ABSTRACT

There has been a phenomenal growth of industries in Delhi in the last 2-3 decades, with a sharp increase in the number of industrial units. According to the Ministry of Environment and Forests 15 CETP's were to be set up as per the directives issued by Supreme Court and further steps were to be taken by the Delhi government for expediting the construction and commissioning of CETP's. Provision of effluent treatment plants for individual industries especially in the small scale sector in the various industrial estates in Delhi to produce the effluent of desired quality before discharging the effluent is not feasible in the Indian context.

In Delhi there are 13 CETP's but only 11 are in operating condition. Out of these 11 CETP's only one is based upon the biological treatment and rest of the CETP's are working on physio-chemical treatment, which is not efficient in the overall treatment of the industrial wastewater. In order to determine the performance of the CETP, study was carried out on Badli CETP located at north-west district of Delhi.

Samples were collected from inlet and outlet of each units of the treatment plant on daily basis and pH, TDS, TSS, BOD, COD, heavy metals, oil and grease are measured. pH, TSS, BOD and COD measured at inlet and outlet of the treatment plant were varied from 5.5 to 7.8, 493 to 43 mg/l, 98 to 23 mg/l and 480 to 160 mg/l respectively.

Results obtained were analysed and it was found that, at the inlet of the plant almost all the parameters were found exceeding the standard limits and at the outlet parameters were brought under limits before its disposal into drain.

Chapter1

INTRODUCTION

1.1 INTRODUCTION

During the past 30 years the industrial sector in India has quadrupled in size. The bulk of industrial pollution in India is caused by the small and medium scale industrial (SMIs) sector. Though the quantity of industrial waste generated by individual SMIs may not be large, it aggregates to be a large percentage of the total since almost 3 million SMIs are widely scattered throughout the country.

Government policies have been biased toward small industries as employment generators, even though small industries are highly polluting. The SSI policy has no thought on the environmental planning. Promotion of small enterprise is widely seen as a desirable way to achieve sustainable development, for that result, however, their pollution problems, among others, must be overcome. To deal with the effluent in these SSIs the concept of Common Effluent Treatment Plan (CETP) was introduced with a hope that not only it would help the industries in pollution abatement but also as a step towards the clean environment.

Accordingly the Ministry of Environment and Forests instructed various State Pollution Control Boards, to examine the possibilities of establishing CETPs in various industrial estates in the respective states. Even central assistance up to 25percent of the total cost of the CETP is being provided as a grant to the common effluent treatment plant on the condition that the State Governments would give a matching contribution. The remaining costs have to be met by equity contribution by the industries and the loans from financial institutions.

The concept of CETP, which was hyped as a solution to manage water pollution, has failed because of the heterogeneous nature of the effluent from different industries. It has only compounded the toxic content to larger volumes. And also with the changing nature of effluent many toxic substances like organo chlorines, polychlorinated biphenyls (PCBs) and heavy metals have found their way into the waste stream. The various standards formulated for inlet and outlet effluent has no mention of these toxic chemicals and other volatile fugitives. The management of Persistent Organic Pollutants (POPs) and inorganic residues in fluid form goes beyond the capacity of primary and secondary treatment in CETPs. Reverse Osmosis, Granulated Activated Carbon, Ultra-filtration, ion exchange and other tertiary treatment methods, which could be effective, in this case are not used by CETPs mainly for economic reasons. This concept also faced many operational and institutional problems, as many participating industries started withdrawing from the scheme. With the growing pace of industrialization these CETPs are unable to cater to the need of the industrial clusters, which has resulted in bypassing the treatment and directly discharging the untreated effluent in water bodies. The sludge that is settled in aeration tanks having concentrated amounts of heavy metals and organochlorines, is disposed openly.

World Bank is still promoting CETPs under "Pollution Prevention Programme" as a viable solution to control industrial pollution. Also in most of the water pollution cases the courts have given the ruling to abate the problem using this concept (M.C. Mehta vs. Union of India 1987, Kanpur tanneries). This myopic vision about managing effluents with an end-of pipe technology has been ineffectual even in controlling the basic parameters of the effluents.

There is a need to approach this problem of waste generation at each stage of product life cycle, starting from the types of chemicals used, technology, final product, waste minimization and its proper disposal. The waste management hierarchy would seem to work best in individual waste-generator cases. Logically, after receptor-related treatment is ensured, waste minimization efforts are taken up with the objective of progressively reducing the need for individual treatment.

In India the paradox of starting backwards is legally enforced in that, no industry of the ‘Red’ or ‘Orange’ category can commence operations unless and until the end-of-pipe hardware is in place. Till this year, end-of-pipe pollution control hardware costs could be depreciated 100 percent in the first year and import of ETP related equipment still get through with low duties. The same subsidy is not available for waste minimization or preventive measures related hardware and software. These incentives coupled with command and control enforcement of standards, shifts the whole focus away from waste minimization towards operation of treatment and disposal systems.

According to the Ministry of Environment and Forests 15 CETP's were to be set up as per the directives issued by Supreme Court and further steps were to be taken by the Delhi government for expediting the construction and commissioning of CETP's. Delhi State Industrial Development Corporation (DSIDC) is the sole agency for construction and implementation of the CETP project but only 11 CETP's were installed and operational in Delhi till date against the commissioning of 15 CETP's.

Common effluent treatment plant at Badli industrial area is meant for treatment of wastewater generated from 400 numbers of small and medium scale industrial units located in the Badli industrial complex, Delhi. Physio-chemical process is being adopted for the treatment of wastewater at 12 MLD BADLI CETP

1.2 OBJECTIVE OF STUDY

The CETP Badli installed and commissioned in the year is serving the industries located around it. To find out the efficiency of the CETP and its units and to compare the performance of the unit of CETP Badli with that of published standards, a study was carried out aimed at following.

1. To collect the information regarding the sources of wastewater input to CETP Badli.
2. Characterization of wastewater inflow to CETP Badli.
3. To collect the information about the various units of CETP Badli.
4. To determine the inflow to the treatment plant and compare the same with that of the designed flow of the CETP.
5. To determine the efficiency of treatment of each unit of CETP Badli.
6. To assess the effectiveness of functioning of each unit of CETP with that of published standards for the same and/or with the design targets.

Chapter 2

LITERATURE REVIEW

2.1 INTRODUCTION

Common Effluent Treatment Plant is the concept of treating effluents by means of a collective effort mainly for a cluster of small scale industrial units. This concept is similar to the concept of Municipal Corporation treating sewage of all the individual houses. The main objective of CETP is to reduce the treatment cost for individual units while protecting the environment.

1. To achieve 'Economics of scale' in waste treatment, thereby reducing the cost of pollution abatement for individual factory.
2. To minimise the problem of lack of technical assistance and trained personnel as fewer plants require fewer people.
3. To solve the problem of lack of space as the centralized facility can be planned to ensure that adequate space is available.
4. To reduce the problems of monitoring for the pollution control boards.
5. To organize the disposal of treated wastes and sludge and to improve the recycling and reuse possibilities.

2.2 TECHNOLOGICAL ASPECT OF CETP

2.2.1 Feasibility assessment of Common effluent treatment plants

2.2.1.1Identifying institutional, environmental and infrastructural issues

The initial stage of a feasibility assessment involves gathering information on existing and proposed institutional, environmental and infrastructural issues in the particular geographic area. The study also aims at identifying and establishing various parameters that ultimately influence the design of the plant.

While determining whether a CETP is feasible for a group of Industries, it is important to recognize that certain characteristics of industries, certain regional and regulatory considerations favour the establishment of CETPs. Preliminary investigation of the following factors is essential during the feasibility assessment -

1. **Number of Industries -** This is a very important factor as this decides the unit cost of treatment. The more the firms participate; the lower would be the unit cost of treatment for each firm.

2. **Location of Industries -** This factor has a major impact on the transportation costs which strongly influences the feasibility and cost-effectiveness of a CETP.

3. **Presence of sewer system -** This also has a positive effect on the feasibility of CETP. Proper laid out sewer lines aid in conveyance of effluents from the individual factories to the centralized facility. If no sewer line is present then good roads are essential for truck access.

4. **Strength and volume of waste-** Firms that produce waste of small volume of concentrated waste are more likely to benefit from CETP while firms that produce large quantities of waste are more likely to find that installing their own waste treatment system is more economical. In some cases a firm can reduce it’s waste flow using recovery, recycling and waste reduction practices and then join a CETP.

5. **Size of the unit –** Size of the unit is also an important factor that affects the applicability and usefulness of CETP. Small firms often lack the ability to raise the capital needed to install pollution control equipment. Using CETP, small firms need to implement less costly waste reduction techniques and install small storage facility.

6. **Existence and enforcement of waste water regulations-** Existence & enforcement of regulations is the key, otherwise if such regulations are absent, firms will not take initiatives for installing on site pollution control equipment or utilizing a CETP.

2.2.1.2Conducting a waste inventory

The second stage of feasibility assessment involves conducting a waste inventory of the specific industries for which the CETP is being proposed. It involves the following steps-

1. **Identifying industries in the geographic area-** Identification of the industries that are the potential users of the CETP, which includes determining the number and type of industries, sources such as industrial associations, trade organizations and local governmental organizations can be consulted.

2. **Identifying types and volumes of wastes generated -** Collecting data on the types and volumes of wastes is a complex and difficult one. Data to be collected on this aspect should reveal enough information that can distinguish among types of wastes such as organic and inorganic and should reveal the volume of diluted and concentrated wastes and the amount of total waste to be received at the CETP. Depending on the waste stream to be treated, it is determined whether a centralized facility to treat hazardous and/or non-hazardous waste is needed and will affect how a CETP is designed and managed.

3. **Estimating future waste loads-** Collecting data about future waste generation from the concerned industries is as important as collecting data about the present load. This may be a difficult task as most of the industries do not plan for more than 2 to 3 years but estimating future loads correctly could be very useful in designing the plant capacity. And to have a provision for new industries coming in that area so as to include them also in the CETP future waste load.

4. **Identifying treatment options-** Once the types and volumes of wastes generated by the industries are identified, the next step is to examine their compatibility and to identify potential treatment options.

5. **Evaluating cleaner technologies-** This is the last but the most important step in the feasibility assessment and the possibility of recommending changes in the raw material, manufacturing processes or finished products to reduce waste generation. For some industries adoption of cleaner technologies should be considered along with or in lieu of development of the CETP itself.

2.2.2 Design Basis

The impact of the possible pollution prevention measures including waste segregation measures have to be assessed based on which characteristics of the combined wastewater will have to be evaluated. Site characteristics and wastewater characteristics form an integral part of design basis. Pre-treatment standards for waters entering the collection system serving the CETP and treatment standards for effluents discharged from CETP also are significant design considerations.

1. **Site characteristics –** The sewer network and CETP could be properly design by considering the site Characteristics like as type of soils, topography, water resources, climate and land use. Slope and depth to bedrock effect the cost of sewer installation, for example elevation distributions that allow gravity flow and adequate depth for burial of pipe are most desirable. Soil characteristics like clay content, sand content, permeability etc. and Soil thickness play a major role while deciding on certain treatment options such as land and lagoon treatment or granular media filtration etc. Climatic factors such as precipitation is important when inflow and runoff is a problem with sewers and evaporation is important when treatment processes being considered rely on evaporation of treated waste water.

2. **Wastewater characteristics-** Physical and chemical characteristics of the wastewater must be considered in designing CETP.

3. **Flow (m^3/day or MLD)-** It is important in determining the size of CETP. Minimum and maximum flows should be computed as they decide the hydraulic computations and the size of distribution pipes. Anticipated future increase should also be incorporated. Temporal flow variations require use of equalisation ponds to allow a

constant flow rate through downstream processes. Mixing of waste water with lower concentration such as addition of sewage helps in reducing toxic shock on treatment processes.

2.2.3 Physical characteristics

1. **Solids**- Solids in the form of floating debris, grease and oil slicks indicate a highly polluted stream and suspended solids contribute to turbidity and silt load and require sedimentation or filtration for removal.
2. **Temperature-** It is an important criterion as it affects chemical reactions and biological activity of bacteria present and it also affect the solubility of gases in sewage. For example high temperatures increase reaction rates and solubility to a certain extent.
3. **Colour and odour-** They serve as indicators of the degree of pollution of a waste stream and their presence in wastewater indicates inadequate pre-treatment prior to discharge.

2.2.4 Chemical characteristics

Chemical characteristics of wastewater help in indicating its strength, extent and type of treatment required for making it safe to the disposal point.These are indicated by-

1. **pH** – The pH is a measure of the acid or alkaline nature of a solution and affects the quality of a water or wastewater. The pH is an important parameter for both natural waste and wastewater.

2. **BOD (mg/l) -** Biological oxygen demand provides an indicator of the amount of organic substances of biological origin such as proteins, carbohydrates, fats and oils and biodegradable synthetic organic chemicals in water.

3. **COD (mg/l) -** Chemical oxygen demand measures non-biodegradable as well as biodegradable organics. The ratio between BOD and COD provides an indicator of the ease of biological treatment.

2.2.5 Conveyance System

Piping system- Piping wastes is practical when participating industries are located close to CETP or we can say piping wastes are limited to an industrial estate. Design of piping system for CETP's require more attention to corrosion prevention and control which is mainly done by preventing sulphide content to enter the pipes. Pipe thickness can be increased to allow for some corrosion.

2.2.6 Treated effluents discharge standards

Waste water treatment processes differ in reducing the concentration of parameters of concern such as BOD or Suspended solids etc. and the standards of discharge determine whether a given combination of treatment processes provide an acceptable level of treatment. Thus before designing a CETP effluent discharge standards should be identified. Standards may vary depending on the point of discharge of treated wastewater.

2.3 WASTEWATER TREATMENT TECHNOLOGIES

2.3.1 Preliminary treatment

It involves a number of unit processes to eliminate undesirable characteristics of wastewater. Processes include use of screen sand grates for removal of large particles, communitors for grinding of coarse solids, pre-aeration for odour control and some removal of grease.

2.3.2 Primary treatment

It involves removal of readily settable solids prior to biological treatment. Sedimentation chambers are the main units involved but various auxiliary processes such as floatation, flocculation and fine screening may also be used.

Table2.1: Treated effluent quality standards for CETP

S.No.	Parameter	Into inland surface water (mg/l)	On land for irrigation (mg/l)	Into marine coastal areas (mg/l)
1	pH	5.5 – 9.0	5.5 - 9.0	5.5- 9.0
2	BOD (3 days at 27°C)	30	100	100
3	Oil & Grease	10	10	20
4	Suspended solids	100	200	i)100-Process water ii)10 percent above total suspended matter of influent -cooling water Nil
5	Dissolved solids	2100	2100	1.0
6	Total residual Cl	1.0	Nil	
7	Ammonical nitrogen (as N)	50	Nil	50 250
8	COD	250	Nil	2.0
9	Lead (Pb)	0.1	Nil	2.0
10	Cadmium (Cd)	2.0	Nil	2.0
11	Chromium (Cr)	2.0	Nil	3.0
12	Copper (Cu)	3.0	Nil	15
13	Zinc (Zn)	5.0	Nil	5.0
14	Nickel (Ni)	3.0	Nil	Nil
15	Chloride (Cl)	1000	600	15
16	Fluoride (F)	2.0	Nil	1000
17	Sulphate (SO_4)	1000	1000	Nil
18	Sulphide (S)	2.0	Nil	0.2
19	Cyanide (CN)	0.2	0.2	

2.3.3 Secondary treatment

It involves purification of wastewater primarily by decomposition of suspended and dissolved organic matter by microbial action. A number of processes are available but mainly used are land treatment, activated sludge process or the biological filtration methods.

2.3.4 Auxiliary treatment

This mainly includes large number of physical and chemical treatment processes that can be used before or after the biological treatment to meet the treatment objectives.

Design of the actual treatment system for a CETP involves selection of alternative processes based on the ability of individual treatment processes to remove specific waste constituents.

2.4 PHYSICAL TREATMENT PROCESSES

Physical treatment separates solids from wastewater mechanically with screens or using density difference as with sedimentation and floatation.

2.4.1 Preliminary treatment - These are mainly physical processes. This includes:

2.4.1.1 Grit chamber

Grit chamber use gravity to remove grit and dirt which mainly consists of mineral particles and coarse screens strain out large solids and when organic material enters as large particles comminutors can be used to reduce particle size to enhance treatment in later stages.

2.4.1.2 Equalisation

Equalisation is a process to equalise wastes by holding waste streams in a tank for a certain period of time prior to treatment in order to obtain as Table waste stream that is easier to treat. Equalisation helps in mixing smaller volumes of concentrated wastes with larger volumes at lower concentrations. It also controls the pH to prevent fluctuations that could upset the efficiency of treatment system, by mixing acid and alkaline wastes. Equalisation tanks are equipped with agitators that help not only in proper mixing of waste water but also prevent suspended solids from settling to the bottom of the unit.

2.4.1.3 Pre-chlorination

Pre-chlorination is applied to prevent odor problems associated with the breakout of hydrogen sulfide. It is also helps to reduce plant load, (BOD) and aids in the settling of solids and grease removal during primary clarification.

2.4.2 Primary treatment - These are also mainly physical processes. These include-

2.4.2.1 Sedimentation

Removal of readily settleable inert and organic solids is accomplished in sedimentation. Fine screens may also be used in the treatment process. Sedimentation chambers may also include baffles and oil skimmers to remove grease and floatable solids and may include mechanical scrapers for removal of sludge at the bottom of the chamber.

2.4.2.2 Dissolved air floatation

It is the process of using fine bubbles to induce suspended particles to rise to the surface tank where they can be collected and removed. Gas bubbles are introduced into the wastewater and attach themselves to the particles, thus reducing their specific gravity and causing them to float. Bubbles may be generated by

i. dispersing air mechanically
ii. by drawing them from water using vacuum or
iii. by forcing air into solution under elevated pressure followed by pressure release.

This is called dissolved air floatation. It is used to remove suspended solids and dispersed oil and grease from oily wastewater. It reduces the sedimentation times of suspended solids that have a specific gravity slightly greater than 1.0. Wastewater is pressurized and contacted with air in a retention tank. The pressurized water that is nearly saturated with air is passed through a pressure- reducing valve and introduced into at the bottom of floatation tank. As soon as pressure is released the supersaturated air begins to come out of solution in the form of fine bubbles. The bubbles get attached to suspended particles and become enmeshed in sludge flocs, floating them to surface. Float is continuously swept from the surface and sludge may be collected from the bottom. Addition of certain coagulants increases the oil removal efficiency of DAF units.

2.4.2.3 Flocculation

It is physical- chemical process that encourages the aggregation of coagulated colloidal and finely divided suspended matter by physical mixing or chemical coagulant aids. Flocculation process consists of a rapid mix tank and a flocculation tank. The waste stream is initially mixed with a coagulant in the rapid mix tank and after mixing the coagulated waste water flows to the flocculation basin where slow mixing of waste occurs which allows the particles to agglomerate into heavier more settleable solids. Either mechanical paddles or diffused air provide mixing. Three different types of chemicals used in coagulation are inorganic electrolytes, natural organic polymers and synthetic poly electrolytes. The selection of a specific chemical depends on the characteristics and chemical properties of the contaminants.

2.4.2.4 Clarification

Clarification system utilise gravity to provide continuous, low cost separation and removal of particulate, flocculated impurities and precipitates from water and generally follow the processes which generate suspended solids such as biological treatment. In a clarifier wastewater is allowed to flow slowly and uniformly, permitting the solids more dense than water to settle down. The clarified water flows from the top of the clarifier over the weir. Solids get collected at the bottom and sludge must be periodically removed, dewatered and disposed.

2.4.2.5 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 by physical filtration, physical chemical sorption and biological decomposition.

i. 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.

ii. Dual or multimedia filtration consists of two or more media and it operates with the finer, denser media at the top and coarser, less dense media at the top. Common arrangement being garnet 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.

iii. Granular media filters can separate particle size (generally less than 2 mm) smaller than biological filters which increase their efficiency over other treatment process. These processes are most commonly used for tertiary treatment in municipal wastewater treatment plants and for supplemental removal of residual suspended solids from the effluents of chemical treatment processes.

2.4.3 Chemical treatment Processes

Chemical treatment may be used at any stage in the treatment process as and when required. Mainly used methods are-

Neutralization- This process is used to adjust pH of the waste water to optimise treatment efficiency. Untreated wastewater has a wide range of pH values and may require neutralization to eliminate either high or low values prior to certain treatment. Acids such as sulphuric or hydrochloric may be added to reduce pH or alkalis such as sodium hydroxide may be added to raise pH values. Neutralization may take place in a holding, rapid mix or an equalisation tank. It can be carried out mainly at the end of the treatment system to control the pH of discharge in order to meet the standards.

2.4.4 Biological treatment Processes

Biological treatment processes are used primarily for secondary treatment and use 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. Success of biological treatment depends on many factors such as the pH, temperature, nature of pollutants, nutrient requirement of microbes, presence of inhibiting pollutants and the variations in the feed stream loading.

Biological treatment can be either aerobic where microbes require oxygen to grow or anaerobic where microbes will grow only 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 in activated sludge process. Biological treatment methods either require large area such as land treatment and stabilization ponds/lagoons or small area requirement using engineered methods such as activated sludge process, biological filters and anaerobic treatment systems.

2.4.4.1 Stabilization ponds/lagoons

Also called oxidation ponds, treats waste water by the interaction of sunlight, wind and algae with or without assistance of mechanical aeration equipment. Lagoons are smaller than ponds and have a second pond to remove suspended solids. Lagoons are simple in design and require low operation and maintenance costs and the control of discharge may eliminate the need for additional treatment. Disadvantages include large area requirements and bad odours.

2.4.4.2 Activated sludge process

It is continuous flow, aerobic biological treatment process that employs suspended growth aerobic micro organisms to biodegrade organic contaminants. In this process a suspension of aerobic microbes is maintained by mechanical mixing or turbulence induced by diffused aerators. Influent is introduced in the aeration basin and is allowed to mix with the contents. A series of biochemical reactions is performed in the basin degrading organics and generating new bio mass. Micro-organisms oxidize the matter into carbon dioxide and water using the available supplied oxygen. These organisms agglomerate colloidal and particulate solids. After a specific period the mixture is passed to a settling tank or a clarifier where micro-organisms are separated from the treated water. Major portion of the settled solids are recycled back to the aeration tank to maintain a desired concentration of micro-organisms in the reactor and the remainder of the settled 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 –

i. 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 mixed liquor suspended solids (MLSS). F/M ratio affects BOD removal, oxygen requirements and bio mass production.

ii. Sludge retention time or sludge age is the measure of the average retention time of solids in the system and it affects the degree of treatment and the production of waste sludge.

iii. Hydraulic detention time determines the size of the aeration tank and

iv. Oxygen requirements are based on the amount required for biodegradation of organic matter and the amount required for endogenous respiration of micro organisms.

2.4.4.3 Biological filters

These filters provide a surface that is repeatedly exposed to wastewater and air and on which a microbial layer can grow.

i. In trickling filters treatment is provide by a fixed film of microbes that forms on the surface which adsorbs organic particles and degrades them aerobically. Wastewater is distributed over a bed made of rock or plastic and flows over the media by gravity.

ii. In a rotating biological contactor which consists of a series of corrugated plastic discs 40percent of the area is immersed in waste water and the remainder of the surface is exposed to atmosphere, provide a surface for microbial slime layer. The alternating immersion and aeration of a given portion of the disc enhance growth of the attached micro organisms and facilitate oxidation of organic matter in a relatively short time and provide a high degree of treatment.

2.4.4.4 Anaerobic treatment systems

They are rarely used in wastewater treatment systems except as a means for sludge stabilization. These processes more slowly than aerobic degradation and when sulphur is present obnoxious hydrogen sulphide gas is generated. But many toxic organic compound specially chlorinated hydrocarbons that are not amenable to aerobic degradation can be anaerobically treated.

CHAPTER 3

STATUS OF CETP'S IN DELHI

3.1 INTRODUCTION

There has been a phenomenal growth of industries in Delhi in the last 2-3 decades, where a sharp increase in the number of industrial units from 26,000 in 1971 to 1,37,000 in 1999 has been recorded. Due to public pressure against the increasing pollution and congestion in Delhi, the supreme court (M.C. Mehta vs. Union of India) directed that hazardous industries be moved out of the city. The order also stated that other industries falling under the conforming areas should comply with the various environmental standards. For which construction of 15 CETP's in 1997 were commissioned and plants were scheduled to be completed by Dec 31st 1998.

Delhi Pollution Control Committee (DPCC) has divided Delhi (National Capital Territory) into 28 industrial estates. Industrial estates in Delhi houses a number of small-scale industries and pose a serious threat to the environment of Delhi. Small-scale sector is not ready to invest in pollution control measures because of unprofessional lack of financial measures, lack of technical expertise, unavailability of land etc. In order to control water pollution in the state idea of installing Common Effluent Treatment Plants was promoted by the DPCC.

According to the Ministry of Environment and Forests 15 CETP's were to be set up as per the directives issued by Supreme Court and further steps were to be taken by the Delhi government for expediting the construction and commissioning of CETP's. Delhi State Industrial Development Corporation (DSIDC) is the sole agency for construction and implementation of the CETP project but only 11 CETP's were installed and operational in Delhi till date against the commissioning of 15 CETP's. List of 11 CETP's are enclosed below.

Provision of effluent treatment plants for small scale sector in the various industrial estates in Delhi to produce the effluent of desired quality before discharging the effluent is not feasible in the Indian context. Firstly, it is expensive on both the capital and operating cost front and secondly, there is no guarantee of performance by the individual industries. Further the disposal of treated effluents is also problematic as every individual industry cannot reach the water body through it's own pipeline nor can it purchase land for inland irrigation. Thus, Government of India floated the idea of Common effluent treatment plant to overcome these problems. Accordingly Ministry of Environment and Forest, Government of India instructed the various State pollution control boards to examine the possibilities of establishing CETP's in various industrial estates. Till 1990 Delhi had no CETP.

Table 3.1: List of CETPs in NCT Delhi

S.No.	**Name of CETP**	**Industrial Area Served**	**Installed Capacity (MLD)**
1	Badli	Badli Industrial Area	12
2	G T Karnal	G T Karnal Industrial Area	6
3	Jhilmil	Jhilmil and friends colony Industrial Area	16.8
4	Lawrence road	Lawrence road Industrial Area	12
5	Mangolpuri	Mangolpuri Industrial Area	3.4
6	Mayapuri	Mayapuri Industrial Area	12
7	Nangloi	Nangloi Industrial Area and SIIDC complex	12
8	Okhla	Okhla Industrial Area ph-I and Ph-II	24
9	SMA	SMA, SSI and Rajsthan Udyog Nagar Industrial Area	12
10	Wazirpur	Wazirpur Industrial Area	24
11	Narela	Narela Industrial Area	23.5

Waste water treatment processes differ in reducing the concentration of parameters of concern such as BOD or Suspended solids etc. and the standards of discharge determine whether a given combination of treatment processes provide an acceptable level of treatment. Thus before designing a CETP effluent discharge standards should be identified. Standards may vary depending on the point of discharge of treated wastewater.

3.2 DATA COLLECTION FROM THE CETPS

3.2.1 Mayapuri CETP

Table 3.2: General Information on Mayapuri CETP

S.No.	Item	Information
1.	Design Capacity	12 MLD
2.	Managed by	CETP Society
3.	Type of Industries	Printing unit, Soap Industries, Manufacturing of machinery, Spare parts and Others Total No. of Industries = Approx. 3,850
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank + Flash Mixer + Tube Settlers + Dual Media Filter + Activated Carbon Filter
5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	Industrial/ Domestic effluents is mixed. About 4 MLD of effluent is reaching CETP. Sewage from residential localities other than Mayapuri industrial area has been now diverted. Drains in Mayapuri area are under construction; more flow is expected from the area.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on Mayapuri CETP

1. CETP was operational.
2. Working of the CETP was based on physio-chemical process.
3. Both the equalization tanks were in use.
4. 6 Nos. of DMF, and 4 Nos. of ACF were operational
5. Odor Problem & fine particles in the final tank.

3.2.2 Lawrence Road CETP

Table 3.3: General Information on Lawrence Road CETP

S.No.	Item	Information
1.	Design Capacity	12 MLD
2.	Type of Industries	Food processing, Slaughter house, Bakery, Plastic, Printing, Dying and washing, Others Total No. of Industries = Approx. 435
3.	Managed by	DSIIDC
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank + Flash Mixer + Flocculator + Tube Settlers + Dual Media Filter + Activated Carbon Filter
5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	Industrial sewers About 1.9 MLD of effluent is reaching the CETP.

Salient Observations on Lawrence Road CETP

1. Odour problem was prevalent.
2. Two agitators were working, one in each tank, sludge was found in to be accumulating.
3. It was reported that the dosing in Post Chlorination tank had been stopped.
4. BOD is high.
5. Vacuum filter found non operational.
6. During visit 4 DMF and 2 ACF (which are in use) found operational.

3.2.3 Mangolpuri CETP

Table 3.4: General Information on Mangolpuri CETP

S.No.	Item	Information
1.	Design Capacity	3.4 MLD
2.	Type of Industries	Plastic molding, Plastic washing, Rubber molding and

		Others Total No of Industries = Approx. 450
3.	Managed by	CETP Society
4.	Treatment Scheme	Screen + Grit Chamber + Equalization tank + Primary Settling Tank + Aeration Tank +Secondary Settling Tank + Dual Media Filter +Activated Carbon Filter Activated sludge process is used but effluent from both PST and SST contains a high concentration of SS.
5.	Sludge storage and Management	Sludge is stored within CETP premises.
6.	Effluent collection	Effluent from both Phase I and Phase II is reaching the CETP. The total flow is about 1- 2 MLD.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River.

Salient Observations on Mangolpuri CETP

1. On the screens pieces of plastics were found.
2. Two agitators were found to be working one in each tank. The mixing is not adequate with the two agitators.
3. The weir of the primary as well as secondary clarifier tank was properly levelled.
4. The sludge from the secondary clarifier was of good settling characteristic.
5. Working of the CETP was based on biological process.

3.2.4 GT Karnal Road CETP

Table 3.5: General Information on GT Karnal Road CETP

S.No.	Item	Information
1.	Design Capacity	6 MLD
2.	Type of Industries	Textile, Auto-parts, Service Stations & Others Total No of Industries = Approx. 250
3.	Managed by	CETP Society
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank + Flash

		Mixer + Tube Settlers + Dual Media Filter + Activated Carbon Filter
5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	About 3.5 MLD of effluent was reaching the CETP. Most of the industries were connected to conveyance system.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on GT Karnal Road CETP

1. Out of four agitators in equalization tank one agitator was found not working & sludge was found to be accumulating in the equalization tank
2. Sludge thickener is working properly.
3. Settling properties of sludge found in good condition.
4. Odour problem was prevalent.

3.2.5 Badli CETP

Table 3.6: General Information on Badli CETP

S.No.	Item	Information
1.	Design Capacity	12 MLD
2.	Type of Industries	Electroplating, Pickling, Dying and Others Total No of Industries = Approx. 500
3.	Managed by	CETP Society
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank + Flash Mixer +Flocculator+ Tube Settlers + Dual Media Filter + Activated Carbon Filter
5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	Low pH of the influent indicates that the individual ETPs

		of some units where pH correction and separation of sludge is to be carried out are not working. The old collection system was damaged due to the acidic effluents. The flow in the main drain was 1.0 MLD.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on Badli CETP

1. Sludge was found accumulating in the equalization tank.
2. Second vacuum filter found operational.
3. Flow meter at inlet found operational.
4. Working of the CETP was based on physio-chemical process.
5. CETP society facing problem with respect to storage of hazardous waste & its disposal method.

3.2.6 SMA CETP

Table 3.7: General Information on SMA CETP

S.No.	Item	Information
1.	Design Capacity	12 MLD
2.	Type of Industries	Synthetic Yarn, Casting (iron, gun metals), Pickling & Others Total No of Industries = Approx. 250
3.	Managed by	CETP Society
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank + Flash Mixer + Tube Settlers + Dual Media Filter + Activated Carbon Filter
5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	Only 1.5 MLD flow was reaching the CETP. The

		CETP was to receive effluent from SMA, SSI and Rajasthan Udyog Nagar industrial areas.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on SMA CETP

1. A high pH effluent is being received at inlet. Caustic soda was being used to maintain the pH of the influent.
2. Equalization tank was found to having 1-1.5 m depth of sludge.
3. Both the Equalization tanks were operational.
4. Pressure gauge of DMF and ACF found operational.
5. Inlet flow meter found functional.
6. One of the Vacuum pump was found to be non functional and cloth needs to be changed.
7. Total qty. of sludge stored as per log book 250 T.
8. Sludge is stored at the plant itself at separate storage yard.
9. CETP society facing problem with respect to storage of hazardous waste & its disposal method.

3.2.7 Okhla CETP

Table 3.8: General Information on Okhla CETP

S.No.	Item	Information
1.	Design Capacity	12 MLD
2.	Type of Industries	Service Stations, Automotive Parts, Leather Article, Electronics, Pharmaceuticals, Dyeing and Others No. = Approx. 4,000
3.	Managed by	CETP Society
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank + Flash Mixer + Flocculator + Tube Settlers + Dual Media Filter + Activated Carbon Filter

5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	About 3 MLD of effluent was reaching the CETP. Effluent from industries of Phase I from industries located on west side of the Sarita Vihar drain was being discharged into Sarita Vihar drain. Untapped effluent also flows in an open drain near Z-Block in Phase II. It is estimated that if total effluent generated from Phase I and Phase II is tapped then more flow will reach CETP.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on Okhla CETP

1. Two 4 MLD equalization tank were found, out of which one was found to be working and sludge was found in second tank.
2. Only one vacuum filter and pump installed at the CETP and same found functional.
3. Total quantity of sludge- 384 MT (approx.)

3.2.8 Jhilmil CETP

Table 3.9: General Information on Jhilmil CETP

S.No.	Item	Information
1.	Design Capacity	16.8 MLD
2.	Type of Industries	Paint Based, Dye, Engineering, Copper, Aluminum, Zinc, Chrome-plating, Auto Mobile & Service Station and Others Total No of industries = Approx. 1,300
3.	Managed by	CETP Society
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank + Flash Mixer +Tube Settlers + Dual Media Filter + Activated Carbon Filter
5.	Sludge storage and Management	Sludge is stored within CETP premises

6.	Effluent collection	About 4 MLD of effluent was reaching the CETP from Jhilmil industrial area. DJB had laid conveyance system in the Friends Colony industrial area. Conveyance system had not been laid in few lanes of the Friends Colony industrial area.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on Jhilmil CETP

1. Oil & Grease found in equalization Tank.
2. One equalization tank is being used, second equalization tank kept isolated for removal of sludge.
3. About half of the equalization tank (approx. 2 m depth) of sludge was found filed in the equalization tank.
4. CETP society had installed sludge pump to remove sludge and to pump it in a separate shed for drying.
5. Proper dosing being done, using alum and poly.
6. Sludge thickener system was not functioning properly.
7. Flow meter is in working condition.

3.2.9. Nangloi CETP

Table 3.10: General Information on Nangloi CETP

S.No.	Item	Information
1.	Design Capacity	12 MLD
2.	Type of Industries	Electrical Machines, Yarn, Plastic and Rubber molding and Others Total No of Industries = Approx. 3.000
3.	Managed by	CETP Society
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank + Flash Mixer + Flocculator + Tube Settlers + Dual Media Filter + Activated Carbon Filter

5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	The CETP was receiving effluents from Udyog Nagar and Nangloi industrial area and was operational with1- 1.5 MLD flow.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on Nangloi CETP

1. Flow meter found operational.
2. Oil and grease was observed at inlet.
3. Tube settler was working properly.
4. Sludge thickener was working properly.
5. The final effluent tank was having foaming problem.

3.2.10. Narela CETP

Table 3.11: General Information on Narela CETP

S.No.	Item	Information
1.	Design Capacity	23.5 MLD
2.	Type of Industries	Plastic, Processing, Agro, PVC Footwear, and others Total No of Industries = Approx. 2,000
3.	Managed by	DSIIDC
4.	Treatment Scheme	Screen + Grit Chamber + Equalization tank + Primary Settling Tank + Aeration Tank +Secondary Settling Tank + Dual Media Filter +Activated Carbon Filter
5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	1.O MLD Industrial sewers
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on Narela CETP

1. There is acute power shortage, due to which it was reported that the plant could not be run for the required number of hours.
2. Sludge was found in the equalization tank.
3. Oil and grease found.
4. Sludge found in tube settler.
5. Sludge removal from the various units was done.

3.2.11 Wazirpur CETP

Table 3.12: General Information on Wazirpur CETP

S.No.	Item	Information
1.	Design Capacity	24 MLD
2.	Type of Industries	Electroplating, Anodizing, Hot rolling, Service stations, Pickling, Textile and dying, Banquet Halls, Automobile spares manufacturing, Rubber products, plastic products, Electrical and electronics, Printing, Utensil manufacture, Engg and other types. Total No of Industries = Approx. 3000
3.	Managed by	CETP Society
4.	Treatment Scheme	Screen + Grit Chamber + Equalization Tank +Flash Mixer + Tube settlers + Dual Media Filter +Activated Carbon Filter
5.	Sludge storage and Management	Sludge is stored within CETP premises
6.	Effluent collection	The wastewater from the industrial estate is collected in raw water pump house by the help of conveyer.
7.	Disposal of Treated Effluent	Open Drain ultimately leading to Yamuna River

Salient Observations on Wazirpur CETP

1. pH at the inlet was found to be very low (1.9)
2. It was reported that the pipes and pumps require very frequent maintenance due to low pH influent. Also the chemical dosing for pH adjustment is very high.
3. The CETP is situated in relatively low lying area and faces the problem of flooding very frequently. Due to this the plant could not be run at many occasions and also the sludge management becomes a big problem area.
4. Size of sludge withdrawal pipe of the tube settler was found to be small and frequent choking was reported.
5. As the plant is located in a low lying area, problem of flooding is encountered during rains.
6. Sludge was found in equalization tank.
7. Out of three agitators only two were working
8. Sludge holding tank was observed to be full.
9. The plant capacity should be augmented.

CHAPTER 4

CASE STUDY OF BADLI CETP

4.1 INTRODUCTION

Common effluent treatment plant at Badli industrial area is meant for treatment of wastewater generated from 400 numbers of small and medium scale industrial units located in the Badli industrial complex, Delhi. Physio-chemical process is being adopted for the treatment of wastewater at 12 MLD BADLI CETP

4.2 TREATMENT UNITS OF BADLI CETP

4.2.1 Screen Chamber

Screening are used to remove coarse solid consist of sticks, rags, board and other large objects from waste water. The primary purpose of screens is to protect pumps and other mechanical equipment and to prevent clogging of valves and other appurtenances in the plant. The function of screen channel is to remove coarse solids and floating material of size 10 mm or more from the raw effluent. As the effluent passes through the manual bar screen the floating materials and other debris are arrested by the screens. The screenings are raked out by hand rake at the top. A standing screening container disposes off the debris from the treatment units for final disposal.

Description:

No. of screen channel	:	3 nos.
Size of each screen	:	1.25 m width X 1.4 m total depth
Type	:	Manual
Flow to each unit (peak)	:	12 MLD
Clear spacing	:	10 mm

Cross section of the bars	:	10 mm X 50 mm
Angle of inclination	:	45

Fig 4.1: Screen chamber

4.2.2 Grit Chamber

Object: Raw effluent contains inorganic solids such as pebbles, sand, silt, egg shells, glass and metal fragments. The object of grit chamber is to remove sand particles, cinders and other inorganic materials from the raw effluent. Removal of the above material protects the mechanical equipments from abrasion, reduces the formation of deposit in pipeline, prevents scouring of conveying channels, conduits and RCC structures etc.

Process: The screened influent is conveyed to grit chamber by gravity. As the effluent passes through the grit chamber, materials having higher density i.e. sand and other inorganic materials are settled within the system by gravity owing to the reduction of velocity of flow. The settled grit is swept by mechanical scrapping mechanism to a peripheral pit at one side of tank where from it is lifted continuously with the help of rake classifier and conveyed to a standing trolley. The effluent free from the grit particles overflows the grit chamber and is conveyed to the manual bar screen.

Description :

No. of units	:	3 nos.
Material of construction	:	R.C.C.
Average flow	:	800 m^3/hr
Size	:	5m X 3.5 m X 1.5 m
Area of grit chamber	:	19.824 m^2
Surface overflow rate	:	959 m^3 /day/ m^2

Fig 4.2: Grit Chamber

4.2.3 Equalization Tank

Object: The object of the equalization tank is to equalize the flow rate variations so as to improve the performance of downstream processes. Flow equalization simply is the damping of flow rate variation so that a constant or nearly constant flow rate is achieved.

Process: The degritted effluent after flow measurement in the grit chamber free from oil and grease is received in the equalization tank. The air diffusers are used for continuous mixing. The principal objective of providing air diffusers is to mix completely one substance to another and maintain the contents of the equalization tank in a completely mixed state.

Description :

No. of tanks	:	2 nos.
Size	:	44m X 22m X 4.2 m + 0.6m FB
Volume	:	4065.6 m^3
Detention time	:	8 hours (approx)
Floating aerators	:	3 nos.
RPM	:	1460

Fig 4.3: Equalisation tank

4.2.4 Pre Chlorine Contact Tank

Object: The object of the chlorine contact tank is to allow the sufficient contact time for the equalized effluent with the chlorine solution to achieve the desired level of disinfections. Pre-chlorination is primarily applied to prevent odor problems associated with the breakout of hydrogen sulfide. Pre-chlorination also helps to reduce plant load, (BOD) and aids in the settling of solids.

Process: The equalized effluent after is conveyed to chlorine contact tank through pumping. The RCC baffles are used for mixing. The principal objective of providing chlorine contact is to provide sufficient contact time to mix the chlorine with the equalized effluent completely.

Description :

No. of tanks	:	2 nos.
Size	:	24m X 8m X 1.6m

Fig 4.4: Pre-chlorination tank

4.2.5 Flash Mixer Tank

Object: The object of the flash mixer tank is to mix properly the lime and poly with the raw effluent. In the flash mixer, coagulant chemicals are added to the wastewater and the wastewater is mixed quickly and violently to evenly distribute the chemicals through the water. Flash mixing typically lasts for 30 to 60 seconds. If the water is mixed for less than 30 seconds, then the chemicals will not be properly mixed into the water. However, if the water is mixed for more than 60 seconds, then the mixer blades will shear the newly forming floc back into small particles

Process: The chlorinated effluent, free from screenings and grit, pumped to flash mixer with the help of flash mixer feed pump. Lime and poly as per the requirement is continuously dosed in the flash mixer tank. One number agitator in each tank is used for continuous mixing of alum and lime with the effluent. The principal objective of flash mixer tank is to prepare homogeneous mix of effluent, lime and poly.

Description:

No. of tanks	:	4 nos.
Size	:	1.2 dia X 1.8m depth +0.6m FB
Volume	:	8.33 m^3
Detention time	:	60 seconds

4.2.6 Flocculation tank

Object: The object of the flocculator is to floc the chemical mix effluent. Following the Flash mixer, flocculation is the slow stirring process that causes the flocs to grow and to come in contact with particles of turbidity to form larger particles that will readily settle. The purpose is to produce a floc of the proper size, density and toughness for effective removal. Floc formation depends on the rate at which collisions between flocs and particles occur and how the flocs stick together after collision.

Fig 4.5: Flash Mixer

Process: The effluent after flash mixer tank is conveyed to flocculator tank by gravity. The floc is formed with the help of flocculator continuously by slow mixing of the chemically mixed effluent received from the flash mixer tank.

Description:

No. of tanks	:	1 nos
Size	:	16m X 2m X 1.6m
Volume	:	41.6 m^3
Detention time	:	5 min (approx)

4.2.7 Tube settler tank

Object: The object of the tube settler is to allow the settlements of the suspended flocks, which has been formed during the flocculation process in the flocculator tank continuously.

Process: The effluent after flocculation tank is conveyed to tube settler through gravity. The air diffusers are used for continuous mixing. The principal objective of providing air diffusers is to mix completely one substance to another and maintain the contents of the equalization tank in a completely mixed state.

Description:

No. of tanks	:	2 nos.
Size	:	7.1m X 7.1m X 1m
Surface area of each tank	:	$50.41m^2$
Surface loading rate	:	$5\ m^3/m^2/hr.$
Hopper slope	:	1:1
PVC TUBEDEK		
Factor of safety	:	0.7
Angle of Inclination	:	60
Shape of tubedek	:	Hexagonal
Hydraulic Radius of tube	:	15mm
Height of tubedek	:	0.75m

Fig 4.6: Tube Settler

4.2.8 Sludge Thickener

Object: The sludge thickener is meant for the thickening the primary sludge. The sludge thickening is done to increase the solid contents of sludge by removing a portion of liquid fraction. The primary sludge pumped from the tube settler with a content of 2% solids can be thickened to a content of 4-6% solids, then a five foid decrease in sludge volume can be achieved.

Process: The primary sludge from the tube settler is fed in the sludge thickener. The quantity and frequency of the sludge wasting is calculated upon the quantity of sludge

Description:

No. of units	:	1 no.
Sludge flow	:	778.2 kg/day
Material of construction	:	R.C.C.
Size (each)	:	10.2m X 3.3m + 0.3 FB
Solid loading rate	:	25 kg/ m^2/ day

4.2.9 Dual Media Filter (DMF)

Object: Filtration is a process of removal of residual flocs in settled effluents from tube settler. Filtration is also used to remove residual precipitates from the metal salts and is used as a pretreatment operation before treated wastewater is discharged to activated carbon filters.

Process: In pressure filter the filtration is carried out in a closed vessel under preessurized conditions achieved by pumping. Pressure filters are operated at higher terminal head loss. This results in longer filter runs and reduced backwash requirements. The applied pressure must overcome the resistance offered by filter bed and the under drain system. When the filtration has attained the maximum permissible head loss, it is taken out of sevice for cleaning and backwashing.

Description:

No. of units	:	12
Material of construction	:	M.S.
Size	:	3m dia X 2m Ht.
Hydraulic loading rate	:	$6m^3/m^2/hr$.

Fig 4.7: Dual Media Filter

4.2.10 Activated Carbon Filter (ACF)

Object: Filtration throygh activated carbon filter is to remove the odor and color from the wastewater. The wastewater after DMF is passed through ACF under pressure. After ACF the wastewatre is being conveyed to clear water sump.

Process: In pressure filter the filtration is carried out in a vessel under pressurized conditions achieved by pumping. Pressure filters are operated at higher terminal head loss. This results in longer filter runs and reduced backwash requirements. The applied pressure must overcome the resistance offered by activated carbon filter bed and the under drain system. When the filtration has attained the maximum permissible head loss, it is taken out of service for cleaning and backwashing.

Description:

No. of units	:	8
Material of construction	:	M.S.
Size	:	3m dia X 2m Ht.
Hydraulic loadind rate	:	$10m^3 /m^2/hr.$

Fig 4.8: Activated Carbon filter

4.3 SAMPLING AND ANALYSIS

Monitoring of pollutants involves sampling and chemical analysis of the parameters. The sample should be taken at the inlet and outlet of each treatment units in addition to the final effluent as it leaves the CETP premises.

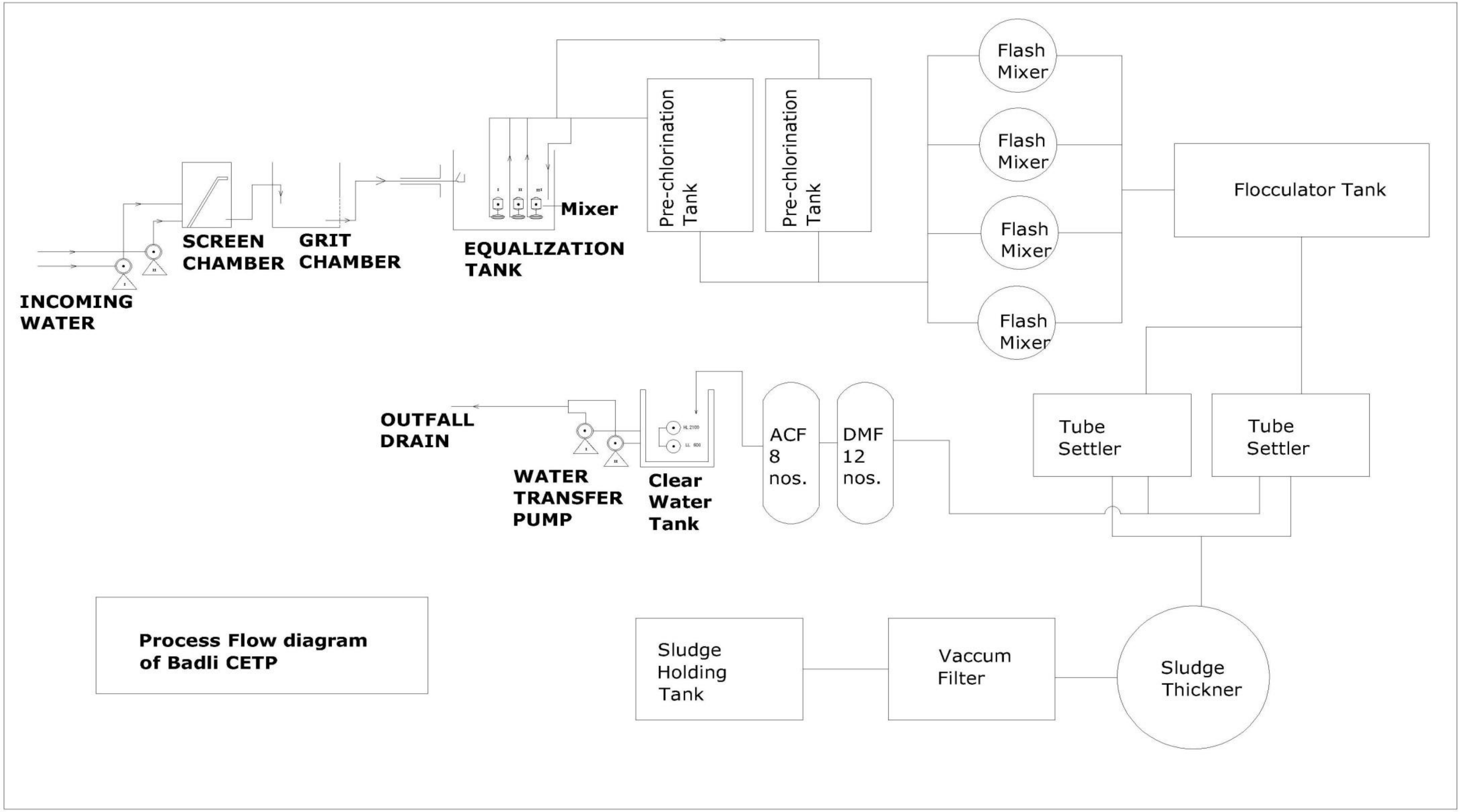

Fig 4.9: Process Flow chart of Badli CETP

The data obtained from sample analysis are meaningful provided the samples are representative which necessitate a well designed sampling technique. There is no universal procedure for sampling which exists, hence sampling must be tailored to fit the operation of each manufacturing unit, regulatory requirements and economics.

In general, samples should be taken from a point one third the water depth from the bottom. When collecting samples, care should be taken to avoid creating excessive turbulence.

Basically, the samples may be collected either on grab or composite basis. It is suggested to collect composite samples everyday for the final effluent whereas grab samples may be taken at other points. However, weekly composite samples for each treatment units and combined wastewater are recommended. In this study composite samples were collected from the each units of the treatment plant.

TDS, TS, pH, BOD, COD, oil & grease, heavy metals constitute as primary pollutants needing frequent analysis. Estimation of parameters should be done according to the various standard procedures available.

4.4 ANALYSIS OF EFFLUENT SAMPLES

The composite effluent samples thus collected from every units were analysed for major pollutional parameters such as pH, TSS, TDS, COD, BOD, etc. All the analysis was carried out as per standard testing procedures of Standard Method for Examination of Water & Waste Water (APHA-AWWA-WPCF).

4.5 MEASUREMENT OF EFFLUENT FLOW

The measurement of flow is a critical & sensitive parameter with respect to assessment of magnitude of various pollutants discharged in effluent. The CETP was having flow meter at the inlet and hence flow measurement was carried out. The flow measurement was carried out after regular intervals during the entire duration of effluent sampling.

CHAPTER-5

RESULTS AND DISCUSSION

5.1 INTRODUCTION

The Government of India issued a policy statement in February 1993 for the abatement of Pollution. The policy emphasises that it is not enough for the Government to notify laws which are to be complied with, and affirms the Government's intention to integrate environmental and economic aspect in the development planning, with the stress on the preventive aspects for the pollution abatement and promotion of technological inputs to reduce industrial pollutants. Specific steps identified to meet this objective are :

1. Prevent pollution at source,
2. Develop, Encourage and apply the best available practical technical solutions,
3. Ensure that the polluters pays for the pollution and control arrangements,
4. Focus protection on river stretches and heavily polluted areas,
5. Involve public in decision making,
6. Increase safety of industrial operations.

Inspite of laying done said above objectives by the government of India, none of the above are adopted by any of industry, people of india and even by the authorithies. Increase in pollution level, degradation of natural flow of river and several health diseases are common, due to the negligence of policy, rules and direction provided for the pollution abatment. In this regard, to determine the performance of the Badli CETP, study was carried and following results were found.

5.2 FLOW

Total designed capacity of the Badli CETP was 12 MLD, but the capacity under utilization was found only 1 -1.5 MLD. Flow was measured at the regular interval using flow meter and there were great variation observed in the flow during the day.

Details of the flow measured on daily basis and hourly basis are shown in Fig 5.1 and fig 5.2 respectively.

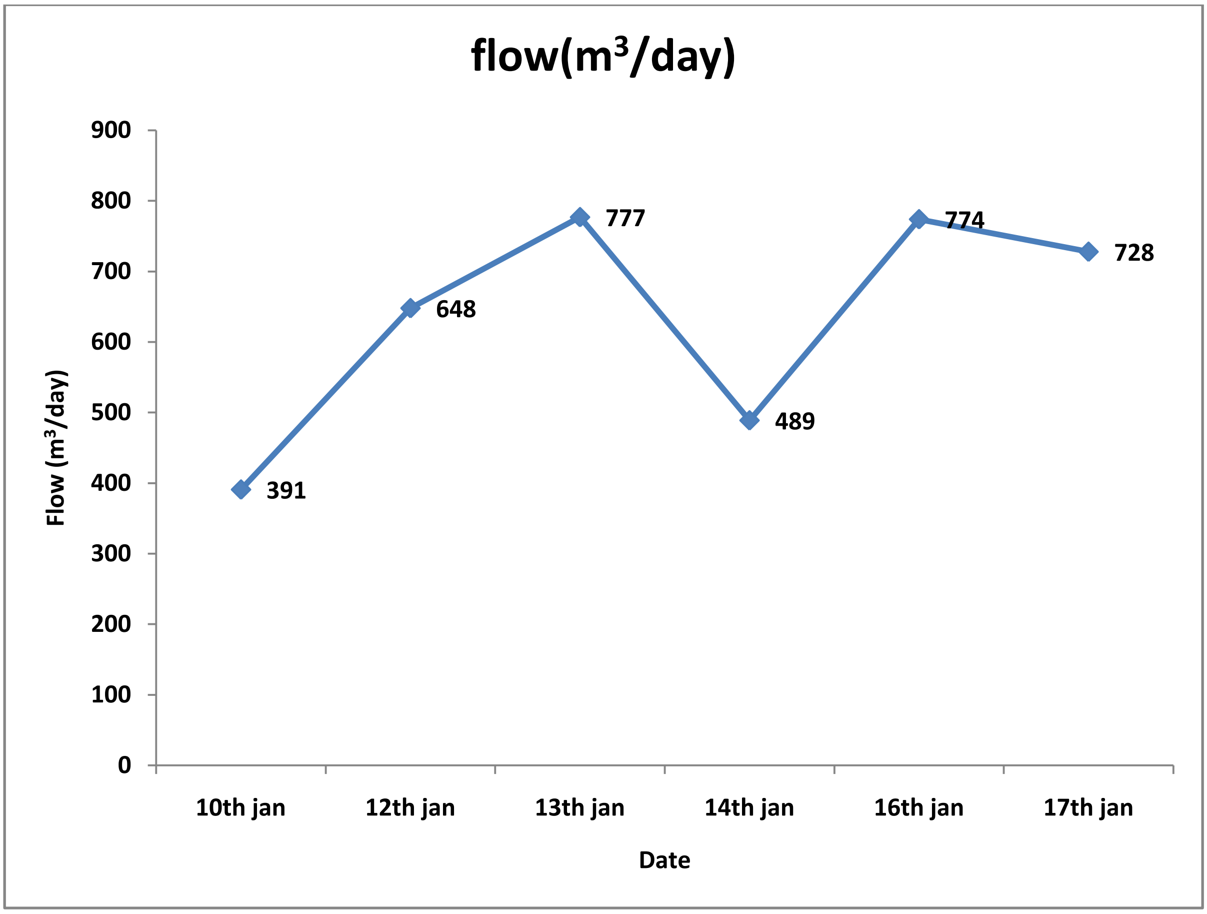

Fig 5.1: Daily variation In flow

5.3 pH

Waste water samples were collected from the different units for the physio-chemical analysis of the samples. pH of the sample collected from the inlet, equalization tank, tube settler, DMF, ACF and outlet of the treatment plant were found 5.5, 5.5, 8, 7.95, 7.85 and 7.8 respectively. Initially acidic pH was observed in the plant. pH is maintained by the addition of lime. In the rest of the treatment units ph were found under standard limits as shown in Fig 5.3.

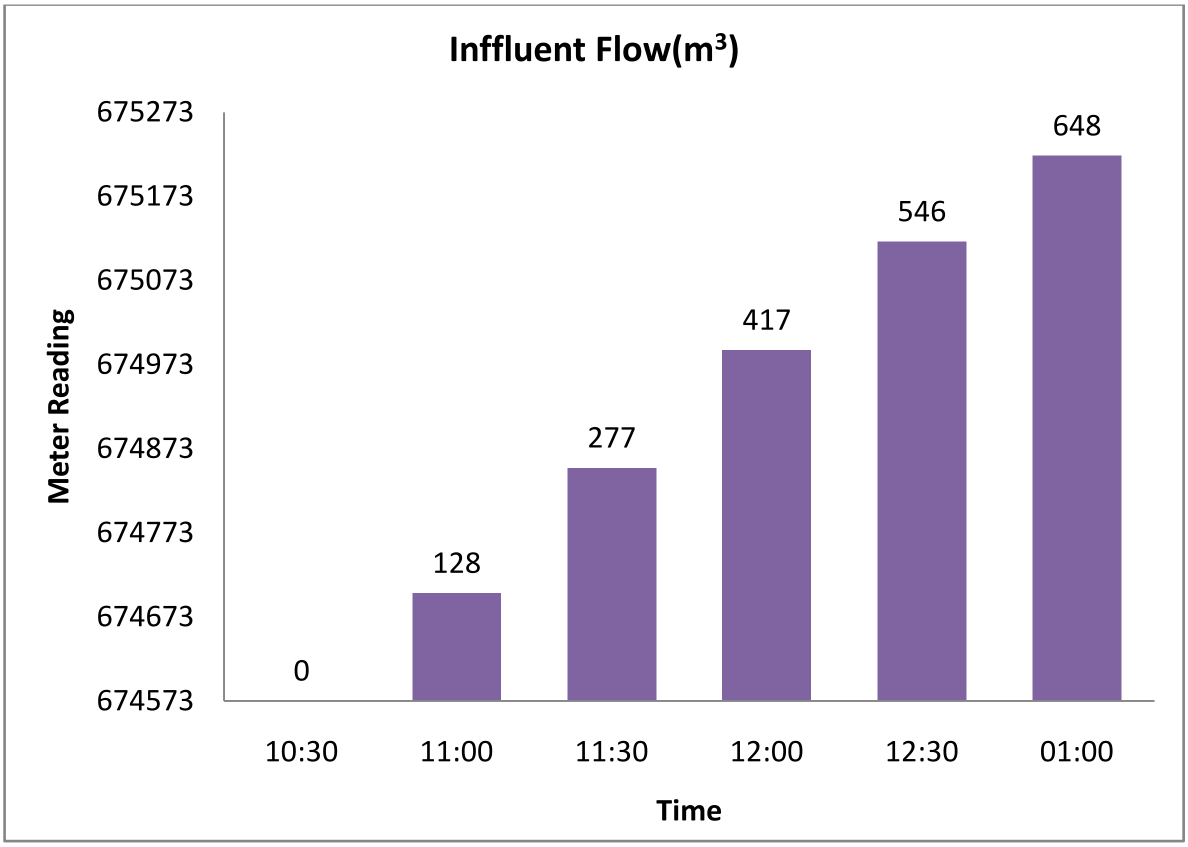

Fig 5.2: Hourly variation in flow

5.4 TSS & TDS

TSS & TDS were also measured from the different treatment units of the plant. Before the treatment TSS were found exceeding the standard limit that is 493 mg/l but after the treatment TSS well reduced to 43 mg/l. Whereas, TDS were found under limits even at the inlet of the plant. At the inlet of the plant TDS were found 2005 mg/l and at the outlet of the plant were found 1997 mg/l. Results of TSS and TDS are shown in Fig 5.4 and Fig 5.5 respectively.

5.5 BOD & COD

BOD & COD were also measured from the different treatment units of the plant. At the inlet BOD were found exceeding the standard limit that is 98 mg/l ,at equalisation tank, tubesettler, DMF, ACF and outlet BOD were found 85, 52, 40, 30 and 23 mg/l respectively. Results of BOD of different treatments units are shown in fig.5.6. Whereas, COD were also found exceeding the limits.

At the inlet COD were found exceeding the standard limit that is 480 mg/l, at equalisation tank, tubesettler, DMF, ACF and outlet of the plant COD were found 450, 210, 190, 180 and 160 mg/l. Results of COD are shown in Fig 5.7.

All the parameters are also measured on daily basis. Details of the all the measured parameter at each unit of the treatment plant are shown in from fig 5.8 to Fig 5.23

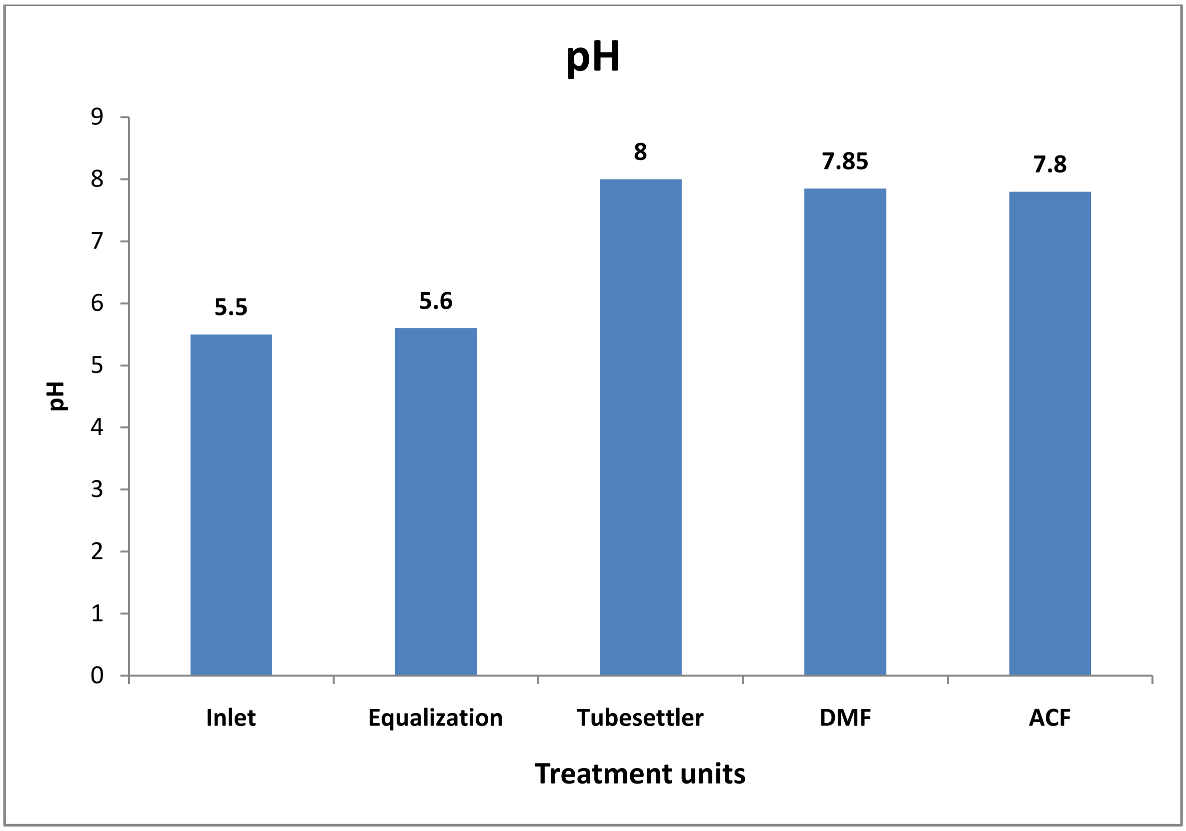

Fig 5.3: pH variation across different treatment units of CETP Badli

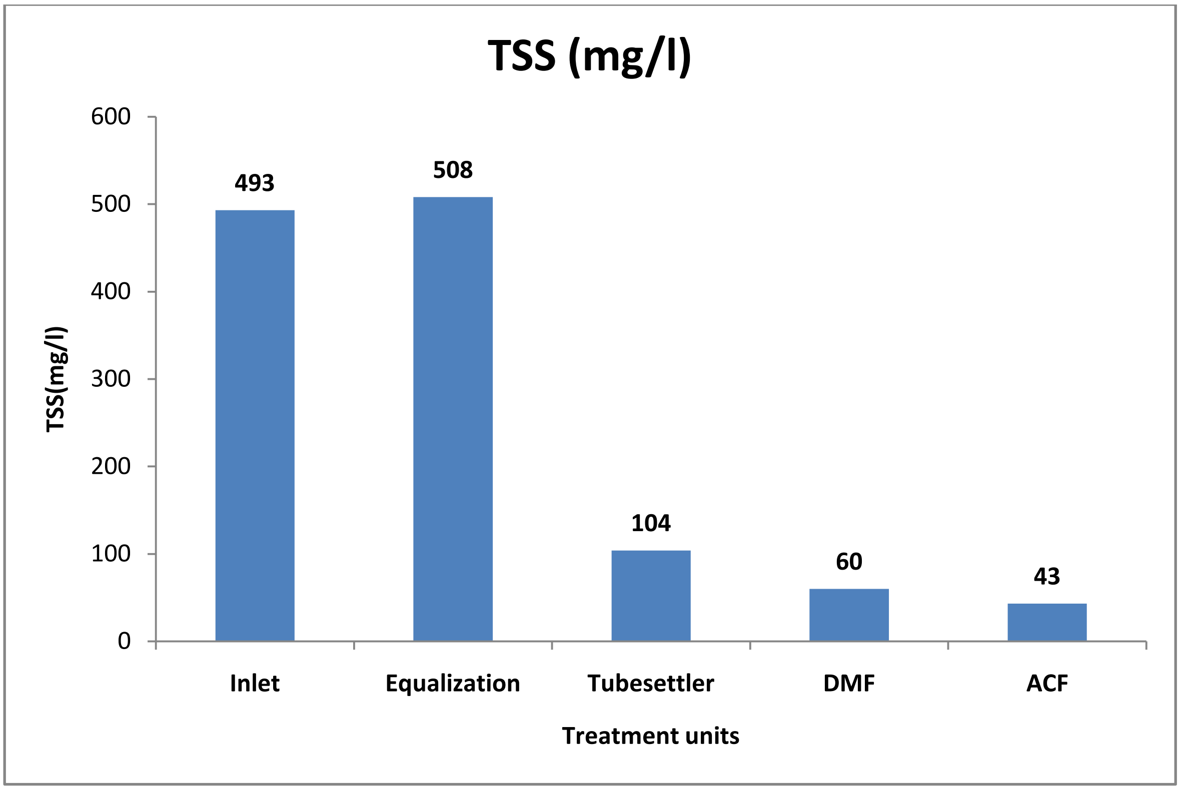

Fig 5.4: TSS variation across different treatment units of CETP Badli

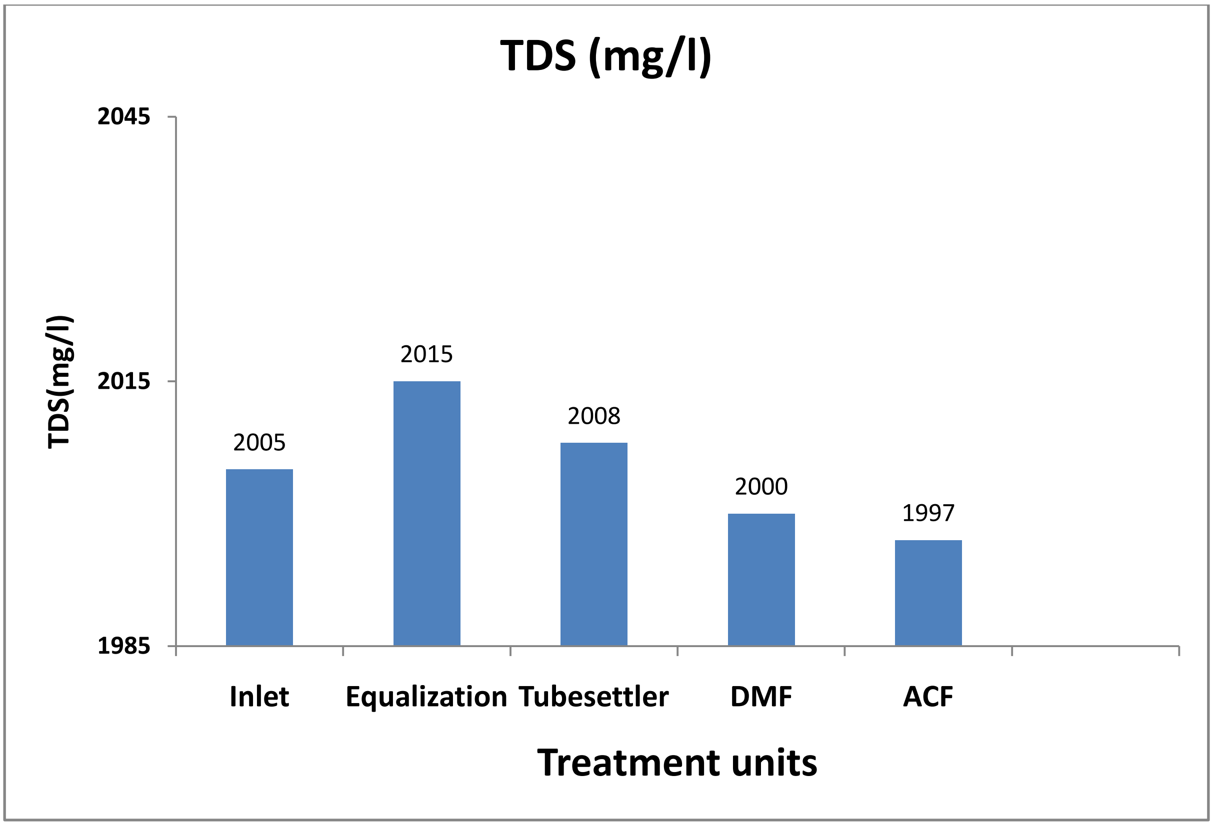

Fig 5.5: TDS variation across different treatment units of CETP Badli

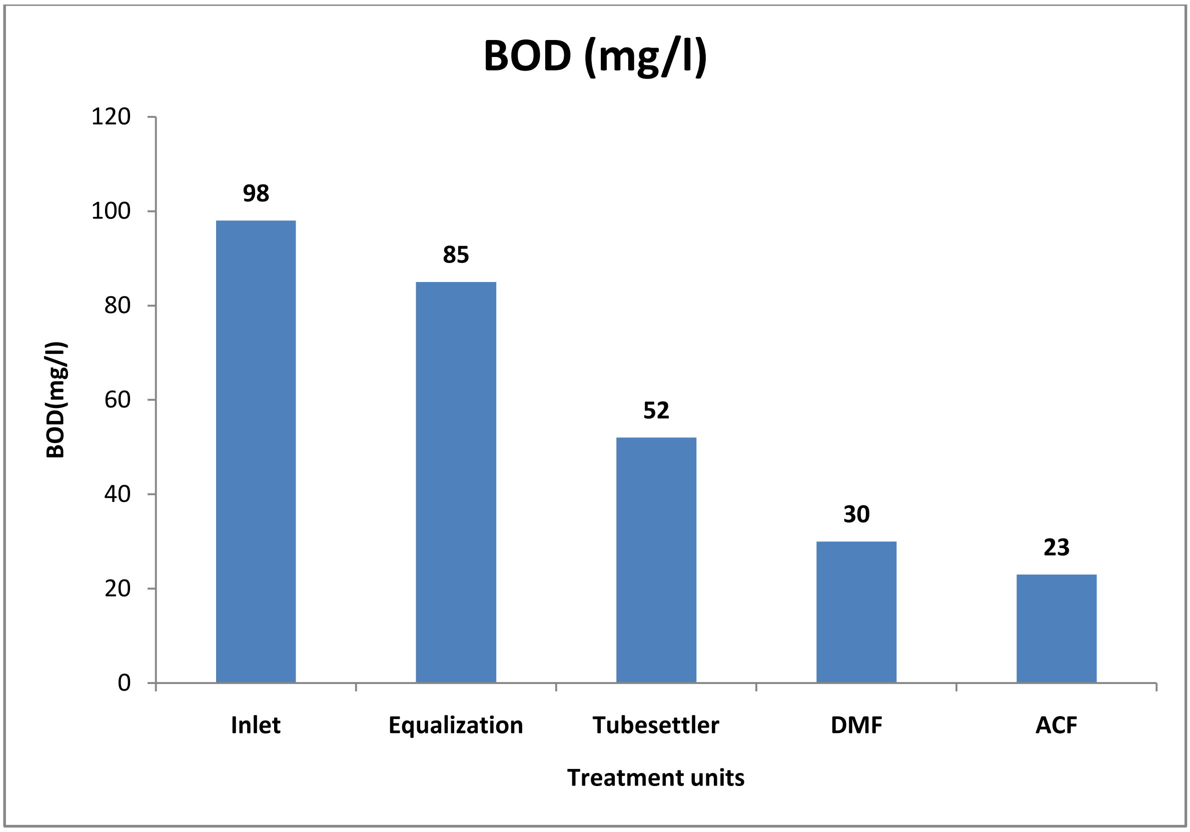

Fig 5.6: BOD variation across different treatment units of CETP Badli

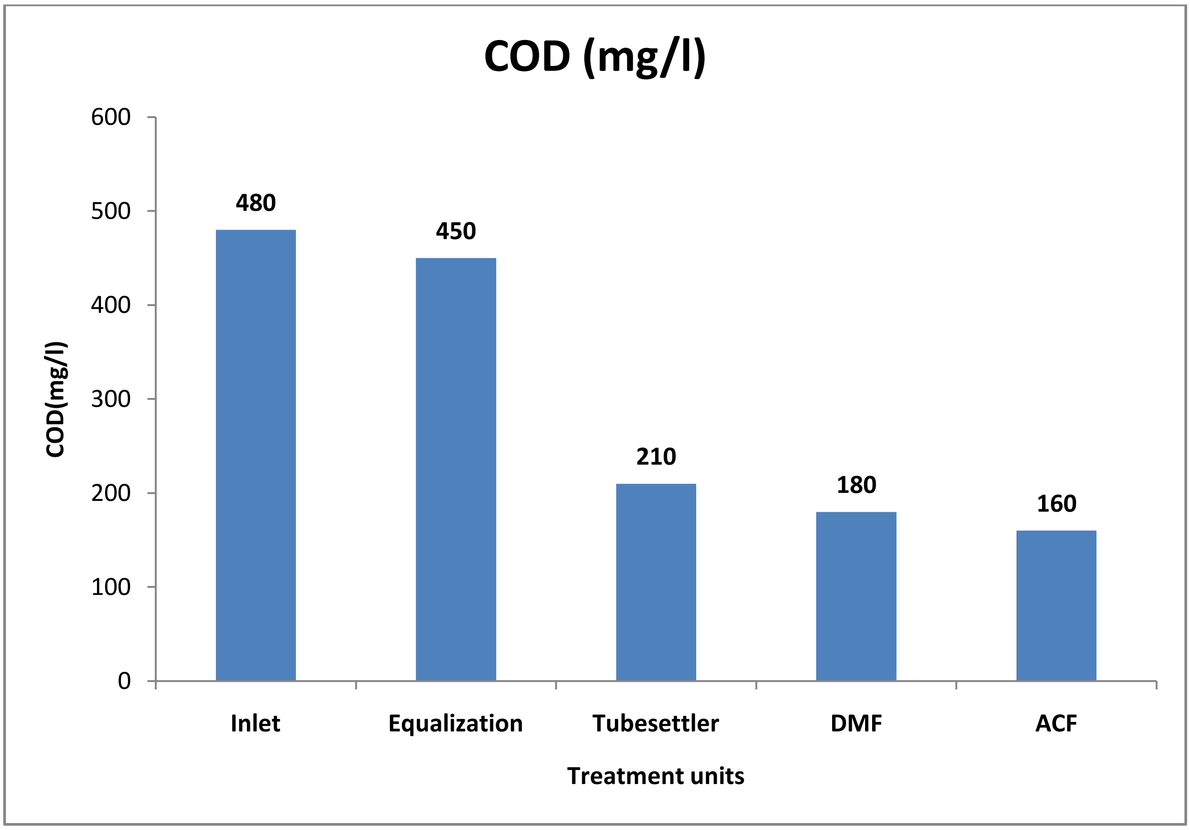

Fig 5.7: COD variation across different treatment units of CETP Badli

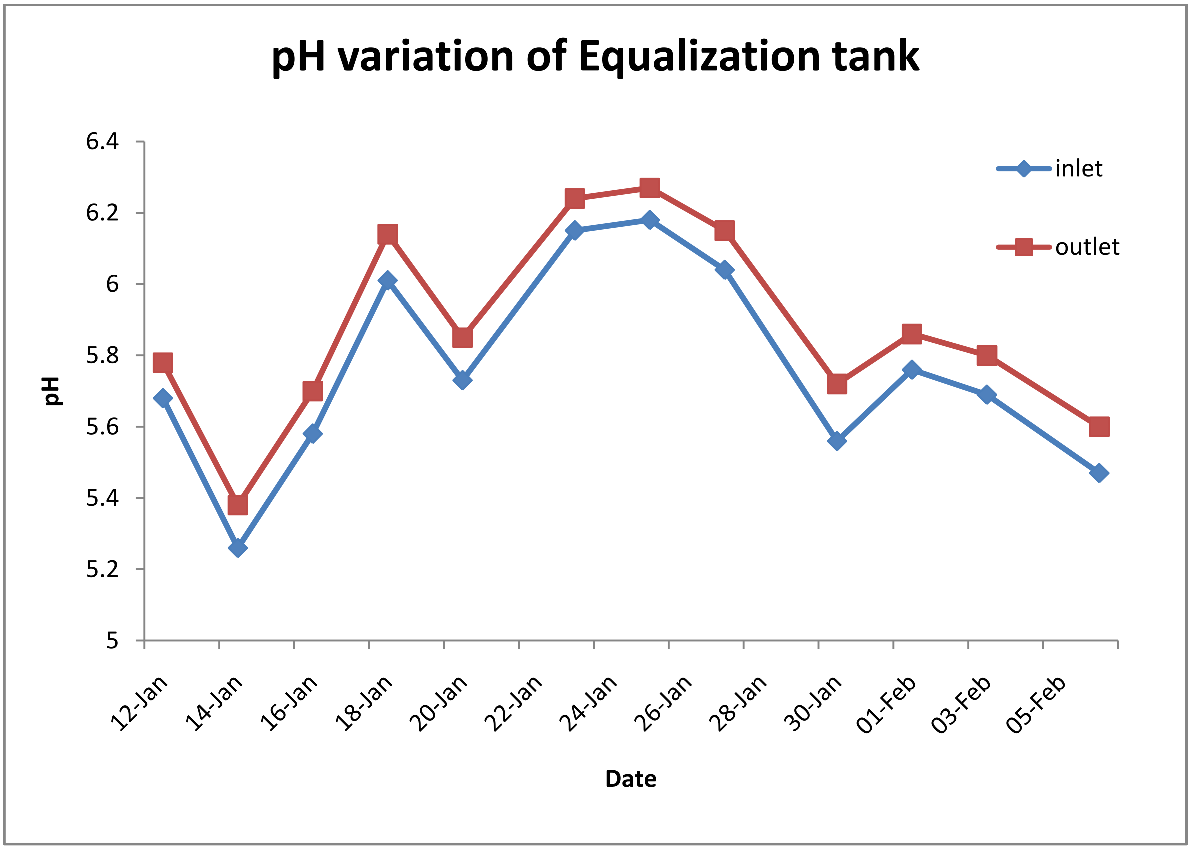

Fig 5.8: pH variation of equalization tank

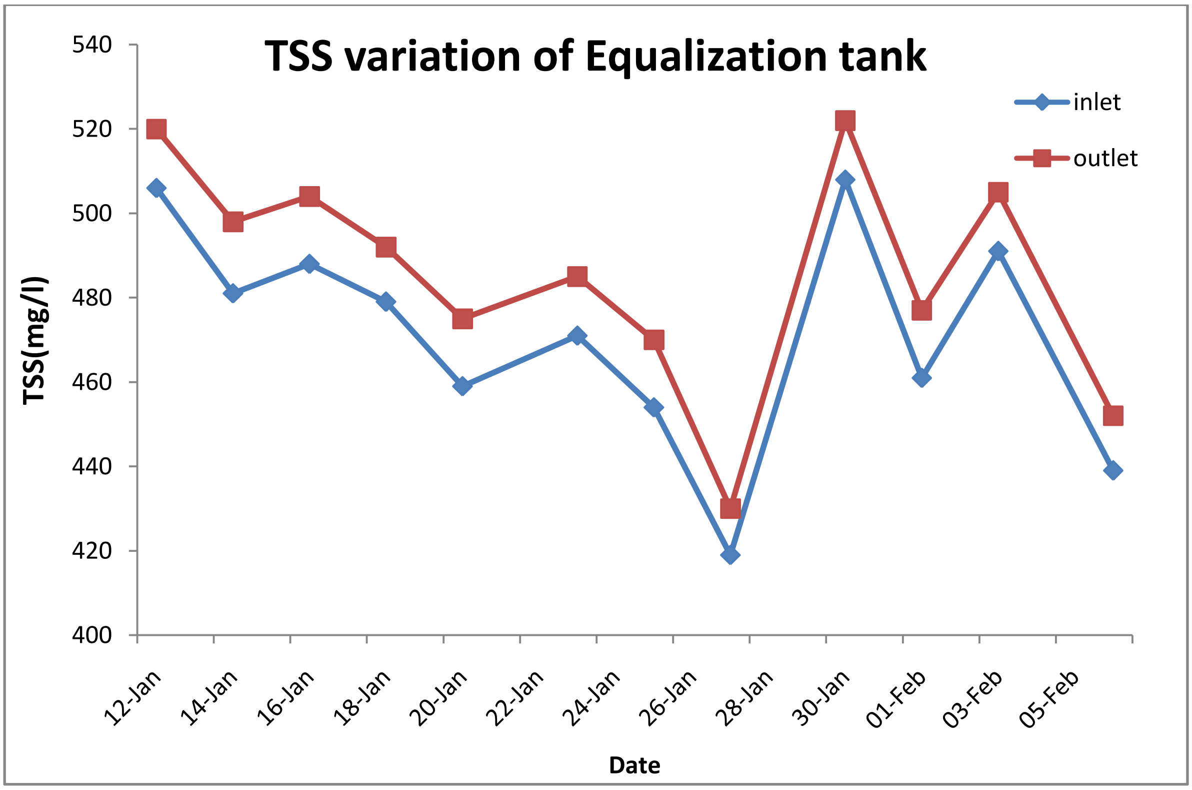

Fig 5.9: TSS variation of equalization tank

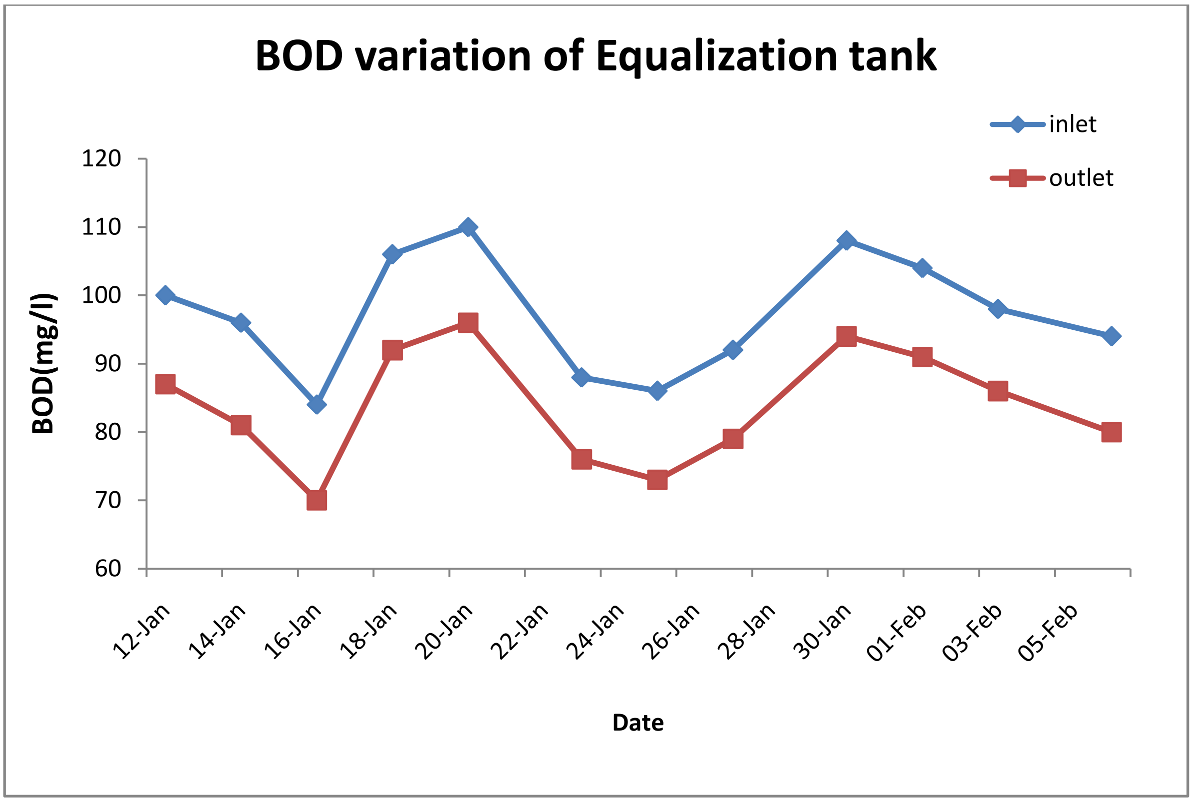

Fig 5.10: BOD variation of equalization tank

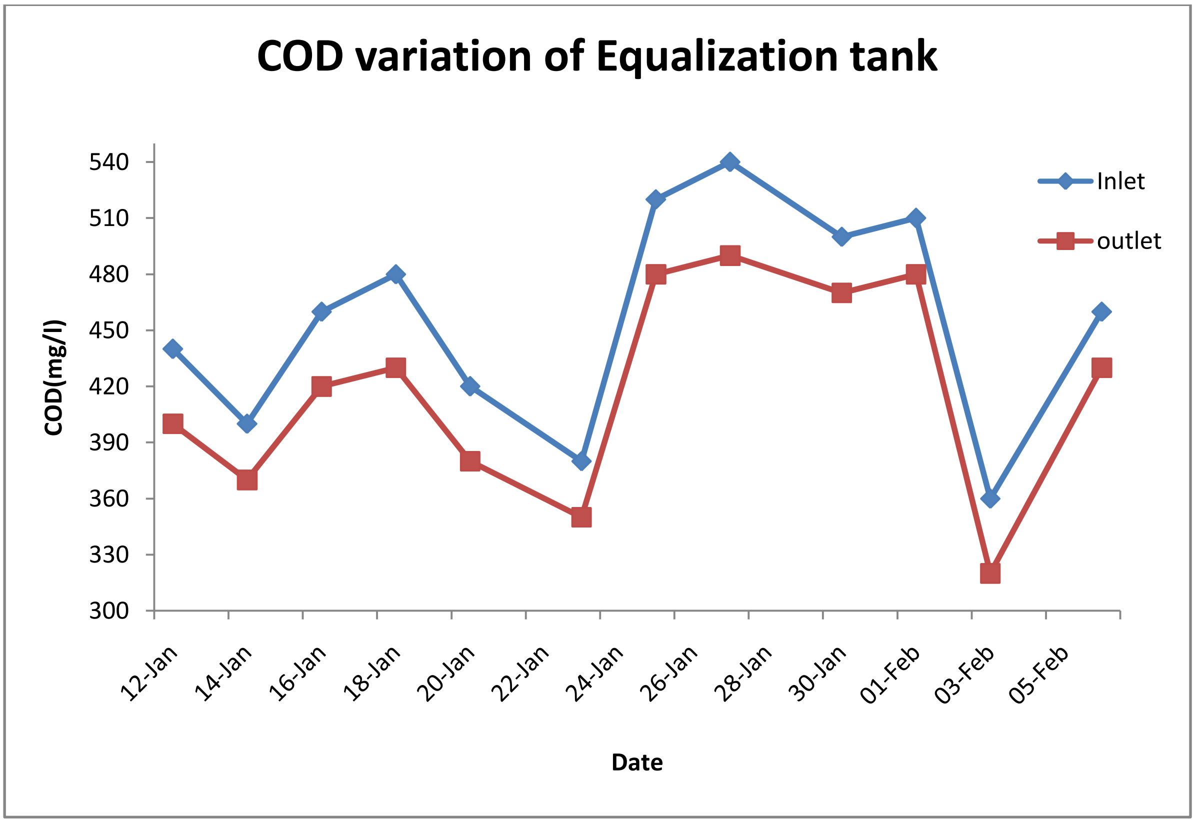

Fig 5.11: COD variation of equalization tank

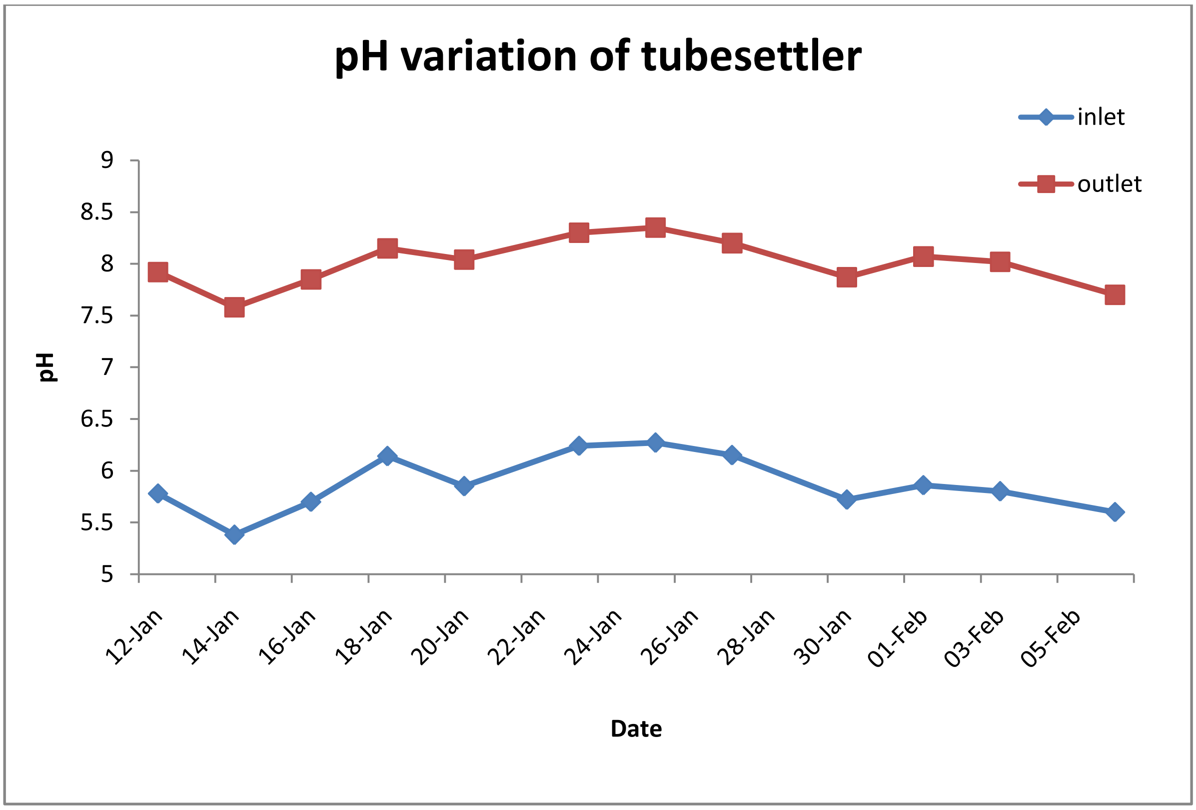

Fig 5.12: pH variation of tubesettler

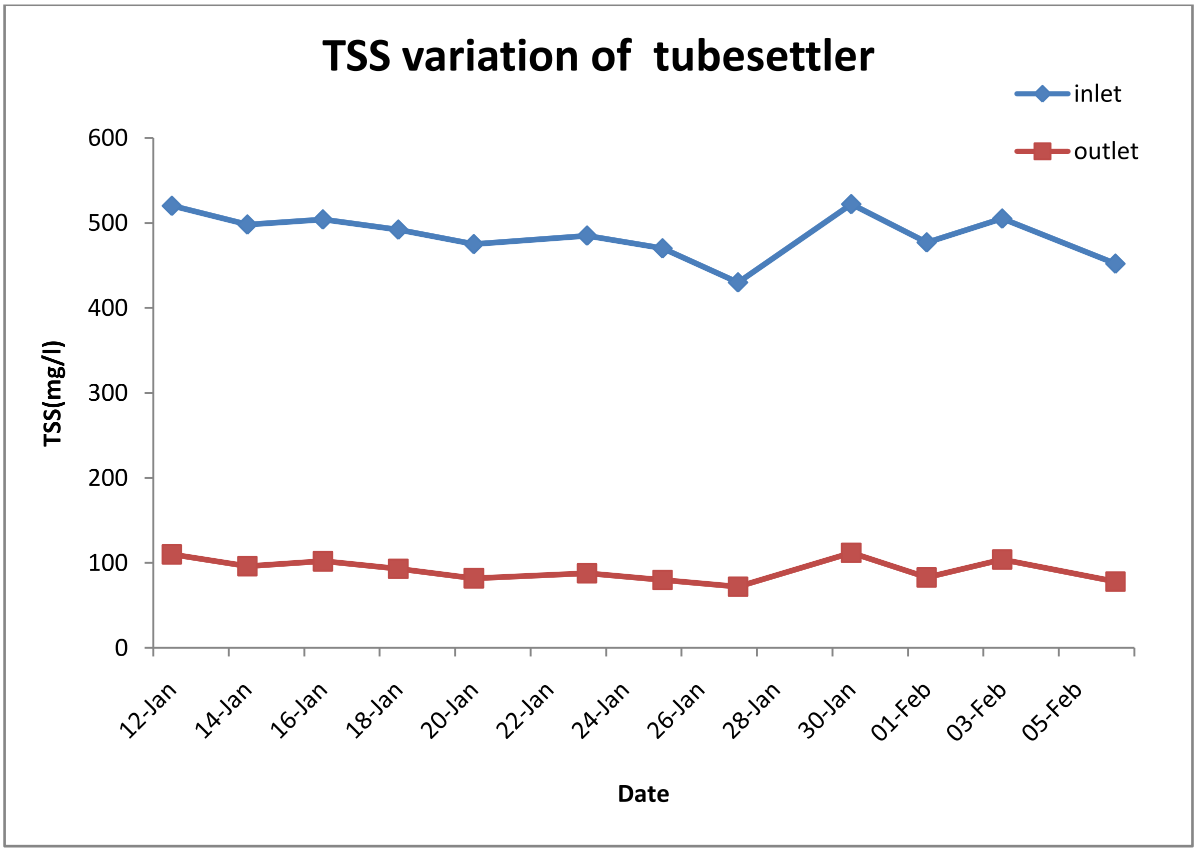

Fig 5.13: TSS variation of tubesettler

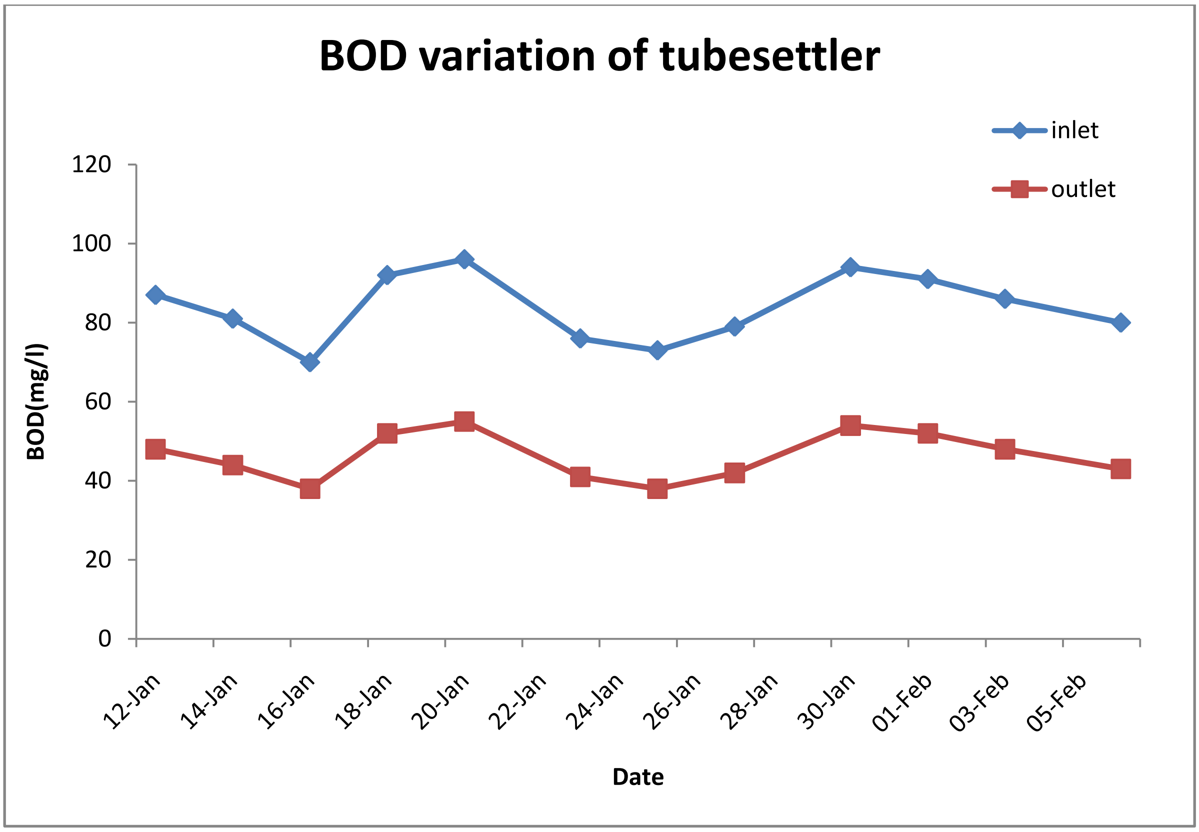

Fig 5.14: BOD variation of tubesettler

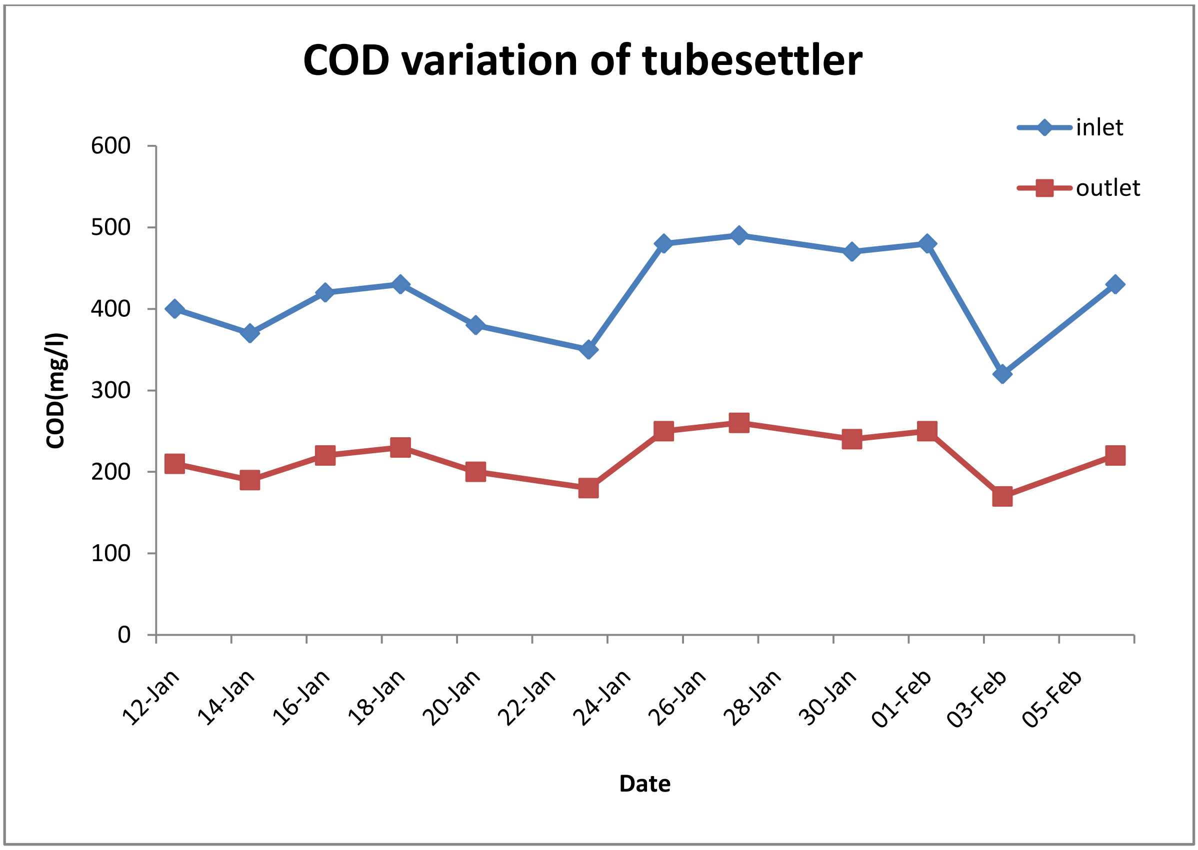

Fig 5.15: COD variation of tubesettler

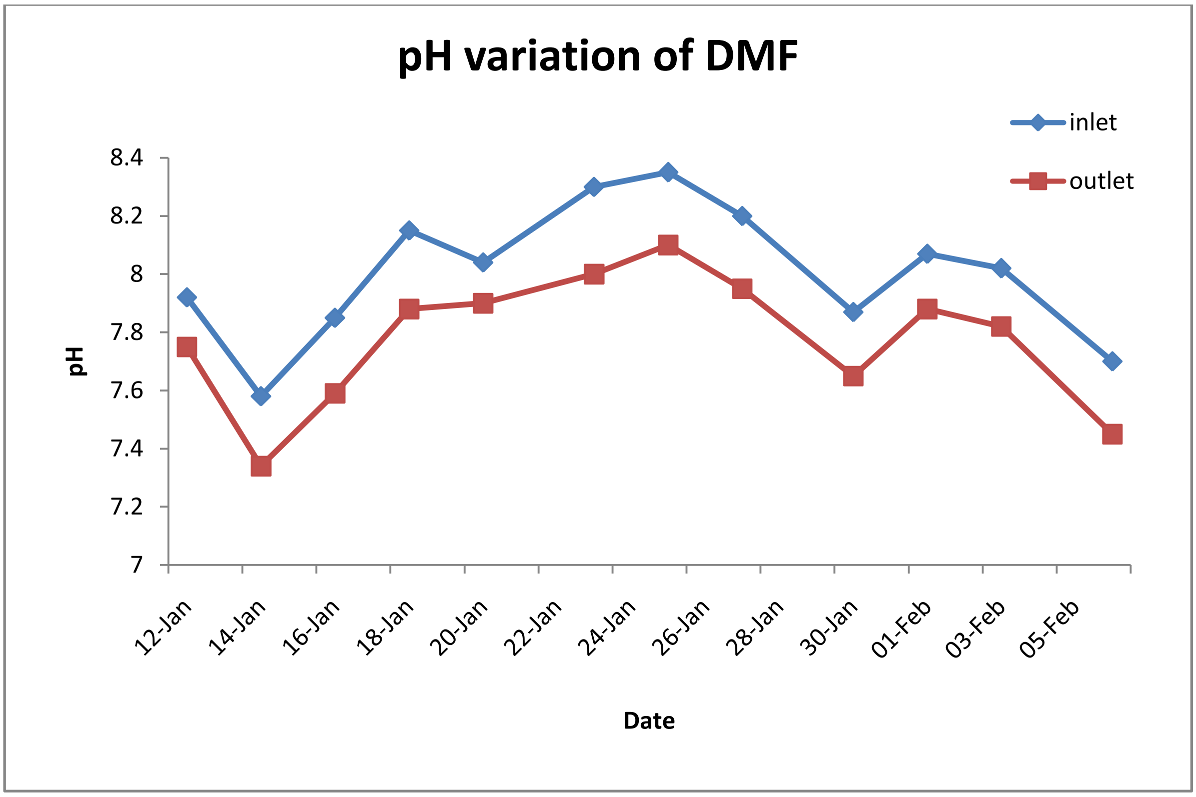

Fig 5.16: pH variation of DMF

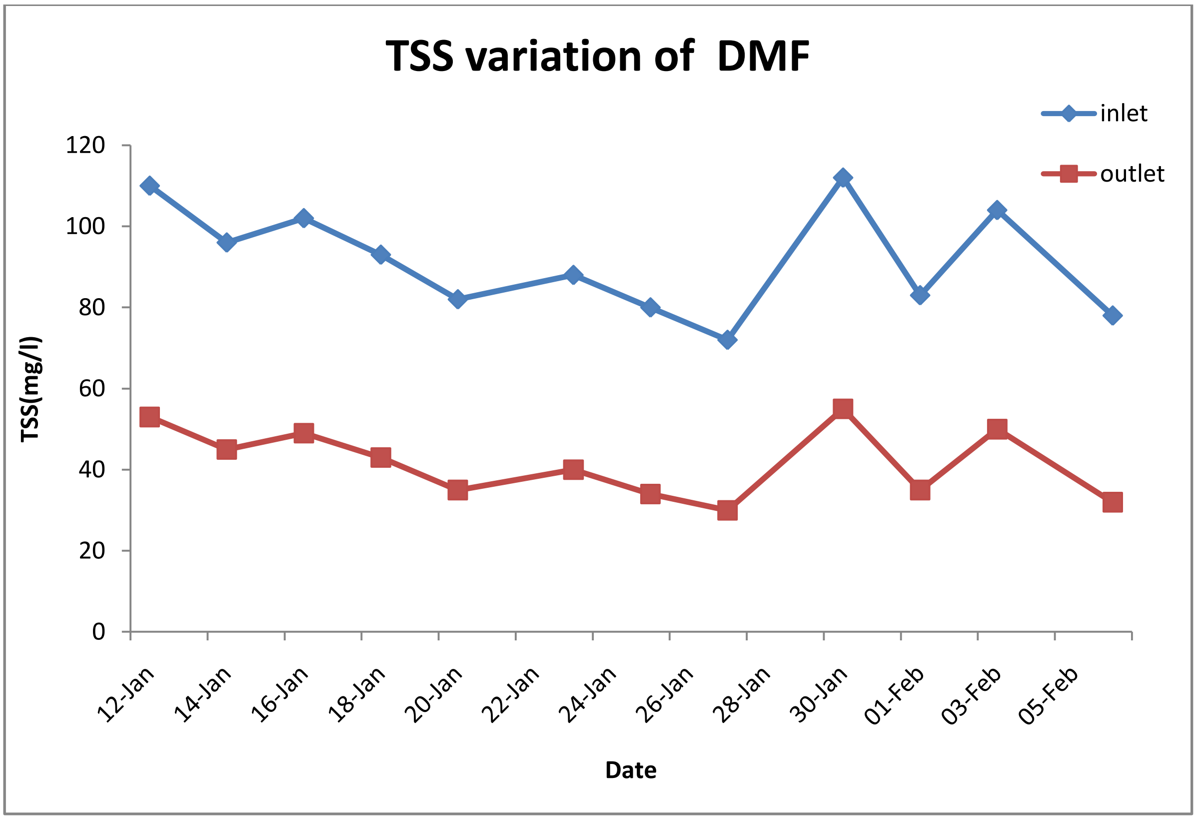

Fig 5.17: TSS variation of DMF

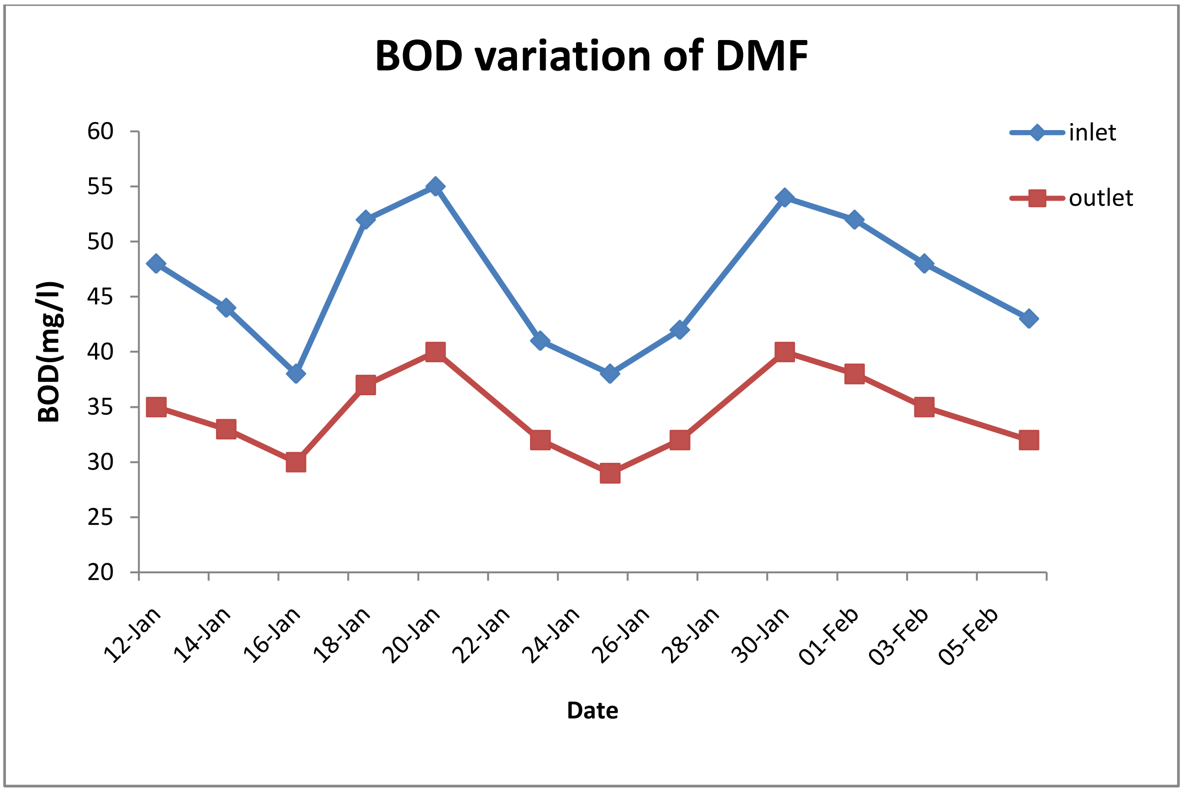

Fig 5.18: BOD variation of DMF

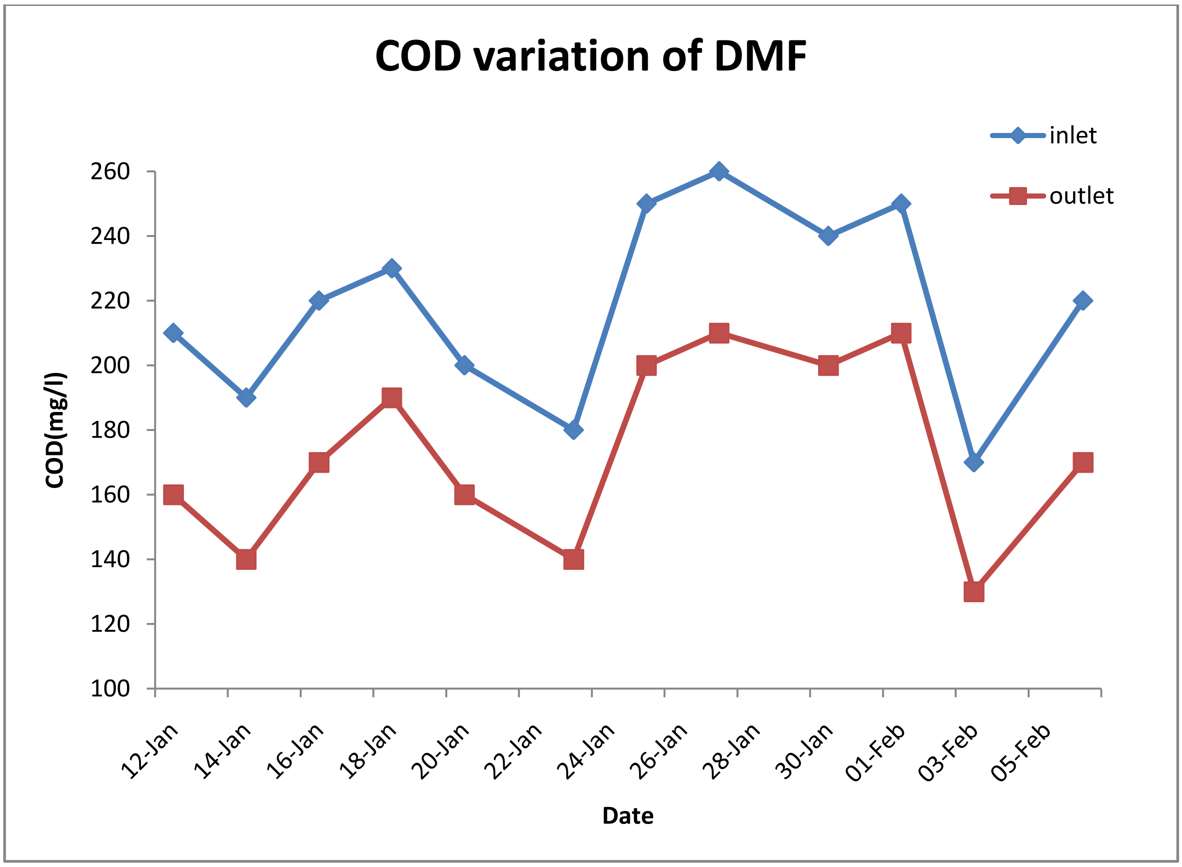

Fig 5.19: COD variation of DMF

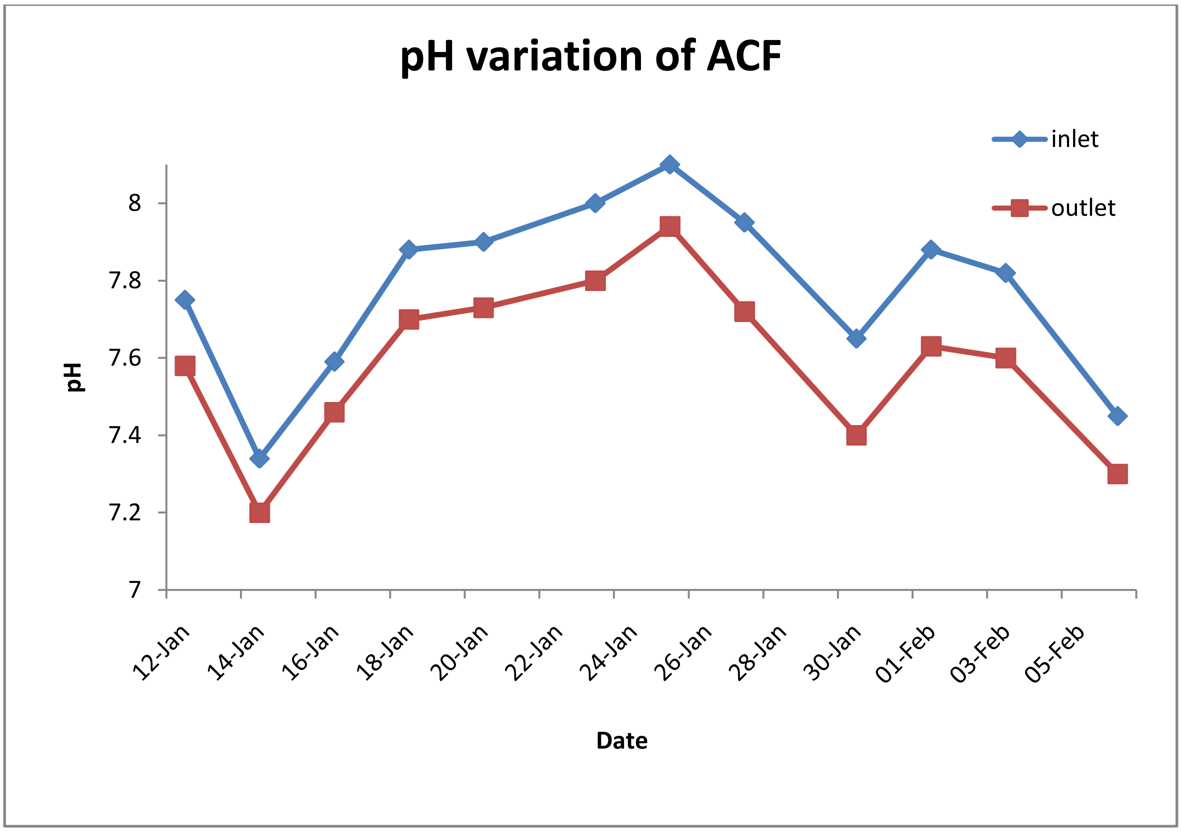

Fig 5.20: pH variation of ACF

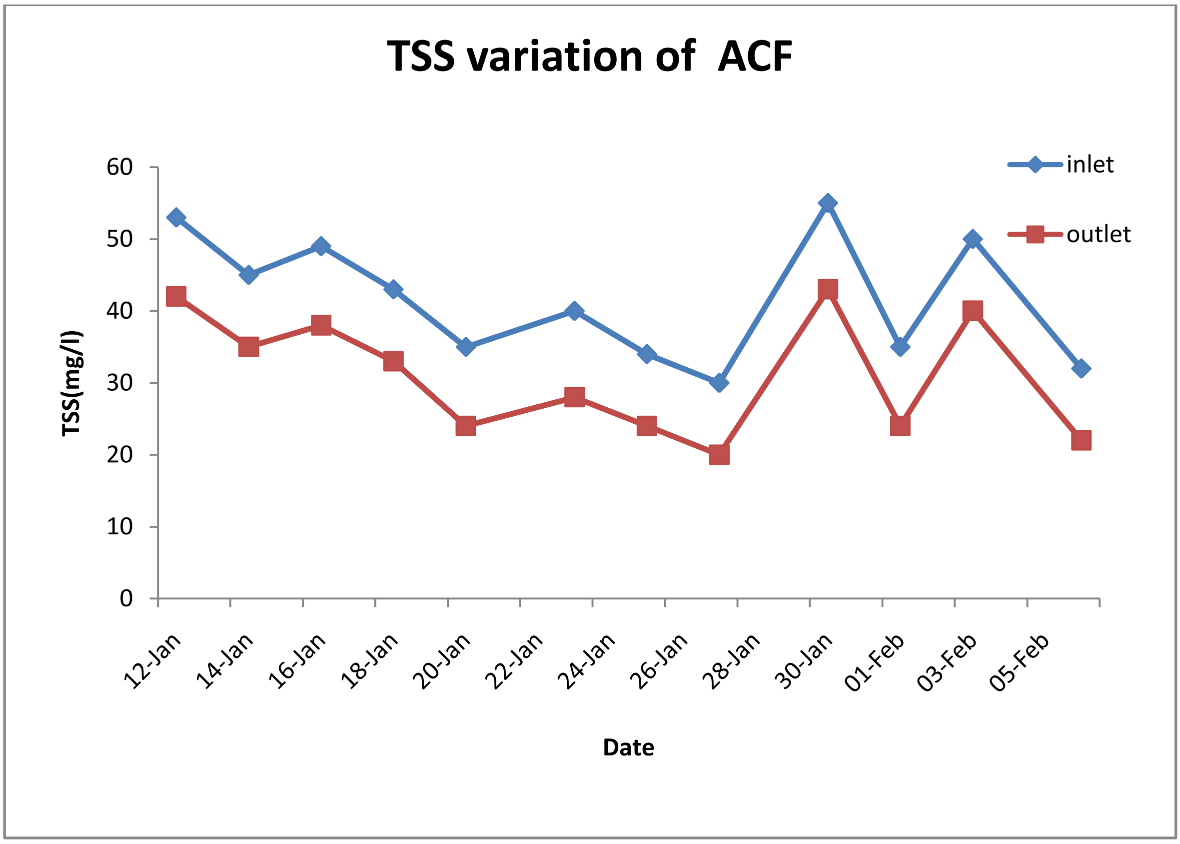

Fig 5.21: TSS variation of ACF

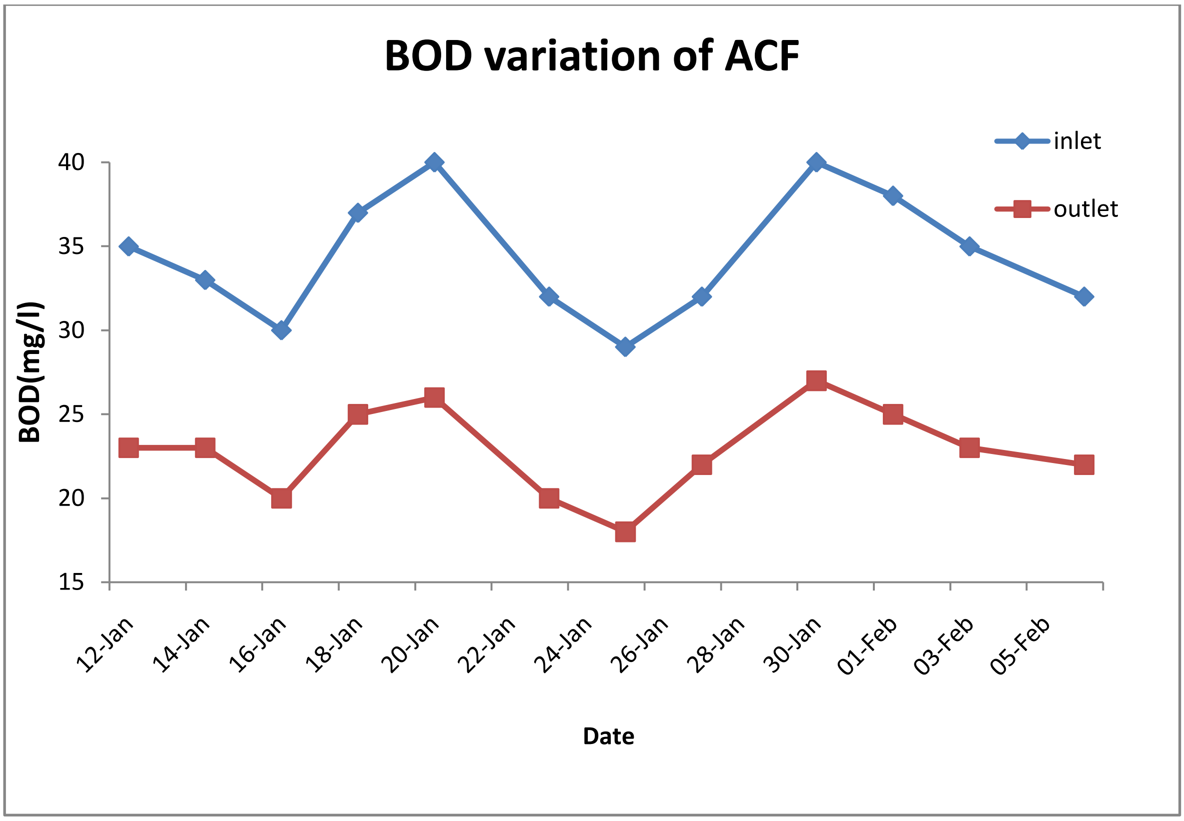

Fig 5.22: BOD variation of ACF

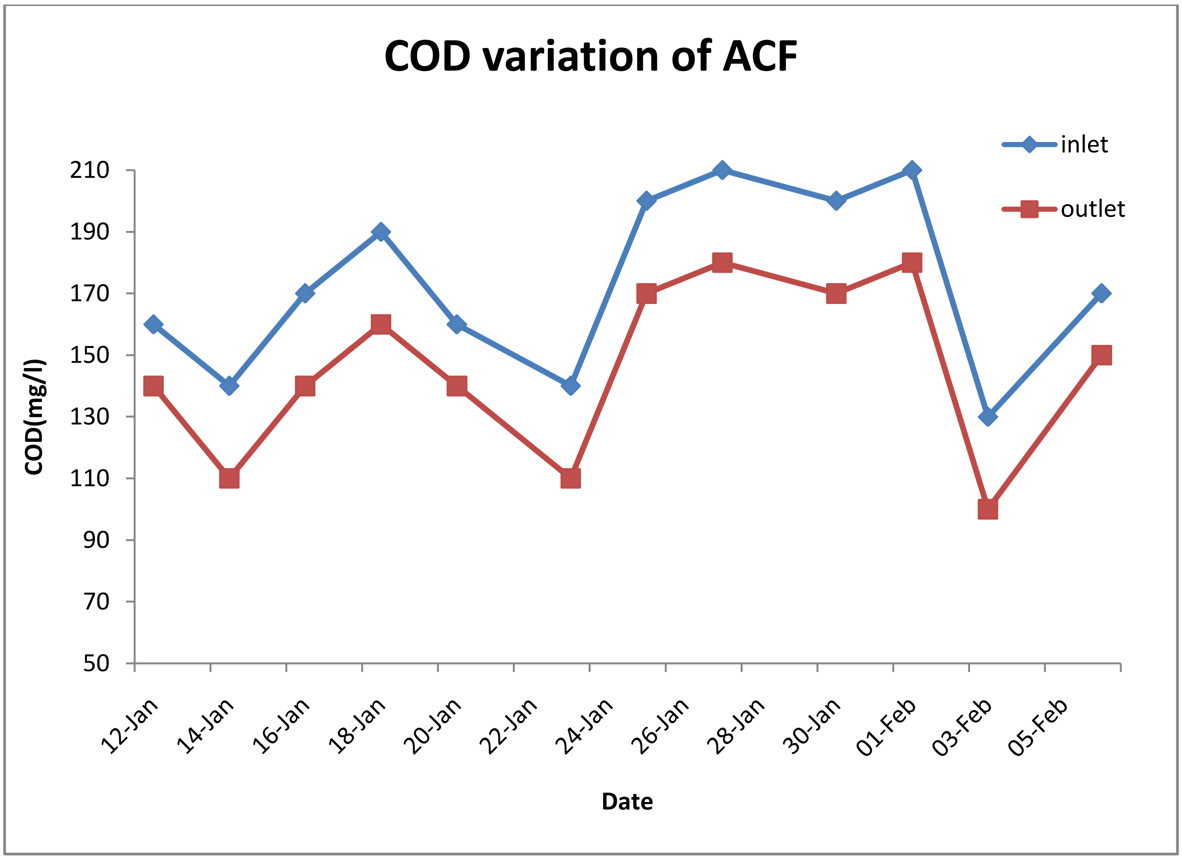

Fig 5.23: COD variation of ACF

Table 5.1: Variation of different parameters across equalization tank

S.No	Date	pH		TSS(mg/l)		BOD (mg/l)		COD(mg/l)	
		Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
1	12 Jan	5.68	5.78	506	520	100	87	440	400
2	14 Jan	5.26	5.38	481	498	96	81	400	370
3	16 Jan	5.48	5.7	488	504	84	70	460	420
4	18 Jan	6.01	6.14	479	492	106	92	480	430
5	20 Jan	5.73	5.85	459	475	110	96	420	380
6	23 Jan	6.15	6.24	471	485	88	76	380	350
7	25 Jan	6.18	6.27	454	470	86	73	520	480
8	27 Jan	6.04	6.15	419	430	92	79	540	490
9	30 Jan	5.56	5.72	508	522	108	94	500	470
10	01 Feb	5.76	5.86	461	477	104	91	510	480
11	03 Feb	5.69	5.8	491	505	98	86	360	320
12	06 Feb	5.47	5.6	439	452	94	80	460	430

Table 5.2: Variation of different parameters across tubesettler

S.No	Date	pH		TSS(mg/l)		BOD (mg/l)		COD(mg/l)	
		Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
1	12 Jan	5.78	7.92	520	110	87	48	400	210
2	14 Jan	5.38	7.58	498	96	81	44	370	190
3	16 Jan	5.7	7.85	504	102	70	38	420	220
4	18 Jan	6.14	8.15	492	93	92	52	430	230
5	20 Jan	5.85	8.04	475	82	96	55	380	200
6	23 Jan	6.24	8.3	485	88	76	41	350	180
7	25 Jan	6.27	8.35	470	80	73	38	480	250
8	27 Jan	6.15	8.2	430	72	79	42	490	260
9	30 Jan	5.72	7.87	522	112	94	54	470	240
10	01 Feb	5.86	8.07	477	83	91	52	480	250
11	03 Feb	5.8	8.02	505	104	86	48	320	170
12	06 Feb	5.6	7.7	452	78	80	43	430	220

Table 5.3: Variation of different parameters across DMF

S.No.	Date	pH		TSS(mg/l)		BOD (mg/l)		COD(mg/l)	
		Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
1	12 Jan	7.92	7.75	110	53	48	35	210	160
2	14 Jan	7.58	7.34	96	45	44	33	190	140
3	16 Jan	7.85	7.59	102	49	38	30	220	170
4	18 Jan	8.15	7.88	93	43	52	37	230	190
5	20 Jan	8.04	7.9	82	35	55	40	200	160
6	23 Jan	8.3	8.0	88	40	41	32	180	140
7	25 Jan	8.35	8.1	80	34	38	29	250	200
8	27 Jan	8.2	7.95	72	30	42	32	260	210
9	30 Jan	7.87	7.65	112	55	54	40	240	200
10	01 Feb	8.07	7.88	83	35	52	38	250	210
11	03 Feb	8.02	7.82	104	50	48	35	170	130
12	06 Feb	7.7	8.02	78	32	43	32	220	170

Table 5.4: Variation of different parameters across ACF

S.No.	Date	pH		TSS(mg/l)		BOD (mg/l)		COD(mg/l)	
		Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
1	12 Jan	7.75	7.58	53	42	35	23	160	140
2	14 Jan	7.34	7.2	45	35	33	23	140	110
3	16 Jan	7.59	7.46	49	38	30	20	170	140
4	18 Jan	7.88	7.7	43	33	37	25	190	160
5	20 Jan	7.9	7.73	35	24	40	26	160	140
6	23 Jan	8.0	7.8	40	28	32	20	140	110
7	25 Jan	8.1	7.94	34	24	29	18	200	170
8	27 Jan	7.95	7.72	30	20	32	22	210	180
9	30 Jan	7.65	7.4	55	43	40	27	200	170
10	01 Feb	7.88	7.63	35	24	38	25	210	180
11	03 Feb	7.82	7.6	50	40	35	23	130	100
12	06 Feb	8.02	7.3	32	22	32	22	170	150

Heavy metals were also tested of the samples collected from the inlet and outlet of the treatment plant. All the tested heavy metals was observed under the standard limit after the treatment. Cyanide and lead were found nil in the sample collected from the inlet. Detailed results of heavy metals are shown in Table 5.5 and treatment units wise physio-chemical parameters are shown in Table 5.6.

Table 5.5: Result of Physio-chemical, heavy metals, oil and grease analysis

S.NO	Parameter	Inlet	Outlet
1	pH	5.5	7.80
2	TSS (mg/l)	493	43
3	TDS (mg/l)	2005	1998
4	BOD (mg/l)	98	23
5	COD (mg/l)	480	160
6	Cadmium (mg/l)	0.8	0.15
7	Chromium (mg/l)	3.2	0.40
8	Copper (mg/l)	1.43	0.21
9	Cyanide (mg/l)	Nil	Nil
10	Lead (mg/l)	Nil	Nil
11	Nickel (mg/l)	3.4	0.23
12	Zinc (mg/l)	1.97	0.48
13	Oil & grease (mg/l)	18	7

Table 5.6: Result of Physio-chemical analysis

S.No	Units	pH	TSS (mg/l)	TDS (mg/l)	BOD (mg/l)	COD (mg/l)
1	Inlet	5.5	493	2005	98	480
2	Equalisation	5.6	508	2015	85	450
3	Tube settler	8.0	104	2008	52	210
4	DMF	7.95	85	2005	40	190
5	ACF	7.85	60	2000	30	180
6	Outlet	7.80	43	1998	23	160

CHAPTER-6

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

As detailed study was carried out on Badli CETP following are the conclusion obtained after the physio-chemical and heavy metals analysis of variuos sample collected from the different treatment units of the plant

1. CETP was found not operating on its full capacity, against its total capacity of 12 MLD, only 1-1.5 MLD of wastewater reaches to the CETP
2. The CETPs are facing problems in operation and maintenance. Most of the problems are due to the (i) poor input quality from the member industries and other sources, (ii) proper operation and maintenance, and (iii) the deviation of input wastewater quantity and characteristics from the design values
3. Sludge was found accumulating in the equalization tank up to the depth of 2-2.25 m, whereas total depth of tank was 4 m.
4. CETP does not have adequate space and facility to store the settled sludge, which hinder the regular cleaning of the various treatment units.
5. Total dose of lime at the 5.5 pH were measured upto 300 mg/l and 250-300 mg/l of poly-electrolyte of wastewater load.
6. Total sludge generated is approximately equal to 1.5 multiplied by lime applied.
7. After vaccum filter, sludge was allowed to store in open tank.
8. After final treatment, pH, TSS, TDS, BOD and COD was measured 7.8, 43, 1997, 23 and 160 (mg/l) respectively. All the parameters were found under standard limits.

6.2 RECOMMENDATIONS

The major recommendations of the study are as follows:

1. CETP operating agencies should carry out performance review and process optimization for improved operation and maintenance of CETP.
2. Jar tests should be conducted to decide type of coagulant and their dozing.
3. Sludge management including disposal is an essential part of CETP projects. In the absence to secured landfill site(s), all the CETPs are storing the sludge within their premises. A permanent solution through suitable treatment and management options shall be examined.
4. It should be mandatory for the member units to reveal the information regarding the types of raw materials, its quantity, by-products, production process and the final product. Any industry using hazardous chemicals should be asked to minimize the use and take measures to finally phase out such chemicals. These should not be diluted in the larger volumes to aggravate the problem.
5. The member industries should be encouraged to reduce hydraulic and pollutant loads in discharges to the CETPs, facilitate CETPs' operation, and help improve CETPs' compliance with environmental requirements.
6. Reusing the treated water from the CETPs for the industrial uses in the same industrial estate, which is responsible for waste generation. This will help in improvement of the performance of CETPs and result in significant load reduction on the environmental resources.
7. Badli CETP is based upon only physio-chemical treatment, which make it unfit for the complete treatment of the organic waste present in the wastewater. Therefore biological treatment method should be incorporated into the treatment process.

REFERENCES

1) APHA : Standard Methods for the examination of water and waste water. 20th Ed. Washington D.C, USA, pp 9-56, 9.47 to 9.53 (1998).

2) CPCB (Central Pollution Control Board): Water Quality Criteria and Goals. MINARS/17/2001-2002.

3) CPCB (Central Pollution Control Board): Report on Status of CETP in Delhi.

4) Metcalf and Eddy Inc., "Wastewater Engineering: Treatment and Resuse", Tata McGraw Hill Book Co., New Delhi, (2003)

5) S. Shanmugasundaram, D.V.S. Murthy "Performance evaluation of the CETP for tanneries at Pammal- Pallavaram Tamil Nadu(India), July 1999 .

6) B. Meenakshipriya, Dr.K.Saravanan, R.Shanmugam "Study of pH System in Common Effluent Treatment Plant" modern applied science,2(4), July 2008.

7) CPCB and MoEF, Performance status of CETP in India, CUPSI6012005-06.

8) Howard S. Peavy, Donald R. Rowe, "Environmental Engineering", Tata McGraw Hill Book Co., New Delhi, (1985)