A Review Paper on Wastewater Management

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ABSTRACT: Wastewater treatment is the process of restoring water to a desirable quality after it has been used or contaminated by humans or nature. Chemical, biological, and physical mechanisms, as well as a mix of these, may be used in the treatment. Water can be treated to any desired level of purity, but the cost of achieving that purity rises as the purity rises. The intended use of water, such as aquatic life, drinking water, or irrigation, determines the required water quality. This chapter's goal is to discuss the most commonly used wastewater treatment technology today. Finally, the technology chosen for one application might not be the best for another. It's also simple to obtain, with good efficacy and the capacity to degrade pollutants. The utilization of waste water treatment technologies to remove contaminants from wastewater, such as halogenated hydrocarbon compounds, heavy metals, dyes, pesticides, and herbicides, which are the most common pollutants in wastewater is discussed in this paper.

KEYWORDS: Management, Sewage, Sedimentation, Technology, Waste Water.

1. INTRODUCTION

Wastewater is water that has had its physical, chemical, or biological characteristics altered by the introduction of certain chemicals, rendering it unfit for specific uses such as drinking. Man's daily activities are largely dependent on water, and as a result, he discharges "waste" into the water. Body waste (faeces and urine), hair shampoo, hair, food scraps, fat, laundry powder, fabric conditioners, toilet paper, chemicals, detergent, home cleansers, dirt, and microorganisms (germs) are just a few of the things that may make people sick and harm the environment. It is well known that much of the water provided ends up as wastewater, necessitating its treatment. Wastewater treatment is the method and technique for removing the majority of pollutants present in wastewater in order to protect the environment and public health. Wastewater management therefore entails treating wastewater in a manner that protects the environment while also ensuring public health, economic, social, and political stability[1], [2].

1.1 Objectives of Wastewater Treatment:

For the reasons stated above, wastewater treatment is essential. It's more important for the:

- *Reduction of biodegradable organic compounds in the environment*- Organic substances in organic matter, such as carbon, nitrogen, phosphorus, and sulphur, must be broken down by oxidation into gases that are either released or stay in solution.
- *Reduced nutrient content in the environment*- Nutrients such as nitrogen and phosphorus from wastewater in the environment enrich or make water bodies' eutrophic, allowing algae and other aquatic plants to thrive. These plants deplete oxygen in water bodies, causing aquatic life to suffer.
- *Pathogen elimination*- Pathogens are organisms that cause illness in plants, animals, and people. They're also called microorganisms since they're so little that they can't be seen with the human eye. Bacteria (e.g. Vibrio cholerae), viruses (e.g. enterovirus, hepatitis A and E virus), fungi (e.g. Candida albicans), protozoa (e.g. Entamoeba hystolitica, Giardia lamblia), and helminthes (e.g. Schistosoma mansoni, Asaris lumbricoides) are examples Infected animals and people excrete significant amounts of these microorganisms in their faeces.
- *Water recycling and reuse*- Water is a limited and finite resource that is frequently taken for granted. Population growth in the latter part of the twentieth century has put further strain on already precious water supplies. The agrarian nature of many places has also changed as a result of urbanisation. Increased population means more food must be produced, and agriculture, as we all know, is by far the greatest user of available water, implying that economic expansion is putting additional demands on existing water supplies. With groundwater supplies becoming depleted, the temporal and geographical distribution of water is also a key problem. Recycling and reuse are critical for long-term sustainability for these reasons[3]–[5].

1.2 Types of Wastewater:

There have been find out diverse kinds of the wastewaters and their sources around the globe in last decade. Figure 1 illustrates the types of wastewater.

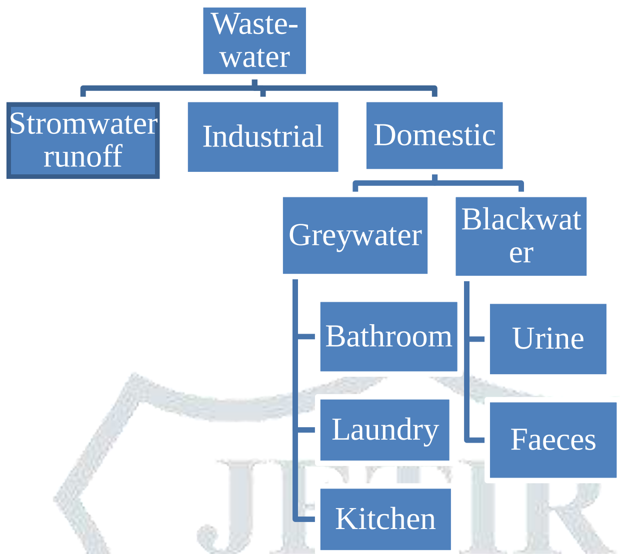

Figure 1: Illustrates the types of wastewater.

1.3 Levels of Wastewater Treatment:

Treatment is divided into three categories: primary, secondary, and tertiary. Preliminary therapy is sometimes used before primary treatment.

- *Preliminary treatment*- Removes ground material suspended and grits in the preparatory treatment. Chambers can be utilised to remove these pollutants by screening and gritting them. This makes it easier for future treatment units to run and maintain. Flow measurement devices like steady wave flumes are needed at this phase of treatment.
- *Primary treatment*- Removes organic and inorganic particles from settling while skimming removes floating materials (scum). This stage enables up to 50% BOD5, 70% suspended particles and 65% of grate and oil to be removed. Also removed are heavy metals, organic nitrogen and organic phosphorus. But no dissolved or colloidal components are eliminated at this stage. The waste waters generated by the main sedimentation units are primary effluent.
- *Secondary treatment*- This is the removal from the original effluent of remaining organics and suspended particles. Biodegradable dissolved and colloidal organic waste is removed additionally by aerobic biologic treatment techniques. When organic material is removed, both phosphorus and nitrogen compounds are removed as well as dangerous microorganisms. Examples of mechanical treatment include filters for trickle, activated sludge methods and RBC or non-mechanical treatment, for example anaerobic treatment, oxidising troughs and stabilisation pools.
- *Tertiary treatment or advance treatment*- When specific waste water components not eliminated by secondary treatment have to be removed, therapeutic therapy or advance therapy is performed. During advanced treatment significant amounts of nitrogen, phosphate, heavy metals, biodegradable organics, bacteria and viruses are removed. The effective filtering of secondary waste can be used by the traditional sand (or similar media) filters and newer membrane materials. Certain filters are enhanced, and filters and membranes eliminate helminths. The newest approach is disc filtering with large fabric discs connected to revolving tambours.

  Disinfection using Chlorine, Ozone, and Ultra Violet (UV) irradiation can be done at this point to bring the water up to current international requirements for agricultural and urban re-use. There are both traditional and non-traditional wastewater treatment technologies that have been proved to be effective in the treatment of wastewater. When compared to non-traditional wastewater treatment technologies, conventional systems have a higher level of automation. Pumping and power are usually required. The system's operation and maintenance need specialised labour[5]–[7]. Figure 2 shows a typical wastewater treatment plant.

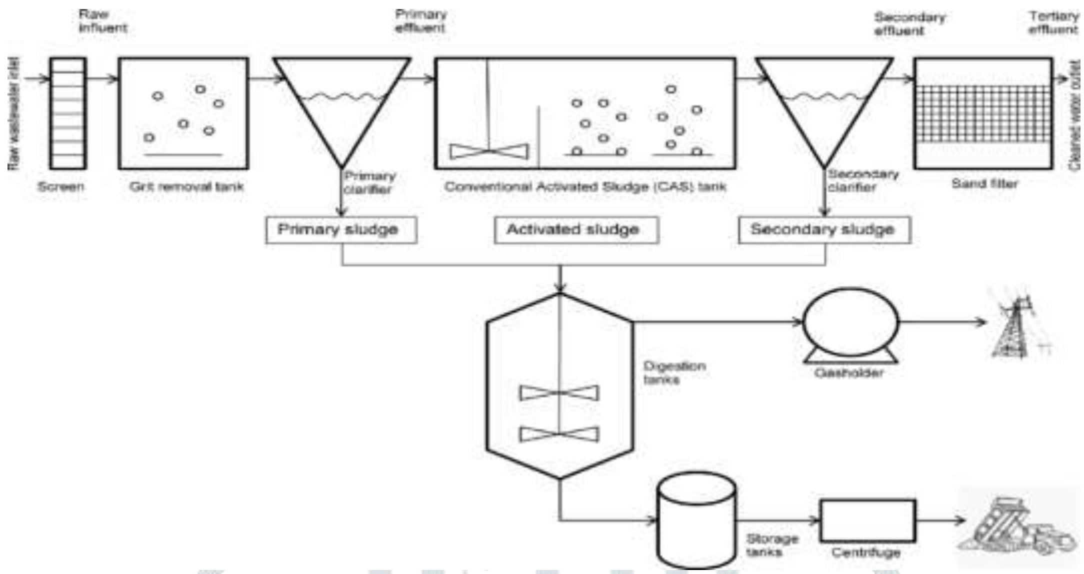

Figure 2: Shows a typical wastewater treatment plant.

1.4 Conventional Methods:

Examples include conventional sludge processing, trickling filters, biological contactor rotational methods. Filters to be truncated are sensitive to temperature, less BOD can be removed, and filters to truncate cost more than sludge systems to build. Activated sludge systems are significantly more costly to work as energy is required to power pumps and blowers (National Technological Learning Programme. The next sections explain these approaches in depth.

1.4.1 Activated Sludge:

Biological approaches for treating organisms in suspension are referred to as activated sludge, which eliminate BOD and suspended particles. It works on the premise that high aeration of waste water generates bacterial flocs (active loam) that break down organic compounds and may be sedimented. The system is comprised of ventilation and installation tanks, return and waste pumps, aeration mixers and blowers and a flow monitoring unit. Some of the sludge activated is recycled to keep active bacteria in the tank concentration. Primary effluent (or influent plant) is combined with a return of activated sludge and aerated for a specific period of time in order to produce the mixed liquor. The organic matter in the system when the system is aerated, is used by activated sludge organisms to produce stable solids and extra organisations.

1.4.2 Trickling Filter:

It is an expanding method in which inert packaging material is connected with medicinal micro-organisms. It is composed of a circular tank containing a carrier material (vulcanic rock, gravel or synthetic). The organic material in the waste water is absorbed into the media as a biological film or as a slime (about 0.1 to 0.2 mm thick) adhesive or slime layer adhered to the medium as a biological or slime-like film (approximately) (approximately 0.1 to 0.2 mm thick). Organic material in the outermost layer of the slime layer is destroyed by aerobic bacteria. Anaerobic organisms are present, since oxygen cannot reach the medium face if the thickness of the layer is caused by microbial growth.

1.4.3 Rotating Biological Contactors:

RBCs (rotating biological contactors) are made up of vertically stacked plastic media revolving on a horizontal shaft. The polymers are between 2 and 4 metres in diameter and up to 10 millimetres thick (Peavy, Rowe ad Tchobanoglous, 1985). As the shaft gently spins at 1–1.5 rpm (required to produce hydraulic shear for sloughing and maintains turbulence to keep solid in suspension), the biomass-coated media are alternately exposed to wastewater and atmospheric oxygen, with about 40% of the media submerged. The vast surface area allows for the development of a large, steady biomass population, with excess growth being shed and eliminated in a downstream clarifier. RBC systems are relatively new, and despite their apparent suitability for treating municipal wastewater, they have been placed in a number of petroleum plants due to their capacity to swiftly recover from disturbed circumstances. Should the need arise, the RBC system is easily extensible, and RBCs are also extremely straightforward to encapsulate should volatile organic content containment be required. RBCs use very little power and can even be operated by compressed air, which helps to aerate the system. They operate according to basic methods and hence demand relatively trained labour. RBCs, on the other hand, are expensive to install and are temperature sensitive.

1.4.4 Membrane Bioreactors:

This technique entails more than one therapy procedure. Membrane bioreactor (MBR) systems are one-of-a-kind procedures that combine anoxic and aerobic biological treatment with an integrated membrane system that can be utilised with virtually any suspended-growth, biological wastewater-treatment system. Before entering the biological treatment tank, wastewater is filtered. Within the aerobic-reactor zone, aeration supplies oxygen for biological respiration while also keeping solids suspended. Submerged membranes are used in MBR to keep active biomass in the process. This permits the biological process to run for longer periods of time than standard sludge ages (usually 20-100 days for an MBR) and to produce more mixed sludge.

MBRs use less acreage since they do not require additional clarifiers, resulting in significant savings in both footprint and concrete costs. They are capable of operating at greater biomass concentrations (MLSS) than traditional treatment methods. Without extending land cover, the facility may be extended by simply adding more membranes to existing basins. It does not require tertiary treatment, polymer addition, or any other treatment methods to fulfil criteria for reuse quality. This decrease in the number of unit processes increases system dependability while also lowering operational costs. The excellent effluent quality decreases the amount of disinfection required throughout the treatment process.

1.5 Non-conventional Methods:

These are biological treatment systems for municipal wastewater that are low-cost, low-tech, and less complicated in operation and maintenance. Despite the fact that these systems require more acreage than traditional high-rate biological processes, they are typically more successful at eliminating pathogens and do so reliably and continuously if the system is correctly built and not overwhelmed. Stabilization ponds, artificial wetlands, oxidation ditches, and soil aquifer treatment are some of the non-traditional approaches.

1.5.1 Waste Stabilization Ponds:

Stabilization of Waste Ponds are shallow, man-made basins that include a single or several series of anaerobic, facultative, or maturation ponds. This is a low-tech treatment method that uses four or five ponds of varying depths and biological activity. The components of wastewater are removed by sedimentation or changed by biological and chemical processes during treatment. The major purpose of anaerobic ponds is to settle and remove suspended particles, as well as to break down certain organic waste (BOD_5). Organic matter is further broken down into carbon dioxide, nitrogen, and phosphorus in facultative ponds by utilising oxygen generated by algae in the pond. Maturation ponds often remove nutrients and harmful bacteria, thus anaerobic ponds receive primary treatment, while facultative and maturation ponds receive secondary and tertiary treatment, respectively. Anaerobic ponds are typically 2-5 metres deep and receive significant organic loads of 100 grammes BOD_5 and m3/d, resulting in anaerobic conditions throughout the pond (Mara et al.1992).

Anaerobic ponds can remove 60% of BOD_5 at 200°C if correctly constructed. Facultative ponds are typically 1-2 metres deep and receive wastewater from an anaerobic pond. They accept raw wastewater and function as a primary facultative pond in some designs. Organic loads are lower in facultative ponds, allowing for algal bloom, which accounts for the wastewater's dark green colour. BOD_5 is broken down by algae and aerobic microorganisms, which produce oxygen. Maturation ponds are typically shallow ponds with a depth of 1.0-1.5 m, allowing aerobic conditions to be established for the treatment of facultative pond effluents. Here, organic materials, nutrients, and harmful bacteria are further reduced. In maturation ponds, the algal population is more varied, and nitrogen and ammonia elimination is more dominant[8].

1.5.2 Constructed Wetlands:

Built wetlands (CWs) are planned systems designed and constructed to utilise wetland vegetation in a more regulated environment than wild wetlands to assist wastewater treatment. The secondary and tertiary treatment methods for municipal and industrial wastewater are efficient and ecologically sound. Everything may be eliminated from organic materials, suspended particles, nutrients, bacteria, heavy metals and dangerous pollutants. They cannot be used for raw sewage or industrial wastewater pre-treatment to maintain the biological balance of the wetland environment. The two kinds of CWs are FreeWater Surface (FWS) and Subsurface Flow (SSF). Water pours over the ground into FWS, whereas plants planted under the water column in the sediment layer, as its name suggests. Water flows into a porous media like gravel, which is rooted in plants in the SSF. As waste water does not come into direct contact with the atmosphere, SSF for public health reasons should be used in the basic treatment of waste water[9], [10].

2. DISCUSSIONS

2.1 Challenges of Wastewater Management:

Although the management of waste water is not technically complicated, socio-economic issues may occur. Some of the problems are discussed below.

2.1.1 Infrastructure:

In most governments, wastewater infrastructure is not regarded as a priority and very little investment is therefore made. However, because almost all water is produced as wastewater it is equally as essential as water treatment facilities. wastewater infrastructure.

2.1.2 Pollution of Water Sources:

The consequences of wastewater discharge on the water quality are considerable; the aquatic environment is affected and the aquatic ecosystem is therefore interrupted. The urine and faeces of the food we eat contain carbonaceous components, nutrients, trace elements, and salts (black water). Medicines (drugs), chemicals and hormones are also available in the waste water treatment plant (contraceptives). The letter must comply with the discharge standards. This ensures that water supplies are viable for the long run. The precautionary and environmental ideas for the prevention or reduction of waste water contamination have been highly beneficial and should be applied in developing nations.

2.1.3 Choice of Appropriate Technology:

Because the economy of most developed countries is donor based, donors are responsible for the bulk of wastewater treatment plants. As a result, the technology to be employed is more likely to be suggested. Through a lack of technical knowledge, power requirements and other reasons the recipients take over the plant, the management and maintenance of operations are exceedingly challenging.

2.1.4 Sludge Production:

Wastewater treatment produces wastewater sludge. A reliable disposal method must be available. The hazards connected with it have to be addressed when utilised in agriculture. As heavy metals are found in wastewater, farm usage is often thought to lead to the build-up of heavy metals in soils that contaminate the crops.

2.1.5 Reuse:

Effluents that meet the discharge conditions, such as aquaculture or irrigation, may be used in agriculture. This is because reuse becomes risky if wastewater treatment systems are not adequately maintained and monitored to ensure adequate effluent quality.

3. CONCLUSION

Without water you cannot survive, thus waste water is with us, and always will be with us. Where water is used for a range of human activities, its characteristics are contaminated or modified, leading to waste water. Waste water may and should be treated to provide a healthy environment and enhance public health.

The technique of wastewater treatment is traditional and non-conventional, and the choice of one should be based on criteria such as the characteristics of the wastewater, whether from a municipality or an industrial sector (chemical, textile, pharmaceutical, etc.). In majority of the impoverished countries, such as Ghana, low-cost low technology solutions like waste stabilisation ponds have proven successful, but older approaches such as filter trickling and sludge activated systems have failed. The wastewater which meets specific discharge standards can benefit from both aquaculture and irrigation. Despite various barriers to the handling of waste water, adequate attention and financial support may be given to the management.

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