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Industrial Waste Water Treatment Facilities

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Abstract
Most of the river basins are closing or closed to severe water shortages, brought on by the simultaneous effects of agricultural growth, industrialization and urbanization. Performance of state owned sewage treatment plants, for treating municipal waste water, and common effluent treatment plants, for treating effluent from small scale industries, is also not complying with prescribed standards. Thus, effluent from the treatment plants, often, not suitable for household purpose and reuse of the waste water is mostly restricted to agricultural and industrial purposes. 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 are 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: Waste water, effluent Treatment

1. Introduction

Industrial wastewater treatment encompasses the mechanisms and processes used to treat wastewater generated as a by-product of industrial or commercial activities. After treatment, the treated industrial wastewater (or effluent) may be reused, released into a sanitary sewer, or discharged into the environment's surface waters. While many industries produce wastewater, recent trends in the developed world have aimed to minimize such production or recycle wastewater within the production process. However, numerous industries still rely on processes that generate wastewater. It is estimated that every year, 1.8 million people die from waterborne diseases, with many of these deaths indirectly attributed to improper sanitation. Therefore, wastewater treatment is a critical initiative that must be taken more seriously for the well-being of society and the future of our environment.

Wastewater treatment is a process in which contaminants are removed from wastewater and household sewage to produce a waste stream or solid waste suitable for discharge or reuse. An Effluent Treatment Plant (ETP) is a facility specifically designed for the treatment of industrial effluents and wastewater.

ETPs are widely utilized across various industrial sectors, including the pharmaceutical industry, to effectively manage and treat effluents generated from the manufacturing of bulk drugs.

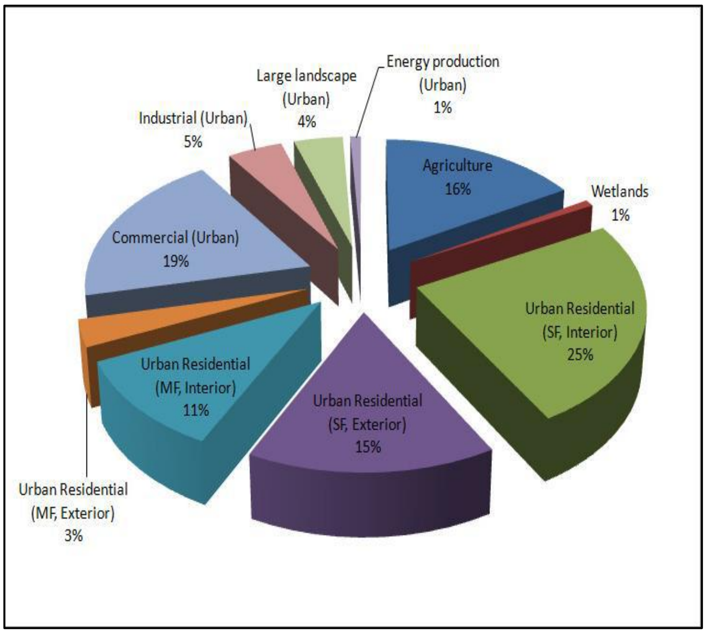

Figure 1 Water used by different sources

2. Objective

- 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.

3. Methodology

3.1 Treatment Levels & Mechanisms of ETP

1. Treatment levels: Preliminary.
2. Primary.
3. Secondary.
4. Tertiary (or advanced)

Treatment levels: Preliminary.

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.

Removal of floating and settle able materials such as suspended solids and organic matter. 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

Secondary.

Biological and chemical processes are involved in this level. Biological unit process to remove or reduce the concentration of organic and inorganic compounds. Biological treatment process can take many forms but all are based around microorganisms, mainly bacteria. Aerobic Processes Aerobic treatment processes take place in the presence of air (oxygen). Utilizes those microorganisms (aerobes), which use molecular/free oxygen to assimilate organic impurities i.e. convert them in to carbon dioxide, water and biomass. Anaerobic Processes the anaerobic treatment processes take place in the absence of air (oxygen). Utilizes microorganisms (anaerobes) which do not require air (molecular/free oxygen) to assimilate organic impurities. The final products are methane and biomass.

Tertiary (or advanced)

Final cleaning process that improves wastewater quality before it is reused, recycled or discharged to the environment. Mechanism: Removes remaining inorganic compounds, and substances, such as the nitrogen and phosphorus. Bacteria, viruses and parasites, which are harmful to public health, are also removed at this stage. Methods: Alum: Used to help remove additional phosphorus particles and group the remaining solids together for easy removal in the filters. Chlorine contact tank disinfects the tertiary treated wastewater by removing microorganisms in treated wastewater including bacteria, viruses and parasites. Remaining chlorine is removed by adding sodium bisulphate just before it's discharged.

Characteristics of effluent

1. Above organic or inorganic matter in the strongest industrial effluent.
2. The effluent is characterized by its color, odor, temp, COD, BOD, TSS etc.
3. The parameters of incoming effluent are COD 1300 – 4000, BOD 100 – 350, and TSS 1000 – 3000 PPM etc.
4. The effluent contains about 11000m3/day and and sludge QTY. is about 15 to 20 MT/Day5.

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3.2 Operation of ETP Plant

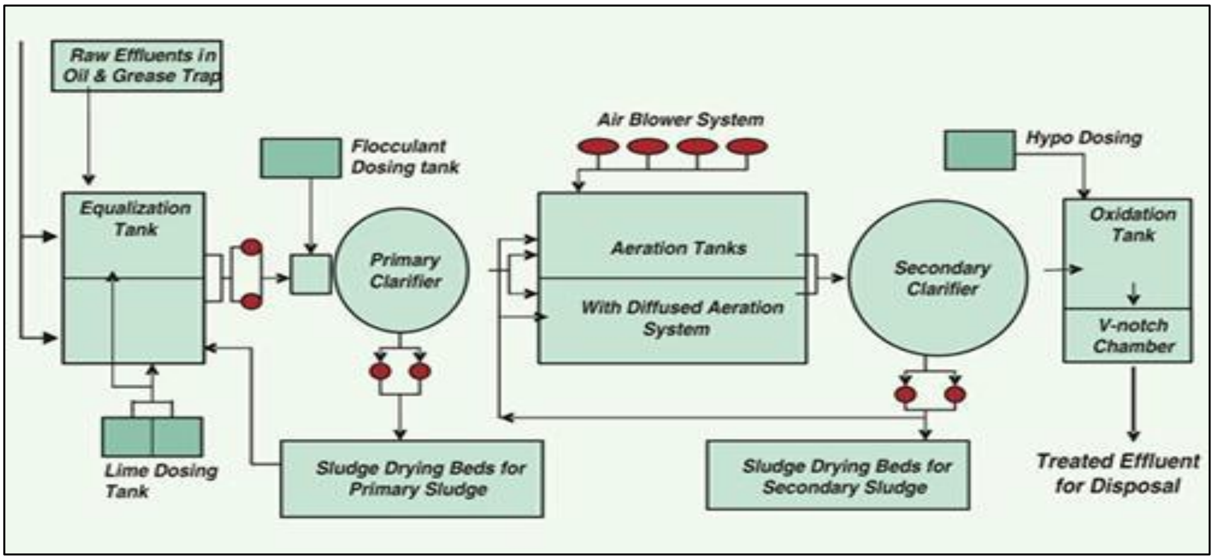

Fig. 2 Flow chart of ETP Plant Operation

- **Screen chamber**: Remove relatively large solids to avoid abrasion of mechanical equipment's and clogging of hydraulic system.
- **Collection tank**: The collection tank collects the effluent water from the screening chamber, stores and then pumps it to the equalization tank.
- **Equalization tank**: The effluents do not have similar concentrations at all the time; the pH will vary time to time. Effluents are stored from 8 to 12 hours in the equalization tank resulting in a homogenous mixing of effluents and helping in neutralization. It eliminates shock loading on the subsequent treatment system. Continuous mixing also eliminates settling of solids within the equalization tank. Reduces SS, TSS.
- **Flash mixer**: Coagulants were added to the effluents: 1. Lime: (800-1000 ppm) To correct the pH up to 8-9 2. Alum: (200-300 ppm) To remove color 3. Poly electrolyte: (0.2 ppm) To settle the suspended matters & reduce SS, TSS. The addition of the above chemicals by efficient rapid mixing facilitates homogeneous combination of flocculates to produce micro flocs.
- **Clarriflocculator**: In the clarriflocculator the water is circulated continuously by the stirrer. Overflowed water is taken out to the aeration tank. The solid particles are settled down, and collected separately and dried; this reduces SS, TSS. Flocculation provides slow mixing that leads to the formation of macro flocs, which then settles out in the clarifier zone.
- **Aeration tank:** The water is passed like a thin film over the different arrangements like staircase shape. Dosing of Urea and DAP is done. Water gets direct contact with the air to dissolve the oxygen into water. BOD & COD values of water is reduced up to 90%.
- **Clarifier:** The clarifier collects the biological sludge. The overflowed water is called as treated effluent and disposed out. The outlet water quality is checked to be within the accepted limit as delineated in the norms of the Bureau of Indian standards. Through pipelines, the treated water is disposed into the environment river water, barren land, etc.
- **Sludge thickener:** The inlet water consists of 60% water + 40% solids. The effluent is passed through the centrifuge. Due to centrifugal action, the solids and liquids are separated. The sludge thickener

reduces the water content in the effluent to 40% water + 60% solids. The effluent is then reprocessed and the sludge collected at the bottom

3.3 Effluent Removal Process

- **Screening Process: -** Screening is the filtration process for the separation of coarse particles from influent. Stainless steel net with varying pore size can be utilized. Screens are cleaned regularly to avoid clogging.

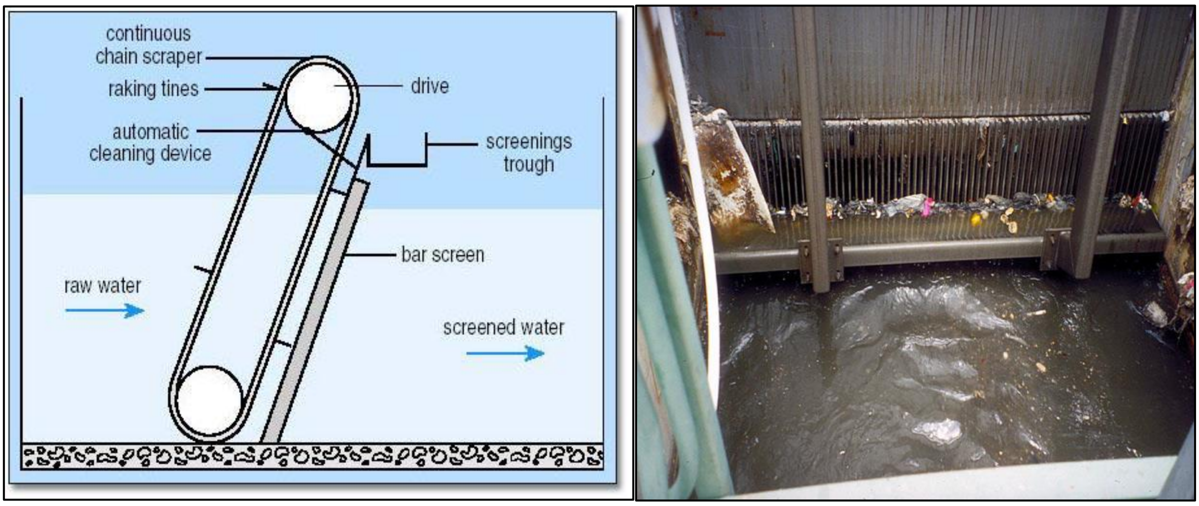

Fig.3 Screening Process

- **Equalization Tank: -** Equalization makes the waste water homogenous. Retention time depends upon the capacity of treatment plant. (Generally, 8-16 hours)
- **pH Correction: -**In this tank pH of the influent is corrected to meet the standard. Acid or alkali is added to the effluent to increase or decrease the pH.
- **Disperse Unit: -**Disperse tank mixes the sludge coming from recycle tank with waste water for to proper aeration.

Fig.4 Disperse Unit

- **Aeration Tank: -**Function of aeration is oxidation by blowing air. Aerobic bacteria is used to stabilize and remove organic material presents in waste.

Fig.5 Aeration Tank

- **Sedimentation Tank: -**In this tank sludge is settled down. Effluent is discharged from plant through a fish pond. Sludge is passed to the sludge thickening unit.

Fig.6 Sedimentation Tank

- **Sludge Thickening Unit: -**Here sludge is dried and discharged. Partial amount of sludge is returned back to the aeration tank from thickening unit through recycle tank called return sludge tank and disperse tank.

Fig.7 Sludge Thickening Unit

Conclusion

Constructed wetlands offer several advantages over conventional wastewater treatment systems, including lower material and energy requirements, simplified operation, elimination of sludge disposal, and ease of maintenance by minimally trained personnel. Their reliance on natural processes driven by solar energy, wind, soil, microorganisms, plants, and animals results in reduced construction, maintenance, and operational costs. To promote planned, strategic, safe, and sustainable wastewater reuse, policy decisions and coherent programs are needed. These initiatives should integrate low-cost, decentralized wastewater treatment technologies, bio filters, efficient microbial strains, organic and inorganic amendments, and appropriate crops/cropping systems. Effective treatment systems must significantly reduce or eliminate pollutant levels in the effluent. In this study, bacterial bioremediation of effluents demonstrated a significant reduction in physico-chemical characteristics within a 15-day retention period.

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