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Study & Analysis of Various Technologies of waste water TreatmentSystems Based on Certain Established Criteria

Aditya Mandrai

M.Tech. Scholar, Department of Civil and Applied Mechanics engineering,

Shri GovindramSeksaria Institute of Technology and Science, Indore, (M.P), India

Devendra Dohare

Assistant Professor, Department of Civil and Applied Mechanics engineering,

Shri GovindramSeksaria Institute of Technology and Science, Indore, (M.P), India

ABSTRACT

The population of the Earth is expected to surpass 10 billion people by the year 2050. We need technology to offer secure and safe supplies of water for the production of food and energy in order to fulfil the fundamental demands of the people. By addressing problems with water resources and establishing new sources of high-quality water supplies, water reclamation, recycling, and reuse attempt to solve these problems. The study and selection of the treatment procedures and technologies that can satisfy the criteria is one of the trickiest parts of designing a sustainable sewage treatment system. This study covers several waste water treatment systems and shows how to choose a good solution based on predetermined standards.

Keywords:*Waste water treatment, Membrane Technology,Moving Bed Biofilm Reactor, Membrane Bio Reactor (MBR) Technology, Water Recycling.*

1. INTRODUCTION

Lack of access to sanitary facilities and clean water is among the most widespread issues affecting people worldwide [1]. The population of the Earth is predicted to surpass 10 billion people by the year 2050. We need technology to offer secure and safe supplies of water for the production of food and energy in order to fulfil the fundamental demands of the people. [2]. Water supply issues affect communities all around the globe as a result of rising demand, droughts, groundwater depletion and pollution, and reliance on solitary sources of supply. By addressing problems with water resources and establishing new sources of high-quality water supplies, water reclamation, recycling, and reuse solve these problems [3]. The broad adoption of water reuse is hampered by a number of fundamental obstacles. There is a need for novel technologies, technology transfer, and novel applications among these; there is also a need for public education and increased acceptance; there is a lack of funding for projects involving the reuse of water; and there is a need for support from appropriate laws and regulations. The study and selection of the treatment procedures and technologies that can satisfy the criteria is one of the trickiest parts of designing a sustainable sewage treatment system. The method should be chosen depending on the needed level of treated water quality. When choosing the best technology, factors like as effluent quality, process complexity, process dependability, environmental concerns, and land needs should also be considered in addition to treatment costs. This essay compiles research on the many waste water treatment systems that are already in use and shows how to choose the best technology based on predetermined standards.

2. WASTE WATER TREATMENT TECHNOLOGIES

Different techniques are used for waste water treatment. According to how well the methods remove different waste water elements, they have been categorized. These entail the removal of colloidal and suspended materials, organic and inorganic, dissolved organic and inorganic, and biological components.

2.1 Process for Activated Sludge

The most popular suspended growth technology utilized for waste water treatment is the activated sludge process (ASP). This method involves aerating waste water that contains organic material so that microorganisms may break down the suspended and soluble organic stuff. A portion of organic material is converted into new cells while a second portion is oxidized into CO2 and water to provide energy. The new cells created during the reaction are removed from the liquid stream in settling tanks in activated sludge systems in the form of a waste sludge. The activated sludge portion of this settled biomass is returned to the aeration tank, leaving the waste or surplus sludge seen in Figure 1.

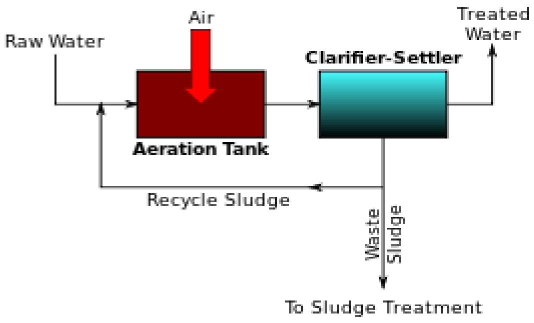

Fig. 1: Schematic of Activated Sludge Process

An activated waste plant is following process:

1. Waste water aeration in the presence of a microbiological suspension is a component of

2. After aeration, solid-liquid separation
3. releasing purified effluent
4. removing surplus biomass, and
5. Bringing back any leftover biomass to the aeration tank.

It has a primary clarifier built in to lessen the organic load in the biological reactor (aeration basin). The amount of organic load that must go into the aeration tank is reduced by around 40% when it is intercepted in the primary clarifier as sludge. The aeration tank's retention time is kept between 4 and 6 hours. The combined liquor is delivered to secondary clarification, where sludge and liquid are separated, after the aeration tank. The sludge is mostly recycled, and any extra is transferred to a digester. If primary clarifier sludge and surplus secondary clarifier sludge are not matured, digestion of such sludge is necessary before disposal. Such sludge creates biogas during anaerobic sludge digestion, which may be utilized by gas engines to generate electricity. The plant may be operated using the generated electricity [4].

2.2 Moving Bed

Moving Bio Reactor Bed Biofilm An aerobic attached biological development process is known as a reactor. Sludge recirculation and primary clarifier are not necessary. Raw sewage is supplied to the biological reactor after screening and regretting. Plastic floating media is provided for the reactor and is kept in suspension. The media's surface generates biological mass. For their metabolism, attached biological mass eats organic stuff. Extra biological matter exits the media's surface and settles in the clarifier. In the reactors, a detention period of typically 5 to 12 hours is show in Fig. 2.

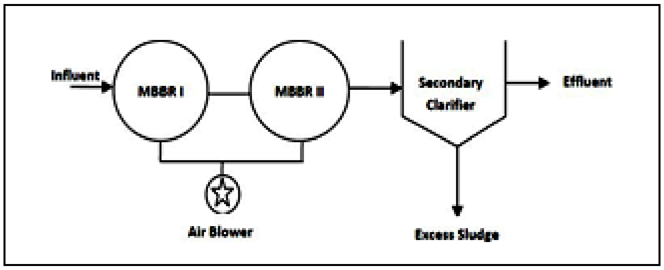

Fig. 2: Schematic of MBBR

The whole tank capacity is used by MBBR to grow biomass. Additionally, the head-loss is relatively minimal. It does not need any sludge recycling, in contrast to the activated sludge reactor. This is accomplished by allowing the biomass to grow on carriers that can freely travel through the reactor's water volume while being contained there by a sieve setup at the reactor exit. The reactor may be utilized for processes that are aerobic, anoxic, or anaerobic [5].

2.3 Sequencing Sample Reactor

Sequencing A fill and draw type activated sludge system is called a batch reactor (SBR). Waste water is added to a single batch reactor in this system, treated to eliminate impurities, and then released. The traditional activated sludge system and the SBR process are the same, but the SBR accomplishes equalization, biological treatment, and secondary clarifying in a single tank utilizing a time-controlled sequence, which is the difference between the two technologies. A single batch reactor, as shown in Fig. 3, may be used to accomplish equalization, aeration, and clarifying.

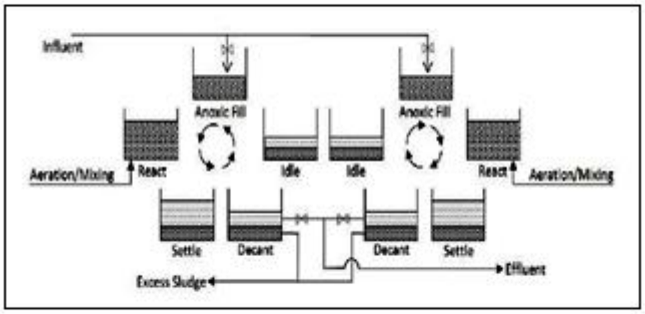

Fig. 3: Schematic of SBR

The sequential batch reactor (SBR) method of treating activated sludge is cyclical. The wastewater is treated in batches using a number of reactors. To decrease total nitrogen to a level that complies with the permit restrictions, sequencing batch reactors will be run to oxidize carbonaceous BOD, nitrify the ammonia, and denitrify. There is no longer a need for separate clarification and return activated sludge systems since all treatment activities, such as equalization, aeration, denitrification, sedimentation, and decanting, take place in the SBRs [6].

Five stages are shared by all SBR systems, and they are completed in the order shown below.

1. **Fill:** As waste water enters the reactor, it mixes with the biomass that is already there. Different conditions may be created by filling influent, such as static fill, mixed fill, and aerated fill.
2. **React:** Depending on the circumstances, such as anaerobic, anoxic, or aerobic reactions, the biomass consumes substrate found in the waste water.
3. **Aeration and mixing** when the reaction enough time to complete, and the biomass is then allowed to separate from the liquid, producing clear supernatant.
4. **Decant:** The reactor is emptied of any clear supernatant processed waste water.
5. **Idle**: During this period of time between cycles, the SBR is prepared for the next cycle. Additionally, it is utilized to modify the interval between SBR reactor cycles. In this step, sludge waste is also carried out.

2.4 Up-flow Blanket of anaerobic sludge

Carbon emissions and, thus, the carbon footprint of water utilities are significant issues today. In this regard, we should think about ways to lessen the carbon footprint of both small and big wastewater treatment facilities. This goal would be accomplished by using anaerobic treatment procedures rather than aerobic ones since there is no need for aeration and methane production may be put to use within the facility. Due to its large loading capacity and minimal sludge output, high-rate anaerobic digesters are quite popular. The up flow anaerobic sludge blanket (UASB) reactors have been the most often used of them all [7]. In an anaerobic process known as an up flow anaerobic sludge blanket (UASB), influent waste water is dispersed at the reactor's bottom and flows upward through the sludge blanket. The significant factors in UASB design includedesign of the gas-liquid-solid separator (GLSS), the distribution system, and the effluent extraction system. UASB permits the utilization of higher hydraulic loading than other anaerobic processes, as seen in Fig. 4.

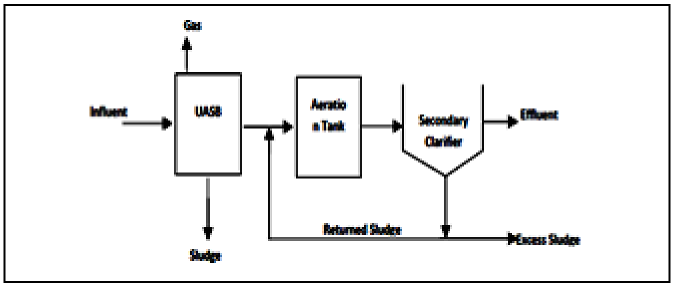

Fig. 4: Schematic of UASB

2.5 Bio Membrane Reactor

In contrast to the traditional activated sludge (CAS) method, which is unable to handle either variations in wastewater composition or flow rate, membrane bioreactor (MBR) technology has become increasingly widespread, prevalent, and accepted in recent years for the treatment of various kinds of wastewaters. In situations when the demand for effluent quality surpasses CAS capabilities, MBR technology is also utilized. It seems that the conventional process is upgraded even when traditional treatment is effective, despite the fact that MBR capital and operating expenses are higher than those of conventional process. It may be connected to the rising cost of water, the necessity for water recycling, and stricter rules regarding the effluent quality. MBR may be required as an update to current technology in wastewater treatment plants (WWTPs) in order to meet regulatory requirements, along with improved awareness of emerging pollutants in wastewater, their biodegradability, and their inclusion in future rules [8].Membrane Bio Reactors (MBR) combine an active sludge-based biological treatment technology for suspended growth with membrane filtration machinery, commonly low-pressure microfiltration (MF) or ultra-filtration (UF) membranes, to treat waste water. The vital task of solid-liquid separation is carried out by the membranes. This is often done in activated sludge plants employing secondary and tertiary clarifiers together with tertiary filtering. It is a biological reactor that has biomass in suspension. A microfiltration membrane with pore diameters between 0.1 and 1.0 m separates the solid from the liquid in a membrane bioreactor. There is no secondary clarifier used, and the system may function at high MLSS concentrations. For continuous membrane surface scrubbing during filtration, air is injected via inbuilt diffusers, which helps with mixing and, in certain situations, adds oxygen to the biological process shown in Fig. 5.

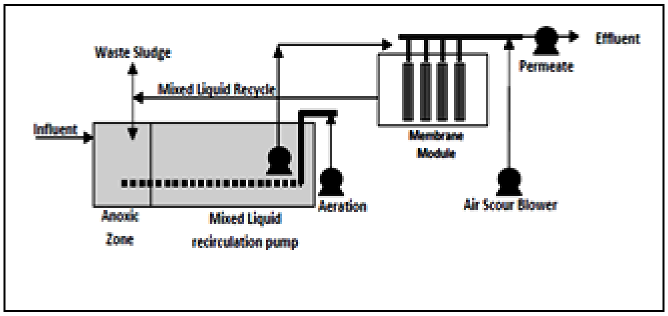

Fig.5: Schematic of MBR

3. COMPARATIVE TECHNOLOGY ANALYSIS

Comparing various technological elements as well as their performance is essential when deciding which technology is best key factors to take into account when choosing a waste water treatment procedure is listed in the table below Table 1. The advantages and disadvantages of various technologies are contrasted with the weighted importance of each criterion. A comparison of the technologies that were discussed in the preceding part is provided in the table below Table 2.

Consideration	Goal
Quality of treated Sewage	Production of treated water of stipulated quality without interruption
Power requirement	Reduce energy consumption
Land required	Minimize land requirement
Capital Cost of Plant	Optimum utilization of capital
Operation & Maintenance costs	Lower recurring expenditure
Maintenance requirement	Simple and reliable
Operator attention	Easy to understand procedures
Reliability	Consistent delivery of treated sewage
Resource Recovery	Production of quality water and manure
Load Fluctuations	With stand variations in organic and hydraulic loads

Table 1: Key Factors Waste water Treatment Procedure

Parameter	ASP	MBBR	SBR	UASB	MBR
BOD, mg/l	<30	<20-30	<5	<30	<3-<5
COD, mg/l	<250	<250	<100	<250	<100
TSS, mg/l	<100	<100	<10	<100	<5
TKN &P mg/l	NT*	NT*	<10 - <2	NT*	NT*
Area, Acres	10.10	5.5	6.3	15.6	5
Capital Cost Rs. Lac (100MLD)	6000	7000	8000	6500	25000
Power cost Rs/m3	1.71	1.8	1.14	1.11	3.0
Chemical Cost	0.07	0.07	0.06	0.07	0.50
Maintenances Rs. /m3	0.22	0.25	0.27	0.22	1.1
Power generation	Nil	Nil	Nil	Yes	Nil

Table 2: Comparison of the technologies in Specimen Parameters

4. TECHNOLOGY HIGH-QUALITYP FACTORS

1.Waste water treatment technique relies on these factors:
2. Waste water nature
3. Process compatibility
4. Contaminant disposal
5. Environmental/economic viability

Using treated effluent for drinking or cooking requires a high level of treatment, thus system components must be eliminated. Waste water's nature relates to the influent's properties, which rely on its contents or pollution level.Compatibility of a treatment procedure refers to its compatibility for a certain situation or waste water type. Also crucial is the mechanism of final disposal of contaminants, as many treatment technologies create secondary pollutants that require safe disposal. The environmental feasibility of a technology relates to the pollution it causes during operation or during storage or disposal of waste. The cost of attaining the specified effluent quality will determine whether a given technology is worth implementing.

5. CONCLUSION

Water recycling and reuse are crucial to reducing water deficit. One-fourth of the world population confronts economic water shortages due to inadequate water management. To solve the water problem, appropriate water recycling and reuse management is needed. Conventional waste water treatment procedures don't provide high-quality effluent. Advanced waste water treatment solutions are needed to increase plant efficiency and provide high-quality effluent for reuse. ASP, MBBR, SBR, MBR, and UASB have been investigated and analyzed for their performance to meet specific requirements. Serving the world's population with clean water and sanitation is crucial for health and prosperity. To fulfil the fundamental requirements of the population, which is expected to reach over 10 billion by 2050, technical advances in water recycling and reuse will supply secure and safe supplies of water for food and energy production.

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