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A Case Study on Common Effluent Treatment Plant at Five Star MIDC, Kagal

Powar M.M., Kore V.S., Kore S.V.

Department of Technology, Shivaji University, Kolhapur

Corresponding author: powar.mrunalini4@gmail.com, korevs@gmail.com

Abstract:

The Common Effluent Treatment Plant located in Kagal Five Star MIDC, Kagal is implemented by SMS infrastructure, Nagpur. The present study gives the details of CETP. Inlet and outlet sample for various parameters is analyzed. Parameters are analyzed like pH, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), oil and grease, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD). Kagal MIDC has developed site near CETP where treated effluent from CETP is discharged by High Rate Transportation System.

Keywords: CETP, textile wastewater, treatment units.

1. Introduction:

Kagal five star MIDC is located 5 Km away from National Pune-Banglore highway. It has cluster of textile industries. It is away from residential areas. Kagal industrial area consists different types of small, medium and large scale industries. The major part of wastewater generated is from large textile based industries. Common Effluent Treatment Plant (CETP) is established there to treat liquid effluent coming from textile industries which is treated at their effluent treatment plant. Wastewater coming to CETP is from four textile industries i.e. Reymond Zambaiti Ltd, Oswal textiles, Soktas and Indocount home textiles. The present CETP is designed for flow of 10 MLD with the provision of 20% hydraulic overload. Design inlet and outlet values of CETP are mentioned in table no.1.

MIDC has developed one site which is near to CETP where treated effluent from CETP is disposed off there by high rate transportation system. Total area of that site is around 50 acre and Neem and Nilgiri trees are planted over there. Quantity of wastewater flow coming from each industry to CETP is upto 2.5 MLD. There are separate pipelines for each industry through which effluent comes to CETP. After mixing of effluent of every industry in collection chamber, it enters in screen chamber by gravity. Effluent characteristics of industries contributing to CETP are given in table no.2.Every industry has provided primary and secondary treatment for effluent. The primary treatment has screen chamber and equalization tank. Chemical treatment followed by Lime, ferrous sulphate and polyelectrolyte. Secondary treatment as biological treatment includes fluidized bioreactors and tube settler clarifier. Sludge treatment is given as sludge thickening and sludge centrifugation and finally sludge is sent to the Ranjangaon.

Table No.1 Design Inlet and Outlet Values of CETP

Parameter	Inlet Values	Outlet Values
pH	5.5-8.5	6.5-8
COD	1800	60-80
BOD_3 at 27^0c	800	<30
Oil and Grease	20-50	<10
TSS	100-500	<100
TDS	2100	<2100
Color	-	<100 (Pt-Co unit)

Except pH all values are in mg/l

Table 2: Wastewater Characteristics of Industries

Parameter	Indocount	Raymond	Oswal	Soktas
pH	8	7	7.56	8
COD	500	232	380	300
Sulphides	Nil	20	Nil	Nil
Chlorides	320	335	450	350

Except pH all values are in mg/l

2. Material and Methods:

The samples were collected at inlet and outlet of some of the treatment units and analyzed as outlined in the standard methods for the examination of water and wastewater.

Daily samples were collected in plastic bottles and rinsed with effluent at the sampling site. Inlet samples consisted of waste effluent and outlet consisted of treated effluent. Parameters were analyzed like pH, COD, BOD, TSS, TDS, chlorides. Wastewater flow is measured through digital electronic flow meter.

Methods for sample analysis

Parameter	Method
pH	Electrometric
TSS	Filtration
TDS	Conductivity meter
COD	Reflux
BOD	Titration by adometric
Chlorides	Titration by $AgNo_3$

Treatment Units:

For meeting the standards of effluent wastewater CETP has provided physicochemical and biological treatment. After biological treatment, tertiary treatment having oxidation tank is also provided in treatment scheme. Physical treatment involves screen chamber, grit chamber, oil and grease trap and equalization tank. Biological treatment consist diffused aeration and settling tank. Tertiary treatment provided is chemical oxidation and filtration. The schematic flow diagram of CETP is shown figure no.1. The details of each unit of CETP are represented in table 3.

2.1 Equalization and Preliminary Treatment:

The wastewater is received in wastewater collection sump having arrangement of screen chamber and grit removal chamber. Screen chamber and grit chamber is provided for the removal of coarse grit, floating matter and any suspended large particles which can damage internal part of pumps and other rotating equipment (Metcalf and Eddy,2003).

From wastewater collection sump, wastewater is pumped using effluent feed pump to equalization tank. Before equalization tank, effluent is passed through oil and grease trap for the removal of floating and insoluble oil and grease particles. Oil and grease trap is a baffled wall channel where wastewater is subjected to up and down flow for the removal of floating particles at the top surface. Separated oil and grease layer is collected from the top layer by manual skimming operation through collecting troughs and drain pipe. From oil and grease trap effluent is collected in equalization tank. Equalization tank is provided to ensure the complete mixing of varying quality and quantity. Complete mixing is achieved by floating type submerged mixers.

2.2 Chemical Treatment and Primary Clarification:

Effluent from equalization tank is transferred to physicochemical treatment section of CETP using effluent feed pump. Chemical treatment is carried out by using chemicals and flocculants mainly to precipitate, flocculate and coagulate suspended solids and to remove this mass by using gravity settling in primary clarifiers.

Effluent is first taken to two series of flash mixers for the reaction of effluent with lime slurry. The pH of effluent is raised in the range of 8.5 to 9.5. Effluent from flash mixer is then taken to flocculator, where ferrous sulfate is added to carry out flocculation and coagulation of suspended and precipitated particles. From flocculator, effluent is passed through reaction channel where suitable polyelectrolyte is added to increase settling rate of flocculated and coagulated mass.

From reaction channel effluent is fed to tube deck type hopper bottom primary clarifier for the separation of precipitated solids from the wastewater by settling under gravity. Clear overflow from primary clarifier is conveyed to Aeration tank for biological treatment. Settled sludge at the bottom of the primary clarifier is transferred to primary sludge sump.

2.3 Biological Treatment:

Biological treatment is achieved by providing activated sludge process. In this treatment soluble BOD is stabilized by oxidation of organic matter by microorganisms. Nutrient and food is supplied to microorganisms for enhancing their growth. Oxygen required is provided by air blower through non-clog type membrane diffusers to achieve higher rate of oxygen transfer efficiency. Mixed liquor overflow from aeration tank is taken into secondary clarification process, for the separation of microorganisms under gravity. Bottom sludge from secondary clarifier is recirculated back in the aeration tank. Excess biomass is transferred into bio-sludge tank. Clear overflow from secondary clarifier is transferred to the tertiary treatment.

2.4 Tertiary Treatment:

Tertiary treatment consists of chemical oxidation, pressure sand filter and activated carbon filter. Effluent from biological treatment is passed through chemical oxidation tanks, where Hydrogen Peroxide dosing is done. Mixing in chemical oxidation tank is provided with air agitation using separate air blowers. Effluent from chemical oxidation tank is collected in intermittent storage tank. From where effluent is further subjected to pressure sand filter and activated carbon filter. Suspended solids get removed in pressure sand filter and activated carbon filter provides treatment for removal of color and COD so that final treated wastewater meets the discharge norms specified by MPCB. Backwashing of both the filters is done daily for cleaning of filter beds. The backwashed water is diverted back into wastewater collection sump for further treatment.

2.5 Sludge Dewatering System:

Sludge from primary and secondary clarifiers is collected in primary sludge sump and bio sludge tank respectively. Excess bio sludge is taken to 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. Leachate collected from sludge dewatering system is collected in leachate collection tank. That leachate is then taken into wastewater collection tank for further treatment. Dried sludge from sludge drying beds is removed, packed and disposed to the Transport, Storage and Disposal Facility site at Ranjangaon for secured landfilling.

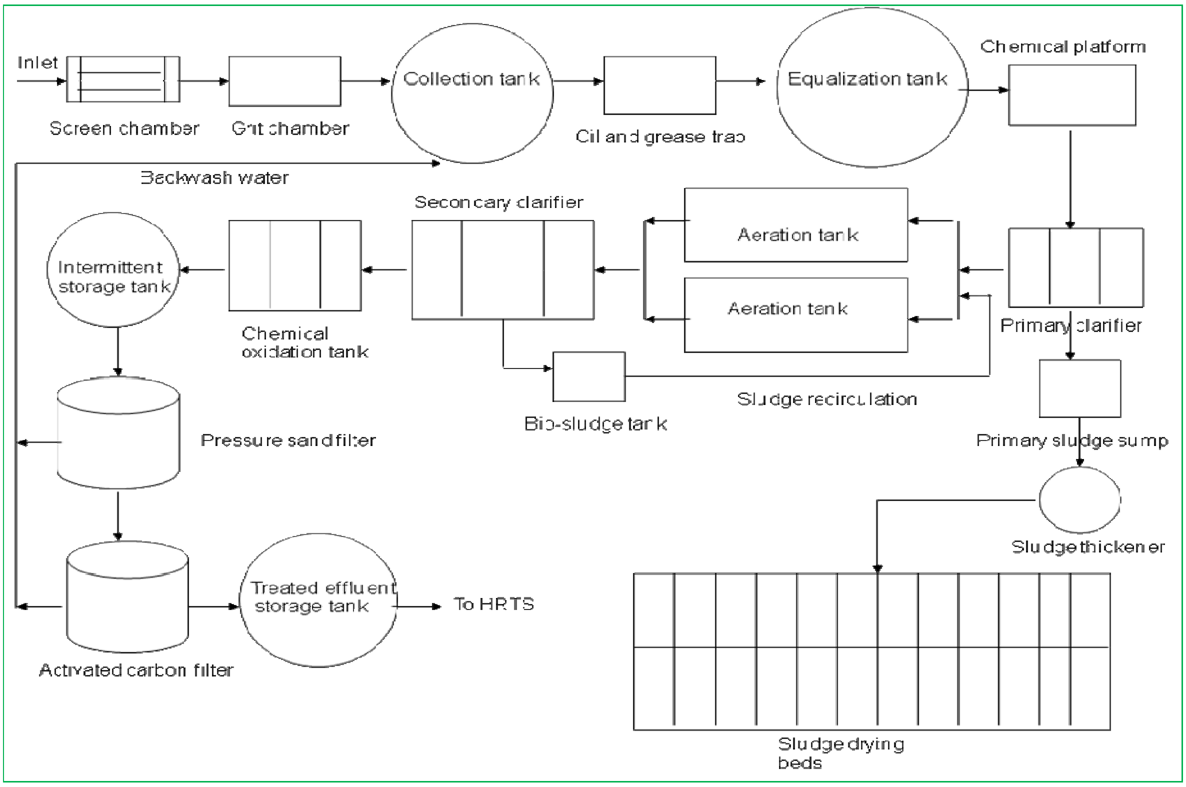

Fig. 1: Flow diagram of Common Effluent Treatment Plant, Kagal

Table 3: Technical Details of CETP Units

Units	Size	Design Details	Quantity
Flow	500 m^3/hr		
Screen Chamber	2.5mx2.5mx2.5m	Design flow velocity: 3-4m/min Screening: Single stage 12 mm * 12 mm size screen	1
Grit Chamber	7mx2.5mx2.5m	Flow velocity: 3.33 m/min at peak flow	1
Collection tank	dia. 25.5mx height 2.5m	HRT: 1.5 hrs	1
Oil and grease trap	8mx2mx2.5m	Detention time provided: 4.8 minutes	1
Equalization tank	dia. 37m xheight4.2m	HRT: 8 hrs	1
Primary clarifier	24mx8mx3.2m	Sedimentation velocity: 0.5m/hr Design surface loading rate: 3 m^3/ m^2/ hr	3
Aeration tank	40m x44m x4.5m	HRT: 15.84 hrs	2
Secondary clarifier	30m x10mx3.2m	Sedimentation velocity: 0.4m/hr Design surface loading rate: 2.5 m^3/ m^2/ hr	3
Chemical oxidation tank	9mx3mx3.5m	Air quantity: 200 m^3/ hr	3
Pressure sand filter	dia.2.6mx ht.1.8 m	Capacity: 85 (each) m^3/hr Filtration rate: 16 m^3/ hr/ m^2 Design pressure: 4 kg/cm^2	6
Activated carbon filter	dia.2.6mx ht.1.8m	Capacity: 85 (each) m^3/hr Filtration rate: 16 m^3/ hr/ m^2 Design pressure: 4 kg/cm^2	6
Primary sludge sump	5m x5mx3m	Sludge quantity 30 m^3/ hr Holding time: 2 hrs	1
Sludge thickener	dia.8m xht.3m	solid loading: 8000 kg/ day	1
Sludge drying beds	10mx5m	Slurry to be fed to sludge drying bed: 106.7 m^3/ d	24

3. Results and Discussions:

Inlet and outlet sample was analyzed for various parameters and results obtained are mentioned in table no.4. Analysis for inlet and outlet sample was carried out for period of 30 days.

Table 4: Values of Inlet and Outlet Parameters

Parameters	Inlet	Outlet
pH	7.8	7.5
COD	500±50	170±20
BOD	258±30	30±5
Oil and Grease	15±5	8±2
Chlorides	500±100	380±50
Sulphides	Nil	Nil
TSS	380±20	85±10
TDS	2500±10	2058±10

Except pH all values are in mg/l.

3.1 Operating Parameters of CETP:

3.1.1 pH:

Figure 2 shows the graph of pH v/s days. Inlet pH value varies between 8.2 to 6. Outlet pH value varies between 7.5 to 6.9. Industries use alkaline base solutions for their process and due to the presence of unskilled staff at their ETP, pH adjustment is not done properly therefore there are variations in inlet pH. Also various chemicals like caustic soda, hypochlorites etc. are used for processes like bleaching, scouring in textile industries that also cause variations in inlet pH.

3.1.2 Oil and Grease:

Figure 3 shows the graph of inlet and outlet oil and grease v/sdays. Inlet oil and grease value varies between 25 mg/l to 13 mg/l. Oulet 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.

3.1.3 Chlorides:

Figure 4 shows the graph of inlet and outlet chlorides values v/s days. Inlet chloride value varies between 590 mg/l to 410 mg/l. Outlet chloride value varies between 310mg/l to 490 mg/l. Variations in inlet chlorides observed due to regeneration time in water softening of industries varies. There is no any considerble reduction in outlet chloride values because chloride removal efficiency of CETP treatment units is less.

3.1.4 COD:

Figure 5 shows the graph of inlet and outlet COD v/s days. Inlet COD varies between 320 mg/l to 550 mg/l. Outlet COD varies between 190 mg/l to 240 mg/l. Variations in inlet COD is due to the chemical consumption of industries is varies according to their process requirement.

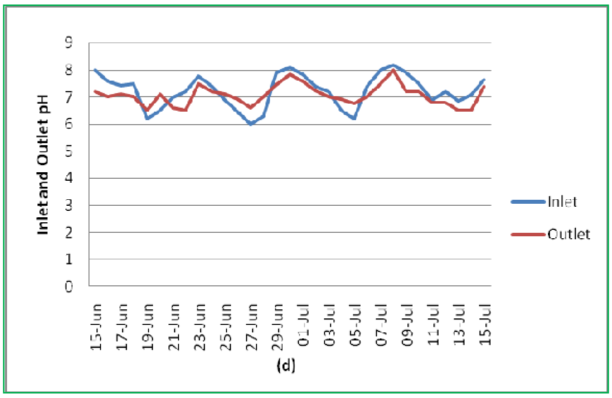

Fig. 2: Graph of inlet and outlet pH v/s day

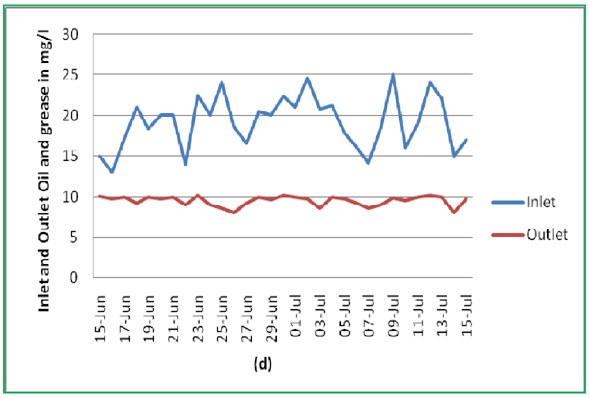

Fig. 3: Graph of inlet and outlet oil and grease v/s days

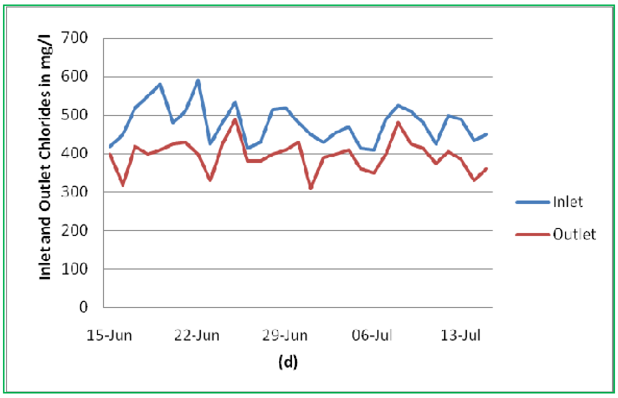

Fig.No.4 Graph of inlet and outlet chlorides v/s days

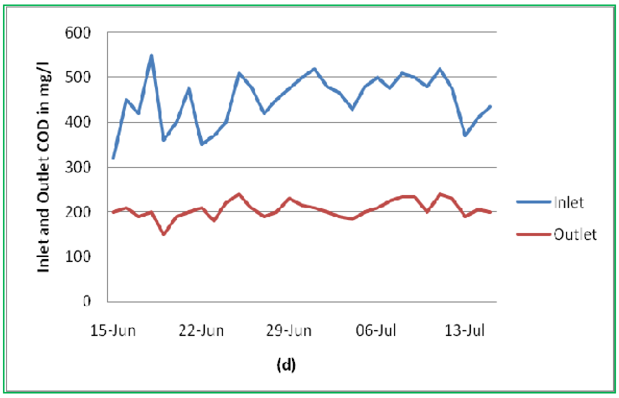

Fig. 5: Graph of inlet and outlet COD v/s days

4. Conclusions:

The study indicates that there is efficient reduction in parameter from treatment units of CETP. Up to 60% 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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