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Industrial Waste Water Treatment

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Abstract: This study has been undertaken to investigate the industrial waste water treatment parameter in chemical and pharmaceutical industries. Stages of waste water treatment primary treatment, secondary treatment (biological treatment) and tertiary treatment. Analysis of waste water like pH, TDS, TSS, COD, Ammonia nitrogen. Comparison between initial waste water and after treatment of effluent. After treatment, the treated industrial wastewater may be reused or released to a sanitary sewer or to surface water in the environment.

1.INTRODUCTION What is Industrial Wastewater?

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.

To begin the discussion on industrial wastewater, it may be useful to compare industrial wastewater with domestic sewage since designers of wastewater treatment facilities often begin their careers and almost certainly their education in environmental engineering by looking at sewage and sewage treatment plants.

All major terrestrial biota, ecosystems, and humans depend on freshwater (i.e. Water with less than 100mg L-1 salts) for their survival. The earth's water is primarily saline in nature (about 97%). Of the remaining (3%) water, 87% of it is locked in the polar caps and glaciers. This would mean only 0.4% of all water on earth is accessible freshwater. The latter is, however, a continually renewable resource although natural supplies are limited by the amounts that move through the natural water cycle. Unfortunately, precipitation patterns, and hence distribution of freshwater resources, around the globe is far from even. Where precipitation falls heavily, there are often difficulties with storage because of space constraints. Furthermore, the available freshwater must be shared between natural biota and human demands. The latter, aside from direct human consumption, includes water for agricultural, urban, and industrial needs. Freshwater shortages increase the risk of conflict, public health problems, reduction in food production, inhibition of industrial production expansion, and these problems threaten the environment. Freshwater shortages are, however, not only due to uneven distribution of freshwater resources and demand for freshwater but also, increasingly, due to the declining water quality in freshwater sources already in use. This declining water quality is primarily due to pollution. It should not be forgotten that in the wider context of resources associated with water, the marine environment is also included in the picture. While the latter was, in the past, primarily associated with the fisheries resource, it can also include tourism and the feed for desalination in the current context. Untreated industrial wastewaters would add pollutants into waterbodies — freshwater and saline. These receiving waterbodies, freshwater and marine, can include ponds, lakes, rivers, coastal waters, and the sea. It would be useful to bear in mind that pollutants introduced into a river, or some other freshwater waterbodies do eventually end up in the sea, the ultimate receptacle for waterborne pollutants if these are permitted to find their way through the environment unimpeded. An example of riverine pollution are the rivers flowing through urban and industrial areas such as Hanoi and Ho Chi Minh City in Vietnam picking up pollutants such as heavy metals and organochlorine pesticides and herbicides. These pollutants reach the sea eventually and therein threaten the fisheries (Nguyen et al., 1995). On Hainan Island (Southern China), for example, industries such as sugar refineries, paper mills, shipyards, and fertilizer plants accounted for about half the total wastewater generated and reaching the sea. This had resulted in incidences of the red tide in Hoashi Bay and an area northwest of the island (Du,1995). Obviously then, inadequately treated industrial wastewater discharged into rivers would not only affect the freshwater in these areas but also the receiving coastal and sea waters. Eventually coastal resources such as the mangrove and reef ecosystems, and thereafter fisheries would be affected. The discharge of inadequately treated industrial wastewaters can therefore have farreaching consequences. In the last decade, the emergence of industrial pollution has been identified as a trend in the coastal areas of Southern China, Vietnam, Kampuchea, and Thailand. The effects pollutants have on the water environment can be summarized in the following broad categories:

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.

2.METHODOLOGY

Treatments Levels:

- (i) Preliminary Treatment
- (ii) Primary treatment.
- (iii) Secondary treatment.
- (iv) Tertiary treatment

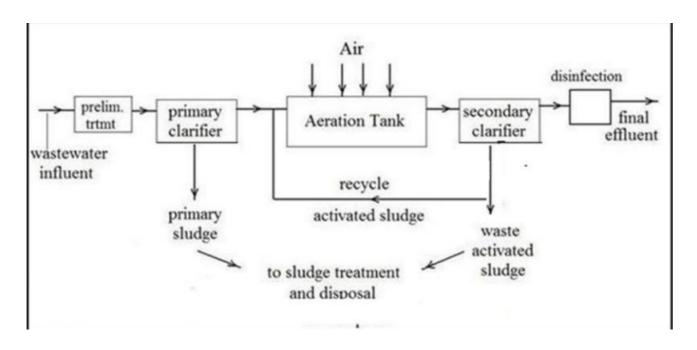
Preliminary Treatment purpose: Physical separation of big size impurities like cloth, plastics, wood logs, paper etc. common unit operation at preliminary level are Screening: A screen with opening of uniform size is used to remove large solids such as cloths plastics etc. generally maximum 10mm is used. Sedimentation: Physical waste treatment process using gravity to remove suspended solids from water.

Primary Treatment

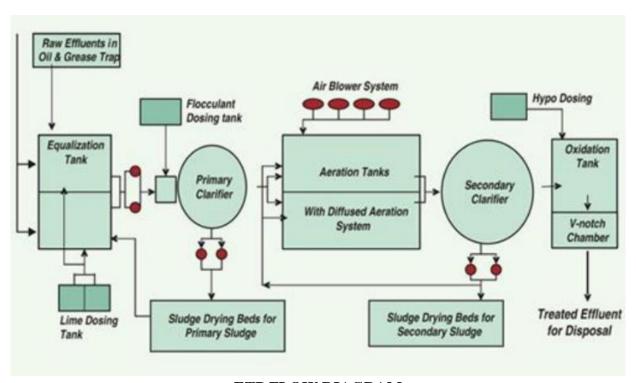
Primary treatment follows the preliminary treatment stage. The purpose of primary treatment is to remove settleable suspended solids (SS) and typically about 60% of these may be so removed with unaided gravity settling. While a small portion of the colloidal and dissolved material may be removed with the SS, this is incidental. Notwithstanding this, 30~40% of the BOD5 in the raw sewage may be removed with the SS. In gravity clarifiers, the relatively quiescent conditions therein would allow the settleable solids to settle to the bottom of the clarifier forming a sludge layer there. To achieve such settling conditions, the surface overflow rates chosen for design and operation of a clarifier usually range from 0.3 to 0.7 mms-1. In large clarifiers a scraper located near the base of the clarifier moves the sludge into a hopper from where it would be pumped to the sludge treatment stage. The settled sewage exits the clarifier by overflowing the outlet weirs. Typically, these weirs extend around the periphery of the clarifier. This is to accommodate the weir overflow rate deemed appropriate for a particular design. Where there is such a necessity, the weir length may be extended by supporting the launder on brackets some distance from the wall of the clarifier. Large Steps typically operate either circular or rectangular clarifiers while the smaller ones can use either circular or square clarifiers. Primary (and secondary) clarification in STPs is typically unaided in terms of coagulant use. Where coagulants have been used, SS and BOD5 removals up to 90% and 70% respectively have been achieved. While the application of coagulants on a large scale in sewage treatment is relatively rare in Asia, it has appeared where there is a requirement to remove phosphorous. The coagulant may then be injected before primary clarification or into the biological aeration vessels. While primary treatment is usually achieved with gravity clarifiers, rotating and static fine screens have been used sometimes. Such screens typically have screen openings of about 0.8mm to 2.3mm. Since fine screens are operated at hydraulic loading rates an order of magnitude higher than those applied on clarifiers, they occupy much less space for equipment installation. If the sewage contains substantial quantities of O&G, then the screen would likely to be located after the O&G trap. This reduces the risk of the O&G combining with fine particulates and blinding the fine screen. Fine screens are not expected to remove as much of the SS and BOD5 as primary clarifiers would. Consequently, a STP which has fine screens in place of primary clarifiers would need to have its secondary treatment stage appropriately sized. Primary clarifiers and screens can be major sources of malodors. Avoiding over-designs especially in clarifiers (resulting in overly long hydraulic retention time and the consequent development of septic conditions) and good Housekeeping would help reduce the incidence of such odors. The development of septic conditions in screens are less likely to occur since the passage of sewage through the screen does provide a degree of aeration

Secondary Treatment

The role of the secondary treatment is to remove the colloidal and dissolved material remaining after the preliminary and primary treatment stages. In sewage treatment, the secondary stage typically includes a biological process. The latter, often an aerobic suspended growth process where the microbial population used to treat the wastewater is suspended in the mixed liquor of the reactor, is housed in an aeration vessel or reactor which has been designed to be complete-mix, plug flow, or a condition between these two extremes arbitrary flow (see Sec. 5.3for discussion on reactor configurations). These reactor variants best suit specific process variants. The latter includes the high rate activated sludge, conventional activated sludge, and extended aeration process. Among the differences between these process variants, two important ones are the hydraulic retention time (HRT)and the cell residence time (CRT). Typically, the high rate activated sludge process the shortest HRTs and CRTs and these parameters would increase in magnitude towards the extended aeration process. This means, for a given reactor volume, the high rate activated sludge system processes more sewage than the extended aeration system. The latter makes up for this "inefficiency" by usually being a more stable process and therefore easier to operate. Even within the three process variants identified above, there are further variants. For example, the oxidation ditch and aerated lagoons are two variants of the extended aeration process but housed in different reactor designs — plug-flow and arbitrary flow respectively. All these variants have the reactors followed by secondary clarifiers. The latter serves to produce a treated effluent with 50 mg L-1 SS or lower and allow the return of biomass (or bio sludge) collected in the hoppers of such clarifiers to the reactors to maintain an adequate microbial population or mixed liquor suspended solids (MLSS) therein. While aerobic suspended growth systems are common, they are by no means the only types used for sewage treatment. Attached growth systems such as the trickling filter and rotating biological contactor may also be encountered in Stashes systems have the micro-organisms forming a biofilm on a support medium which is typically a highly porous formed plastic shape with a large surface area to volume ratio. Such biofilms are not submerged in sewage (e.g. in the trickling filter) or only intermittently submerged (e.g. in the rotating biological contactor). Oxygen for the aerobic process is transferred from the atmosphere into the liquid film which forms on the biofilm an activated sludge process variant which combined suspended growth with attached growth. Unlike the trickling filter and rotating biological contactor, the biofilms in such a system are continuously submerged in the reactor's mixed liquor. Since the biofilm support medium is submerged, its presence is not immediately obvious. Its presence is, however, suggested by the aeration pattern observable on the water surface. Because the diffusers have been concentrated beneath the support medium, the distribution of air bubbles on the water surface is not even as it would have been in an aeration vessel where the diffusers had been distributed evenly on the base of the vessel. In such processes, the biological reactor would also be followed by a secondary clarifier. This is to allow return of settled biomass to the reactor so as to maintain an adequate population of suspended microbes therein. The clarified effluent overflows the clarifier and can be discharged into a receiving waterbody if it does not require further treatment.



Flow Chart of ETP



ETP FLOW DIAGRAM

Tertiary Treatment: Final cleaning process that improves waste water quality before it is used, recycled or discharged to the environment. Process: removes remaining inorganic compounds and substances such as nitrogen and phosphorous. Bacteria, viruses and parasites which are harmful to public health are also removed at this stage. Alum used to help remove additional phosphorous particles and group the remaining solids together for easy removal in filters. Chlorine contact tanks disinfect the tertiary treated waste water by removing microorganisms in treated waste water. The remaining chlorine is removed by adding sodium bi sulphate just before it is discharged.

3.Advantages of ETP (Effluent Treatment Plant)

- Reduce off-site treatment cost.
- Unnecessary water usage during the processing is eliminated.

- Makes your industry self-sustainable.
- Helps reduce the contamination of natural water bodies and make the environment safe for others.
- This is the most cost-effective and environmental-friendly method.

4. Testing of sample

In the study period, samples at different stages of treatment units of ETP were collected and analyzed for evaluation of ETP. The collected samples were analyzed for parameters viz., pH, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and Oil and Grease(O&G).

4.1: pH the pH is determined by measurement of the electromotive force of a cell comprising an indicator electrode (an electrode response to hydrogen ions such as glass electrode) immersed in the test solution and a reference electrode contact between the test solution and the reference electrode is usually achieved by means of a liquid junction, which forms a part of the reference electrode. The emf of this cell is measured with pH meter. This is a high impedance electrometer calibrated in terms of ph. 100ml of the sample was taken in a beaker. The electrodes were dipped in it and the pH was recorded.

4.2: TDS

- 50ml of well-mixed sample was filtered through glass fibre filter.
- Then 10ml of distilled water was allowed to wash for complete drainage between washing and suction was continued for about 3 minutes after filtration is complete.
- Filtrate was transferred to an empty weighed (W1) crucible and evaporated on hot plate hot water bath.
- Crucible was transferred into hot air oven for dryness at $1050C \pm 20C$ for at least one hour.
- Then the crucible was cooled in a desiccator and weighed. The process of drying and cooling and weighing was repeated until a constant weight (W2) was obtained

4.3: TSS

- The Filter paper disk was taken and dried at 105°C for an hour to remove (any water) moisture adhering to its surface.
- Then it was cooled in a desiccator and its weight was taken accurately on a precision balance [W1] (g)].
- Put the membrane filter on filter holder and wet it with water. 50ml of sample was filtered through it (to get a residue of 200mg) under vacuum.
- Filter membrane was filtered and dried at 103 105°C in an oven.
- Then the membrane filter was cooled in a desiccator and weighed. The process of drying, cooling and weighing was repeated until a constant weight (W2) was obtained.



Waste water sample before treatment and after treatment

5: Results and Discussion

Analysis of Industrial Waste Water Samples are collected from different plants before treatment and after treatment. As you can see in photos below, water sample photos are also attached in which we can clearly saw the effects of treatment. Results of Parameters such as pH, TSS, BOD and COD are meeting the Standard outlet parameters Source of SOP by Gujarat Pollution Control Board.

Sr.No.	Tests	Unit	Result Before	Result after
			Treatment	Treatment
1.	рН	-	5-10	6.5-7.5
2.	TDS	mg/L	8000-10000	1000-2000
3.	COD	mg/L	10000-12000	500-1000

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