A Case Study on Waste Water Treatment Plant, CETP (Common Effluent Treatment Plant)

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ABSTRACT: ***The increasing demand for water in combination with frequent drought periods, even in areas traditionally rich in water resources, puts at risk the sustainability of current living standards. In industrialized countries, widespread shortage of water is caused due to contamination of ground and surface water by industrial effluents, and agricultural chemicals. In many developing countries, industrial pollution is less common, though they are severe near large urban centers. However, untreated or partially-treated sewage poses an acute water pollution problem that causes low water availability. Global trends such as urbanization and migration have increased the demand for water, food and energy. Development of human societies is heavily dependent upon availability of water with suitable quality and in adequate quantities, for a variety of uses ranging from domestic to industrial supplies and Rapid industrialization is adversely impacting the environment globally. Pollution by inappropriate management of industrial wastewater is one of the major environmental problems in India as well, especially with small scale industrial sector in the country. To address the pollution coming out from industries, adoption of cleaner production technologies and waste minimization initiatives are being encouraged. The present case studies on Common Effluent Treatment Plants (CETP) for Textile industry are considered as one of the viable solution for small to medium enterprises for effective wastewater treatment. An effluent treatment plant is operating on physical, chemical and biological treatment method with average waste water in flow of 3MLD has been considered for case study. The wastewater is analyzed for the major water quality parameters, such as Biological Oxygen Demand (BOD),pH, Chemical Oxygen Demand (COD), Total suspended solid (TSS) and Total Dissolved Solids (TDS). The effluent samples were collected on a daily basis for a period of one month. The raw waste water pH was highly alkaline it was then bringing down to neutral which was helpful for chemical and biological treatment. The BOD, COD of the treated effluent reduced significantly, where as very small reduction was observed in dissolved solids. Most of all the parameters were within the permissible limits of Maharashtra Pollution Control Board, India.***

Keywords: Environment, Common Effluent Treatment Plant (CETP), pH, BOD, COD, TSS, TDS, chemical and biological treatment, wastewater treatment, Textile industry.

1. INTRODUCTION:

The present study aims on the process of industrialization is adversely impacting the environment globally. Pollution due to inappropriate management of industrial wastewater is one of the major environmental problems particularly in India. To avoid such problem a Common Effluent Treatment Plants (CETPs) are considered as one of the viable solution for small to medium enterprises for effective wastewater treatment.

In India, Ministry of Environment and Forest (MoEF) in 1991 initiated an innovative financial support scheme for CETPs to ensure growth of the small and medium entrepreneurs (SMEs) in an environmentally compatible manner. The provision of the scheme for fund is as follows;

- Central Government matching grants-25% of the project capital cost(this has been increased to 50% since 2012).
- State Government subsidy- 25% of the project capital cost
- Loans from financial institutions- 30% of the project capital cost, and
- Contribution from the SMEs-20% of the project capital cost.

The concept of CETP was adopted as a way to achieve end-of-pipe treatment of combined wastewater to avail the benefit of scale of operation so the CETP scheme was justified on the basis of potential benefits in terms of pollution reduction and environmental improvements.

2. CETP PLANT INFORMATION

CETP in Maharashtra at solapur which have a capacity of 3 mld municipal sewage generated in the CETP, solapur heavily contaminated with various streams of industrial waste and result in to waste water solapur has a good base for Textile industries.

In order to become water self sufficient and to meet increasing process water requirements, the CETP plant realizes the importance of reuse of waste water for agricultural and industrial uses.

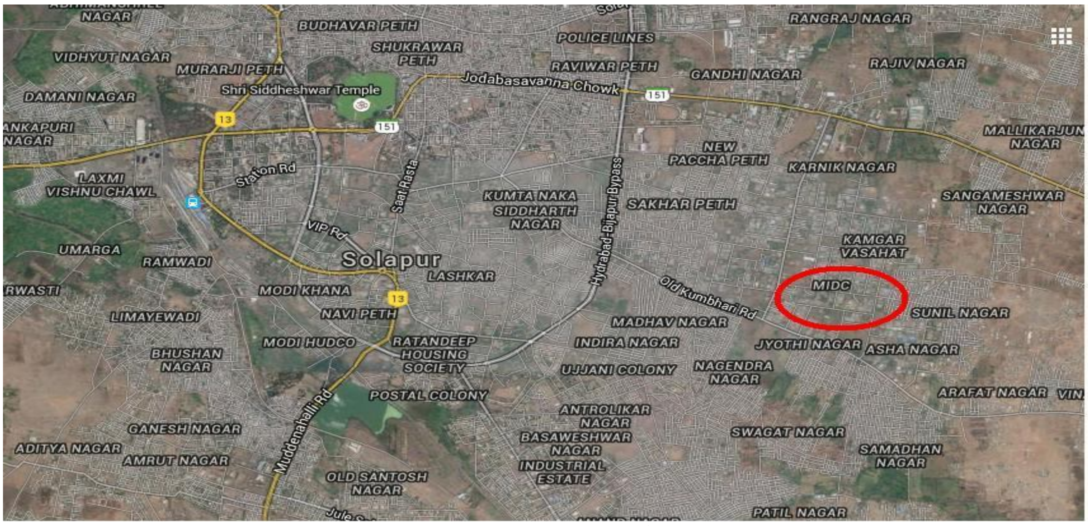

Fig (1): Google map of CETP, Solapur.

Table 1: Effluent Characteristics from Textile Industry

Process	Effluent composition	Nature
Sizing	Starch, waxes, carboxymethyl cellulose (CMC), polyvinyl alcohol (PVA), wetting agents.	High in BOD, COD
Desizing	Starch, CMC, PVA, fats, waxes, pectins	High in BOD, COD, SS, dissolved solids (DS)
Bleaching	Sodium hypochlorite, Cl_2, NaOH, H_2O_2, acids, surfactants, $NaSiO_3$, sodium phosphate, short cotton fibre	High alkalinity, high SS
Mercerizing	Sodium hydroxide, cotton wax	High pH, low BOD, high DS
Dyeing	Dyestuffs urea, reducing agents, oxidizing agents, acetic acid, detergents, wetting agents.	Strongly colored, high BOD, DS, low SS,heavy metals
Printing	Pastes, urea, starches, gums, oils, binders, acids, Thickeners, cross-linkers, reducing agents, alkali	Highly colored, high BOD, oily appearance, SS slightly alkaline, low BOD

Source: Yusuff and Sonibare (2004)

3. LAYOUT OF CETP PLANT MIDC SOLAPUR

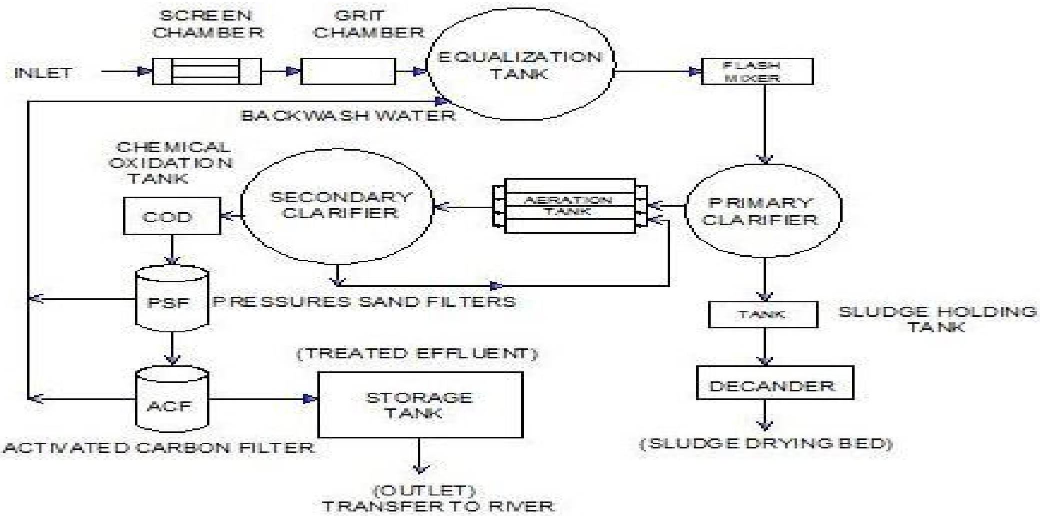

Fig (2): Flow Diagram of CETP Plant solapur Maharashtra

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4. TECHNICAL SPECIFICATION OF CETP UNIT SOLAPUR

Units	Size	Details	Quantity
Screen Chamber	2.0 m x 0.5 m x 0.4 m (LD)	MOC-RCC	1
Grit Chamber	4.8 m x1.2 m x 1.0 m (LD)	MOC-RCC	1
Collection/Equlization Tank	25 m Dia. x 3.0 m (LD)	MOC-RCC	1
Flash Mixer	2.0 m x1.5 m x 1.2 m (LD)	MOC-RCC	1
Primary Clarifier	13 m Dia.x 3.0 m (SWD) + 0.3 m (FB)	MOC-RCC	1
Sludge Holding Tank	4.0 m x 4.0 m x3.0 m (LD)	MOC-RCC	1
Aeration Tank	25 m x 12 m x4.5 m (LD)+0.5 m (FB)	MOC-RCC	2
Secondary Clarifier	16 m Dia.x 3.0 m (SWD) + 0.3 m (FB)	MOC-RCC	1
Chemical Oxidation Tank	7.0 m x 7.0 m x 3.0 m (LD)	MOC-RCC	1
Pressure Sand Filter	3.2 m Dia. x 1.5 m	MS (tponly)	1
Activated Carbon Filter	3.2 m Dia. x 1.5 m	MS (tponly)	1
Treated Effluent Storage Tank	12 m x 12 m x3.0 m	MOC-RCC	1
LD-Liquid Depth	MOC-Made of Concrete	Free Board	
SWD-Side Water Depth	RCC-Reinforced Cement Concrete	MS-Mild Steel	

Table 2: Technical specification of CETP Unit solapur

5. EFFLUENT TREATMENT SYSTEM

This chapter discusses in brief various treatment technologies involved in the process of wastewater treatment. In-depth knowledge of all these technologies and factors regulating the treatment mechanism is important for better management of CETPs or ETPs. Wastewater depending on its characteristics is subjected to different treatment options. Basic wastewater treatment consists of a combination of physical, chemical, and biological processes and operations to remove solids, organic matter and, sometimes, nutrients from wastewater. General terms used to describe different degrees of treatment, in order of increasing treatment level, are preliminary, primary, secondary, and tertiary and/or advanced wastewater treatment. These are described below in brief.

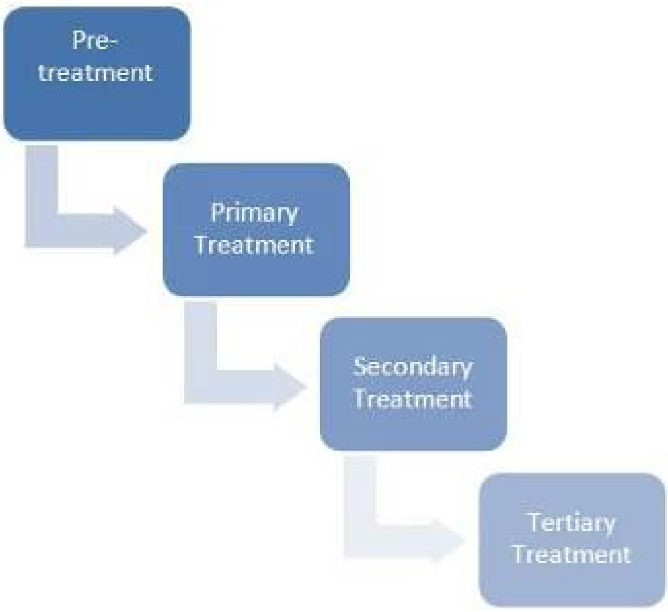

Fig (3) Waste Water Treatment

III.PRELIMARY TREATEMENT

3.1 Preliminary treatment

Preliminary treatment is required to remove the coarse solids and other large materials from raw wastewater. Removal of these materials is necessary to enhance the operation and maintenance of subsequent treatment units. A number of unit operations are engaged in the preliminary treatment of wastewater to eliminate undesirable characteristics of wastewater. The operations include use of screens and grates for removal of large materials, comminutors for grinding of coarse solids, pre-aeration for odour control. Sometimes pH correction and removal of oil & grease is also done. At times, member industries do preliminary treatment in their premises, before sending the effluent to CETP for further treatment. If preliminary treatment or pre-treatment is taken up by individual member industry, it improves the performance of CETP.

3.2 Primary treatment

Primary wastewater treatment, at times, is the first step in the wastewater treatment process or it may be the second step after the preliminary treatment. It involves physical separation of suspended solids from the wastewater using primary clarifiers. This process is helpful in reduction of total suspended solids (TSS) and associated biochemical oxygen demand (BOD) levels and prepares the waste for the next step in the wastewater treatment process. The objective of primary treatment is to remove of settle able organic and inorganic solids by sedimentation and removal of materials that float (scum) by skimming. Approximately 25 to 50% of the incoming biochemical oxygen demand (BOD), 50 to 70% of the total suspended solids (TSS), and 65% of the oil and grease are removed during primary treatment. Some organic nitrogen, organic phosphorus, and heavy metals associated with solids are also removed during primary sedimentation but colloidal and dissolved constituents are not affected.

The effluent from primary sedimentation units is referred to as primary effluent. Primary treatment ensures satisfactory performance of subsequent treatment units. Sedimentation chambers are the main units involved but various auxiliary processes such as fine screening, flocculation and floatation may also be used. The second step may be chemical treatment (generally with lime and alum) which is sometimes preceded by flocculation. The purpose is to remove metals by precipitation but it also removes some associated colloidal BOD. The process generates chemical sludge.

3.3 Secondary treatment

This process involves decomposition of suspended and dissolved organic matter in waste water using microbes. The mainly used biological treatment processes are activated sludge process or the biological filtration methods.

Biological treatment processes mainly used for secondary treatment and are based on microbial action to decompose suspended and dissolved organic wastewater. Microbes use the organic compounds as both a source of carbon and as a source of energy. Biological treatment can be either aerobic where microbes require oxygen to grow or anaerobic where microbes grow in absence of oxygen or facultative where microbes can grow with or without oxygen. Micro-organisms may be either attached to surface as in trickling filter or be unattached in a liquid suspension as in activated sludge process.

3.3.1 Activated sludge process

It is a continuous flow, aerobic biological treatment process that involves suspended growth of aerobic micro-organisms to biodegrade organic contaminants. Influent is introduced in the aeration basin and is allowed to mix with the contents. A suspension of aerobic microbes is maintained in the aeration tank. A series of biochemical reactions in the basin degrade the organics and generate new bio mass. Micro-organisms oxidize the matter into carbon dioxide and water using the supplied oxygen. These organisms agglomerate colloidal and particulate solids. The mixture is passed to a settling tank or a clarifier where micro-organisms are separated from the treated water. The settled solids are recycled back to the aeration tank to maintain a desired concentration of micro-organisms in the reactor and some of the excess solids are sent to sludge handling facilities. To ensure biological stabilization of organic compounds, adequate nutrient levels of nitrogen and phosphorous must be available to the bio mass. The key variables to the effectiveness of the system include:

a) Organic loading which is described as food to micro-organism ratio (F/M) ratio or Kg of BOD applied daily to the system per Kg of biological solids in aeration tank. F/M ratio determines BOD removal, oxygen requirements and bio mass production. Systems designed and operated at lower F/M provide higher treatment efficiency.

3.4 Tertiary treatment

Tertiary treatment may include a number of physical and chemical treatment processes that can be used after the biological treatment to meet the treatment objectives. It is the next wastewater treatment process after secondary treatment. This step removes persistent contaminants that secondary treatment is not able to remove. Tertiary treatment is the final cleaning process that improves wastewater quality before it is reused, recycled or discharged to the environment. Tertiary treatment is used for effluent polishing (BOD, TSS), nutrient removal (N, P), toxin removal (pesticides, VOCs, metals) etc.

Tertiary treatment can also be extensions of conventional secondary biological treatment to further stabilize oxygen-demanding substances in the wastewater, or to remove nitrogen and phosphorus.

Tertiary treatment can also involve physical-chemical separation techniques such as activated carbon adsorption, flocculation/precipitation, membranes filtration, ion exchange, de-chlorination and reverse osmosis. Advanced treatment processes which generally constitute of or are part of the tertiary treatment may also sometimes be used in primary or secondary treatment or used in place of secondary treatment.

Some of the common tertiary treatment processes are described below:

3.4.1 Granular Media Filtration

Many processes fall under this category and the common element being the use of mineral particles as the filtration medium. It removes suspended solids mainly by physical filtration. Two common types of these granular media filers area

a) Sand filters are the most common type which consists of either a fixed or moving bed of media that traps and removes suspended solids from water passing through media.

b) b) Dual or multimedia filtration consists of two or more media and it operates with the finer, denser media at the bottom and coarser, less dense media at the top. Common arrangement is granite base at the bottom, sand in the middle and anthracite coal at the top. Flow pattern of multimedia filters is usually from top to bottom with gravity flow. These filters require periodic back washing to maintain their efficiency.

These processes are most commonly used for supplemental removal of residual suspended solids from the effluents of chemical treatment processes.

3.5 Sludge Dewatering System:

Sludge from primary and secondary clarifiers is collected in primary sludge sump. From primary sludge sump, sludge is transferred to sludge thickener. Thickened sludge is sent to sludge drying beds for removal of water from sludge. Overflow from thickener is taken into primary clarifier. Thickener collected from sludge dewatering system is collected in Decander collection tank. That Decander is then taken into waste water collection tank for further treatment. Dried sludge from sludge drying beds is removed, packed and disposed to the Transport, Storage and Disposal Facility site for secured land filling.

IV. RESULT AND DISCUSSIONS:

Inlet and outlet sample was analyzed for various parameters and average results obtained are mentioned in table no.2. Analysis for inlet and outlet sample was carried out for period of 30 days.

Parameters	Inlet	Outlet
pH	7.9	7.3
COD	900 mg/l	180 mg/l
BOD	600 mg/l	25 mg/l
OIL AND GREASE	20±5 mg/l	6±3 mg/l
TSS	245 mg/l	80 mg/l
TDS	3300 mg/l	2500 mg/l

Table No 3: Average Quality parameters

4.1 Operating Parameters of CETP:

4.1.1 TSS:

Inlet TSS varies between 220 mg/l to 260 mg/l. Outlet COD varies between 75 mg/l to 90 mg/l.

4.1.2 TDS:

Inlet TDS varies between 3000 mg/l to 3300 mg/l. Outlet COD varies between 2200 mg/l to 2700 mg/l.

4.1.3 pH:

Inlet pH value varies between 7.9 to 6.2. Outlet pH value varies between 7.5 to 7.00. Industries use alkaline base solutions for their process therefore there are variations in inlet pH. Also various chemicals like caustic soda, hypochlorite's etc. are used for processes like bleaching, scouring in textile industries that also cause variations in inlet pH.

4.1.4 BOD:

Inlet BOD varies between 500 mg/l to 650 mg/l. Outlet COD varies between 18 mg/l to 25mg/l.

4.1.5 COD:

Inlet COD varies between 800 mg/l to 1600mg/l. Outlet COD varies between 65 mg/l to 200mg/l. Variations in inlet COD is due to the chemical consumption of industries is varies according to their process requirement.

4.1.6 Oil and Grease:

Inlet oil and grease value varies between 26 mg/l to 18 mg/l. Outlet oil and grease value is <10 mg/l. Oil consumption of industries is varies according to their process requirement therefore there are variations in inlet oil and grease value.

V. CONCLUSIONS:

The study indicates that there is efficient reduction in parameter from treatment units of CETP. Up to 20% COD reduction is obtained at biological treatment. Removal of oil and grease is also in desirable range. pH variations are there in outlet but outlet pH values are in required range. Chlorides reduction is not obtained anywhere in the treatment provided at CETP. There is need to provide treatment for chloride removal.

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