concentration (Na, K, Ca, Mg, Fe, Cu, Cr, Pb, Mn As, Cd, Ni, Hg). Sample spike, blank spike and quality control (QC) protocol was followed for each type of sample analysis, including replicate analysis, checking of method blanks, standards of various parameters, etc.

CHAPTR 4
DATA OLLETION AND ANALYSIS

4.1: Main value of different physic-chemical characteristics of waste water.

Test Conducted	Untested Sewage (S1)	Outlet of Primary Sedimentation tank (S2)	Treated Effluent (S3)
pH	6.2+/-0.13	6.0+/-0.13	5.9+/-0.14
Alkalinity (mg/l)	623+/-6.03	278.88+/-4.46	63.2+/-3.36
Total Hardness (mg/l)	413.3+/-3.35	314.18+/-2.13	306.25+/-2.23
TDS(mg/l)	297+/-4.46	284.8+/-3.16	286.2+/-3.7
TSS(mg/l)	771.7+/-4.26	204.05+/-3.95	194.9+/-4.3
DO(mg/l)	0	7.3+/-0.52	7.98+/-0.44
BOD(mg/l)	338.9+/-15.41	113.08+/-5.85	59+/-5.20

Table 1: Main value of different physic-chemical characteristics of waste water.

4.2 CPCB standers for discharge of environmental pollutants.

S.No	Parameter	Inland surface Water	Public Sewer	Land for Irrigation
1.	pH	5.5-9.0	5.5-9.0	5.5-9.0
2.	TSS(mg/l)	100	600	200
3.	BOD(mg/l)	30	350	100

Table 2:CPCB standers for discharge of environmental pollutants.

4.3 Parameters of water before and after treatment (S1,S2,S3)

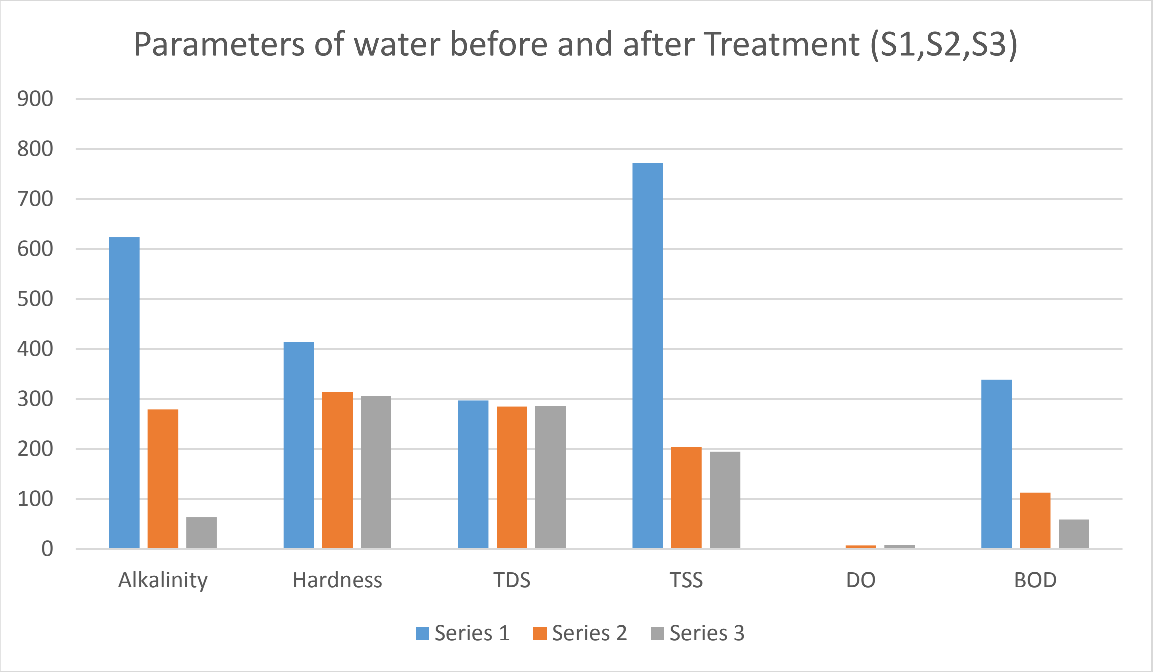

Figure 4: Parameters of water before and after treatment (S1,S2,S3)

CAPTER 5
CONCLUSION

From the above discussion, it has been clear that, the treated water can be used as Irrigation purposes without any further treatment because all standard values for irrigation are justify with treated values. Additionally, the treated water also can be used as aquaculture by treating for modification of TDS, N, P, Fe and MN. Furthermore, the treated water can be used as drinking water by reducing N, Fe, and MN content of treated waste water. Therefore as per the results, it is suggested that the effluent should be pretreated before disposing into the environment. In addition there is an urgent need to improve their efficiency rate by Including advanced tertiary treatment processes such as rapid sand filtration, UV disinfection, chlorination, effluent polishing, construction of artificial wetlands etc. That’s why further treatment are necessary for using the studied water as a drinking and aquaculture purposes by implication of modern method and technology. Since there is no proper treatment plant for sewage in Nag ore Municipal Corporation, it is necessary to construct a Sewage Treatment plant. The plant is designed perfectly to meet the future expansion for the next 30 years (up to the year 2051) in accordance with Indian Coda provisions. The plant is designed perfectly to meet the needs and demands of appropriate 44624 population with a very large time period. The treated sewage water is further used for the irrigation, fire protection, and toilet flushing in public, commercial and industrial buildings and if it is sufficiently clean, it can be used for ground water recharge.

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