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Review on Wastewater Treatment Plant

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ABSTRACT: Wastewater treatment is a process used to remove contaminants from wastewater or sewage and convert it into an effluent that can be returned to the water cycle with acceptable impact on the environment, or reused for various purposes (called water reclamation). The treatment process takes place in a wastewater treatment plant (WWTP), also referred to as a Water Resource Recovery Facility (WRRF) or a Sewage Treatment Plant (STP) in the case of domestic wastewater. Pollutants in wastewater are removed, converted or broken down during the treatment process.The development of innovative technologies for treatment of wastewaters from various industries is a matter of alarming concern for us. Although many research papers have been reported on wastewater pollution control studies, but a very few research works is carried out for treatment of wastewater of steel industries, especially in reference to development of design of industrial effluent Treatment Plants (ETP) system. Another beneficial aspect of this research work will be recycling, reuse of water and sludge from steel industry The whole technologies for treating industrial wastewater can be divided into four categories: - Chemical, Physical, Biological and mathematical approaches.

KEYWORDS: Sewage, Water Treatment Plant. Water Hygiene, Water Filter Suppliers, Sewage Water Treatment Filters

I. INTRODUCTION

Wastewater treatment is a process used to remove contaminants from waste water and convert it into an effluent that can be returned to the water cycle. Once returned to the water cycle, the effluent creates an acceptable impact on the environment or is reused for various purposes (called water reclamation). The treatment process takes place in a wastewater treatment plant. There are several kinds of wastewater which are treated at the appropriate type of wastewater treatment plant. For domestic wastewater (also called municipal wastewater or sewage), the treatment plant is called a sewage treatment plant. For industrial wastewater, treatment either takes place in a separate industrial wastewater treatment plant, or in a sewage treatment plant (usually after some form of pre-treatment). Further types of wastewater treatment plants include agricultural wastewater treatment plants and leachate treatment plants.
Processes commonly used include phase separation (such as sedimentation), biological and chemical processes (such as oxidation) or polishing. The main by-product from wastewater treatment plants is a type of sludge which is usually treated in the same or another wastewater treatment plant. Biogas can be another by-product if anaerobic treatment processes are used. Some wastewater may be highly treated and reused as reclaimed water. The main purpose of wastewater treatment is for the treated wastewater to be able to be disposed or reused safely. However, before it is treated, the options for disposal or reuse must be considered so the correct treatment process is used on the wastewater.

Avaibility of Water and Uses

Water is one of the most vital natural resources for all life on Earth. The availability and quality of water always have played an important part in determining not only where people can live, but also their quality of life. Total utilizable water resource in the country has been estimated to be about 1123 BCM (690 BCM from surface and 433 BCM from ground), which is just 28% of the water derived from precipitation. About 85% (688 BCM) of water usage is being diverted for irrigation (Figure 1), which may increase to 1072 BCM by 2050. Major source for irrigation is groundwater. Water use can mean the amount of water used by a household or a country.

Use of Water is Categorized by following- Commercial water use includes fresh water for motels, hotels, restaurants, office buildings, other commercial facilities, and civilian and military institutions. Domestic water use is probably the most important daily use of water for most people. Domestic use includes water that is used in the home every day,

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including water for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens. Industrial water use is a valuable resource to the nation's industries for such purposes as processing, cleaning, transportation, dilution, and cooling in manufacturing facilities.

Major water-using industries include steel, chemical, paper, and petroleum refining. Industries often reuse the same water over and over for more than one purpose. Irrigation water use is water artificially applied to farm, orchard, pasture, and horticultural crops, as well as water used to irrigate pastures, for frost and freeze protection, chemical application, crop cooling, harvesting, and for the leaching of salts from the crop root zone. Mining water use includes water for the extraction of naturally occurring minerals; solids, such as coal and ores; liquids, such as crude petroleum; and gases, such as natural gas. The category includes quarrying, milling (such as crushing, screening, washing, and flotation), and other operations as part of mining activity. A significant portion of the water used for mining, about 32 percent, is saline.

Public Supply water use refers to water withdrawn by public and private water suppliers, such as county and municipal water works, and delivered to users for domestic, commercial, and industrial purposes. In 1995, the majority of the nation's population, about 225 million, or 84 percent, used water delivered from public water suppliers.

Types of Wastewater Treatment Process: ETP, STP and CETP

Some of the major important types of wastewater treatment process are as follows: 1. Effluent Treatment Plants (ETP) 2. Sewage Treatment Plants (STP) 3. Common and Combined Effluent Treatment Plants (CETP). It is estimated that every year 1.8 million people die due to suffering from waterborne diseases. A large part of these deaths can be indirectly attributed to improper sanitation. Wastewater treatment is an important initiative which has to be taken more seriously for the betterment of the society and our future. Wastewater treatment is a process, wherein the contaminants are removed from wastewater as well as household sewage, to produce waste stream or solid waste suitable for discharge or reuse.

1. Effluent Treatment Plants (ETP):

Effluent Treatment Plants or (ETPs) are used by leading companies in the pharmaceutical and chemical industry to purify water and remove any toxic and nontoxic materials or chemicals from it. These plants are used by all companies for environment protection.

An ETP is a plant where the treatment of industrial effluents and waste waters is done. The ETP plants are used widely in industrial sector, for example, pharmaceutical industry, to remove the effluents from the bulk drugs.

Need of ETP –

∟ To clean industry effluent and recycle it for further use.
∟ To reduce the usage of fresh/potable water in Industries.
∟ To cut expenditure on water procurement.
∟ To meet the Standards for emission or discharge of environmental pollutants from various Industries set by the Government and avoid hefty penalties.
∟ To safeguard environment against pollution and contribute in sustainable development.

Treatment Levels & Mechanisms of ETP –

∟ Treatment levels: Preliminary
∟ Primary
∟ Secondary
∟ Tertiary (or advanced)

Preliminary Treatment level Purpose: Physical separation of big sized impurities like cloth, plastics, wood logs, paper, etc. Common physical unit operations at Preliminary level are: Screening: A screen with openings of uniform size is used to remove large solids such as plastics, cloth etc. Generally maximum 10mm is used. Sedimentation: Physical water treatment process using gravity to remove suspended solids from water. Clarification: Used for separation of solids from fluids.

Primary Treatment Level Purpose: Removal of floating and settleable materials such as suspended solids and organic matter.

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Methods: Both physical and chemical methods are used in this treatment level.
Chemical unit processes: Chemical unit processes are always used with physical operations and may also be used with biological treatment processes. Chemical processes use the addition of chemicals to the wastewater to bring about changes in its quality. Example: pH control, coagulation, chemical precipitation and oxidation. pH Control: To adjust the pH in the treatment process to make wastewater pH neutral. For acidic wastes (low pH): NaOH, Na2CO3 , CaCO3or Ca(OH)2. For alkali wastes (high pH): H2SO4, HCl. Chemical coagulation and Flocculation: • Coagulation refers to collecting the minute solid particles dispersed in a liquid into a larger mass.
• Chemical coagulants like Al2 (SO4)3 {also called alum} or Fe2 (SO4)3 are added to wastewater to improve the attraction among fine particles so that they come together and form larger particles called flocs.
• A chemical flocculent (usually a polyelectrolyte) enhances the flocculation process by bringing together particles to form larger flocs, which settle out more quickly.
• Flocculation is aided by gentle mixing which causes the particles to collide.

II. REVIEW OF LITERATURE

A supply of clean water is an essential requirement for the establishment and maintenance of diverse human activities. Water resources provide valuable food through aquatic life and irrigation for agriculture production. However, liquid and solid wastes produced byhuman settlements andindustrial activities pollute most of the water sources throughout the world. Due to massive worldwide increases in the human population, water will become one of the scarcest resources in the 21st century (Day D., 1996). In the year 2015 the majority of the global population (over 5 billion) will live in urban environments (UN, 1997). By the year 2015, there will be 23 mega-cities with a population of over 10 million each, 18 of which will exist in the developing world (Black, 1994).

Central to the urbanization phenomena are the problems associated with providingmunicipal services and water sector infrastructure, including the provision of both fresh water resources and sanitation services. Currently, providing housing, health care, social services, and access to basic human needs infrastructure, such as clean water and the disposal of effluent, presents major challenges to engineers, planners and politicians (Black, 1994; Giles and Brown, 1997).

As human numbers increase, greater strains will be placed on available resources and pose even greater threat to environmental sources. A report by the Secretary-General of the United Nations Commission on Sustainable Development (UNCSD, 1997) concluded that there is no sustainability in the current uses of fresh water by either developing or developed nations, and that worldwide, water leading to widespread public health problems, limiting economic and agricultural development and adversely affecting a wide range of ecosystems.

Although India occupies only 3.29 million km2 geographical area, which forms 2.4% of the world's land area, it supports over 15% of world's population. The population of India as of March 1, 2001 was 1,027,015,247 persons (Census, 2001). India also has a livestock population of 500 million, which is about 20% of world's total livestock. However, total annual utilizable water resources of the country are 1086 kmwhich is only 4% of world's water resources (Kumar et al., 2005) Total annual utilizable resources of surface water and ground water are 690 and 396 kmrespectively (Ministry of Water Resources, 1999). Consequent to rapid growth in population and increasing water demand, stress on water resources in India is increasing and per capita water availability is reducing day byday. In India per capita surface water availability in the years 1991 and 2001 were 2300 (6.3 m/day) and 1980 m (5.7 m/day) respectively and these are projected to reduce to 1401 and 1191 m by the years 2025 and 2050, respectively (Kumar et al., 2005). Total water requirement of the country in 2050 is estimated to be 1450 km which is higher than the current availability of 1086 km. Much of the wastes of civilization enter water bodies through the discharge of waterborne waste from domestic, industrial and non-point sources carrying unwanted and unrecovered substances (Welch, 1992).

Although the collection of wastewater dates back to ancient times, its treatment is a relatively recent development dating from the late 1800s and early 1900s (Chow et al., 1972). Modern knowledge of the need for sanitation and treatment ofpolluted waters however, started with the frequently cited case of John Snow in 1855, in which he proved that a cholera outbreak in London was due to sewage contaminated water obtained from the Thames River (Cooper, 2001). In developed nations, treatment and discharge systems cansharply differ between countries and between rural and urban users, with respect to urban high income and urban low-income users (Doorn et al., 2006).

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The most common wastewater treatment methods in developed countries are centralized aerobic wastewater treatment plants and lagoons for both domestic and industrial wastewater. The degrees of wastewater treatment vary in most developing countries. Domestic wastewater may be treated incentralized plants, pit latrines, septic systemsor disposedof in unmanaged lagoons orwaterways, via open or closed sewers (UNEP, 2002).

In some cases, industrial wastewater is discharged directly into water bodies, while major industrial facilities may have comprehensive in-plant treatment (Carter et al., 1999; Doorn et al., 2006). In many developing countriesthe bulk of domestic and industrial wastewateris discharged without any treatment or after primary treatment
only. In Latin Americaabout 15% of collected wastewater passes through treatment plants (with varying levels of actual treatment). In Venezuela, 97% of the country's sewage is discharged raw into the environment (Caribbean Environment Programme, Technical Report, 1998). Even a highly industrialized country such as China discharges about 55 percent of all sewage without treatment thevarious water bodies thereby posing very serious health and socio-economic threats to the dependants of such water bodies. Most of sub-Saharan Africa is without wastewater treatment (Sci-Tech. Encyclopaedia, 2007). Modern civilization, armed with rapidly advancing technology and fast-growing economic system is under increasing threat from its own activities causing water pollution, (Singh et al. (1989). India is the seventh largest country in the world with a total landmass of 3.29 million sq. km, population over 1 billion, 29% of which live in urban areas spread over 5162 towns. With enormous natural resources and growing economy India is the second largest pool of technical and scientific personnel in the world.

People's Daily, Friday, November 30, 2001). In a relatively developed Middle Eastern country such as Iran, the majority of Tehran's population has totally untreated sewage injected into the city's groundwater (Tajrishy and Abrishamchi, 2005). In South Africa where some level of wastewater treatment is observed, Momba et al., (2006) reported the poor operational state and inadequate maintenance of most of the municipalities' sewage treatment worksas leading to the pollution.

Pollution from small size industries (SSIs) puts the Indian regulators in front of a difficult arbitrage between economic development and environmental sustainability. Theuncontrolled growth in urban areas has made planning and expansion of water and sewage systems very difficult and expensive (Looker, 1998). Aerobic activated sludge reactors have been used on a limited scale as bio-scrubbers for the treatment of odorous air (Bowker, 2000). Despite numerous positivereports fromfull scaleapplications in North America, little data are available on the actual performance of these systems with wide ranging concerns on reduction of settling efficiency due to changes in filamentous organisms and bacterial flocks (Burgess et al. 2001).

These concerns are alleviated in MBRs where gravitational settling of the microbial solution is replaced by physical filtration. Also, the diffusion and bioconversion of odorous gases are a function of contact time, bubble size, and reactor configuration (Burgess et al. 2001). Submerged MBRs incorporate the membrane unit within the bioreactor and rely on gas and liquidscouring to clean the membrane surface. Since modern livestock operations are equipped withblowers and ventilation systems, booster fans could be added to increase outflow pressure. This concept was explored in past research efforts when biofilter beds (compost and wood chips) were tested for odour removal (Mann et al. 2002).

III. TREATMENT OF SEWAGE

1. Moving Bed Biofilm Reactor (MBBR)

It's a mix of activated sludge process (suspended growth) and bio filter processes (attached growth). Moving Bed Biofilm Reactor (MBBR) process utilizes the entire tank volume for biomass development. It utilizes basic drifting media, which are transporters of attached growth of biofilms. Biofilm carrier movement is caused by the disturbance of air bubbles. This minimal treatment framework is viable in the expulsion of BOD as well as nitrogen and phosphorus while encouraging successful solids separation.

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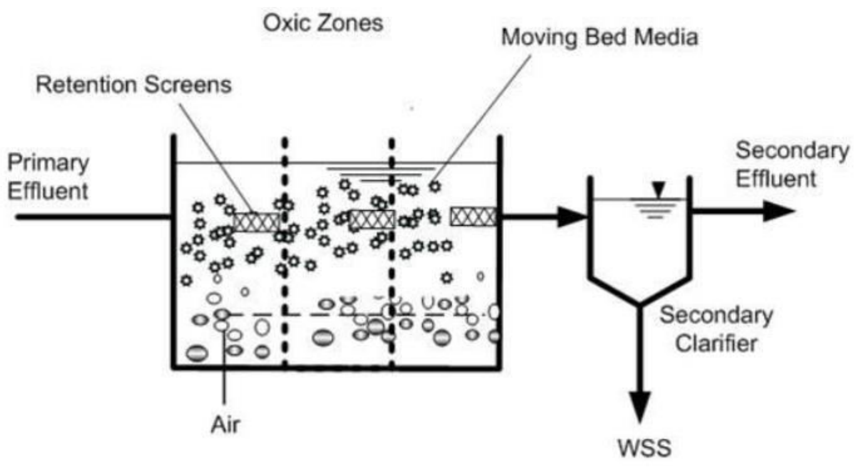
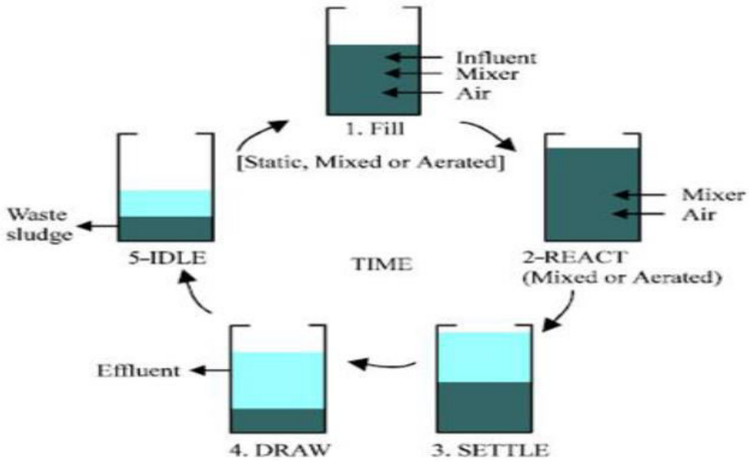


2. Sequential Batch Reactor (SBR)

The sequencing batch reactor (SBR) process is a progressive suspended growth (activated sludge) process in which each major progress occurs in a common tank in sequential order. The aggregate five phases happen in a single reactor by which way it diminishes the impression. SBRs can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, despite clearing TSS and BOD. The five stages of SBR are:

- FILL: Wastewater fills the tank, mixing with biomass that settles in the midst of the past cycle.
- REACT: Air is added to the tank to enable biological growth and felicitate waste diminishment.
- SETTLE: Mixing and Aeration quit in the midst of this stage to empower solids to settle.
- DRAW: Clarified profluent is discharged.
- IDLE: Sludge can be removed in the midst of this stage.



IV. CONCLUSIONS

The problems associated with wastewater reuse arise from its lack of treatment. The challenge thus is to find such low-cost, low-tech, user-friendly methods, which on one hand avoid threatening our substantial wastewater dependent livelihoods and on the other hand protect degradation of our valuable natural resources. The use of constructed wetlands is now being recognized as an efficient technology for wastewater treatment. Compared to the conventional treatment systems, constructed wetlands need lesser material and energy, are easily operated, have no sludge disposal problems and can be maintained by untrained personnel. Further these systems have lower construction, maintenance and operation costs as these are driven by natural energies of sun, wind, soil, microorganisms, plants and animals. Hence, for planned, strategic, safe and sustainable use of wastewaters there seems to be a need for policy decisions and

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coherent programs encompassing low-cost decentralized waste water treatment technologies, bio-filters, efficient microbial strains, and organic / inorganic amendments, appropriate crops/ cropping systems, cultivation

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