KERALA WATER AUTHORITY

DETAILED ENGINEERING REPORT

COMMON EFFLUENT TRETMENT PLANT AT EDAYAR IN ERNAKULAM DISTRICT

Prepared by

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Sewerage Circle, Kochi-11
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osed CETP is having three separate streams viz. Biological or Main Stream, Inorganic or Heavy Metal Stream, Aromatic and Chemical Stream. The main stream is designed to treat organic or bio degradable effluents with MBBR technology followed by PSF, ACF and disinfecting with chlorine and provision has been included to treat sewage waste the industries and for future expansion. For ACS, electro coagulation technology is adopted followed by PSF, ACF and disinfecting with chlorine. In Inorganic or Heavy Metal Stream, after preliminary settling, heavy metals are precipitated in three stages according to reverse solubility by boosting pH with addition of lime. After that it is neutralized by adding ferric chloride and allowed to further settling. As the treated effluent in this stage contains more TDS (TDS limit for discharge into river is <2100mg/l) it requires RO process which is also proposed.

As per the integrated consent to operate issued by Kerala State Pollution Control Board, three industries viz. M/s CMRL, M/s TMS Leathers Ltd and M/s Sud-Cheme are having authorized discharge of their treated effluent to river Periyar. Their treated effluent is proposed to collect in separate delay ponds which will be constructed as part of the CETP with three hours of retention time. The real time monitoring facility will be provided for monitoring basic parameters and if they are not within the standard limits direction will be given to the concern industries to stop for discharging their defaulted treated effluent. The defaulted effluent which is already collected in the delay pond will be taken to respective streams of CETP and after achieving standard limits discharged to river Periyar. If the parameters are within the standard limits, it will be collected in the common clear water sump and discharged to river Periyar through the single point outlet. If any of the industries fail to maintain the standard limits as per the ICO condition, penalty will be imposed based on the damages caused to the proposed CETP processes. The estimate is prepared based on design of components with new DSR rate in PRICE software. Provisions of civil structures, electro mechanical items, instrumentation, operation and maintenance cost etc. are included in the estimate.

The total cost of the project comes to **INR 375000000/-**

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CONSTRUCTION OF CETP AT EDAYAR

ABSTRACT OF ESTIMATES

Sl. No.	Description	Amount
1	Organic/Main Stream	
	Part 1	79918700
	Part-2	81583300
	Part-3	50780400
2	Inorganic (Heavy Metal) Stream	15700000
3	Aromatics and Chemical Stream	12400000
4	Laying Pumping Mains	30500000
5	Electromechanical Equipments	104117600
	Total	**375000000**

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CHAPTER-1

INDUSTRIAL DEVELOPMENT AREA AT EDAYAR

1.1 INTRODUCTION

Edayar area in the Ernakulam district is the major industrial area in Kerala which spreads on either sides of river Periyar in its lower stretches. Major industries in chemical sector having high pollution potential are functioning in this area. The industries located on the banks of river Periyar include chemical industries, rubber processing chemicals, zinc and chrome products, leather products, etc .

These industrial complexes depend on the river for intake of process water and disposal of effluents. The river also provides water for irrigation and domestic use all along its course, besides supporting a rich fishery. The Cochin Corporation and adjoining Municipalities, Panchayath, in the vicinity of river mouth has an intake point upstream of Aluva to meet its water supply. A Regulator cum bridge is constructed at Pathalam in Eloor branch of Periyar River. This bund/regulator prevents the entry of saline water during high tide to the upstream of the river. Some industries in this industrial belt are located in the upstream of bund and as well as just downstream of the Pathalam bridge. Pollution control Board had given permission for 3 industries to discharge the treated effluent to river Periyar in which 2 industries have outlets at the downstream of Patahlam Bund where the river is classified under class E. Only one industry is discharging to the upstream of Pathalam bund which is classified as class C.

The regulators at the Periyar River is closed during summer and opened to reduce the salinity in fresh water. Closing of the regulators leads to stagnation of water which in turn causes the deposition of nutrients especially Phosphates and Nitrates in river bed. Excessive deposition of nutrients causes Algal bloom. The algal bloom later decays and putrefies changing the colour of river into black and it causes the oxygen depletion causing “Eutrophication”. This causes fish death in the river.

The periodic discolouration of the river is a relic of environmental pollution in the Eloor-Edayar belt. The water takes on many colours as it flows here, as a result of the wide variety of chemical pollutants let out by the industries. Industries have been largely responsible for degradation of both ground water and water in river Periyar. This can be attributed to the nonscientific way of industrial effluent

disposal. The situation is so alarming that now this industrial belt is known as "toxic hot spot" in Kerala. Protests over pollution of the river have been gaining momentum for the past few years.

The Chief Secretary is directed to consider all these aspects also while preparing the action plan to protect the Periyar River on the basis of the directions given by the National Green Tribunal. The implementation of the Common Effluent Treatment Plant at Edayar Industrial Estate was brought to the notice of the Government and discussions are being held at Government level with industrial departments.

If the protection of water environment is considered as a collective responsibility instead of an individual responsibility, then Common Effluent Treatment Plant (CETP) is the obvious solution to tackle the problem of wastewater treatment in an industrial estate. Besides, CETP offers the major advantage of economy of scale in terms of money, land and manpower.

1.2 INDUSTRIAL DEVELOPMENT AREA EDAYAR

The process of industrialization, which began in England in the second half of the 18th century, heralded a new age of production, which resulted in fundamental changes in the traditional mode of production. The King of Travancore, His Highness Sri Chitira Tirunal Balarama Varma with the support of the Diwan Sir C.P. Ramaswamy Ayyar took the initiative in the process of industrialisation. Eloor was chosen as the laboratory for industrialization. The Edayar industrial development area is one of the largest area with adequate facilities in Kerala and was established in the early 1960s.The 376 acres of land is occupied by different industrial units, including chemicals companies and rubber processors. Apart from the large scale Industries, other small and medium industries also started in Edayar which are very near to Eloor. Due to many reasons, some of the companies have wound up their activities and now the area is having 336 industries.

The Eloor-Edayar region about 20 km from the point where the Periyar River meets the Lakshadweep Sea is the industrial Hub of Kochi. There are 336 industries in Eloor-Edayar industrial belt which includes 201 RED Category, 46 Orange Category and 89 Green industries operating in the Industrial Estate. Industries are located along the banks of Periyar and concentration of these industries is within a stretch of 5 km in the Eloor–Edayar area. Here are about 30 industries in Eloor industrial area and 247 industries in Edayar industrial Estate. Edayar Industrial

estate is a cluster of industries of which the major industries are Cochin Minerals and Rutile Ltd (CMRL), Sud-cheme India ltd, Arjuna Natural Extracts, TMS leathers ltd, Active Char Product Pvt. Ltd, Indo German Carbon Ltd, Rubber O Malabar Products Pvt. Ltd, Malaya Rub Tech Industries etc., other industries are small scale industries.

In Edayar industrial belt, about 68 Industries are effluents generating industries; other industries are having dry process. The most of the effluent generating industries have installed Effluent treatment Plant or preliminary treatment provisions and three industries have been allowed to discharge their treated effluent to river Periyar namely CMRL, TMS Leathers, and Sud-cheme. These three industries discharge their treated effluent to the downstream of Pathalam Regulator cum Bridge(RCB) except TMS leathers.

Edayar Industrial Estate is located at Latitude $10^0$4’53’’N and at longitude $76^0$18’28’’ E in Ernakulam district of Kerala State. This industrial belt is located on the bank of river Periyar. The land is well connected with roads and railways. Water transport is also accessible. The plot is at about 2 km from Edayar and spread over to an extent of 435 acres. Well-connected roads and public transport system facilitate easy transport of work force. Location map is shown below

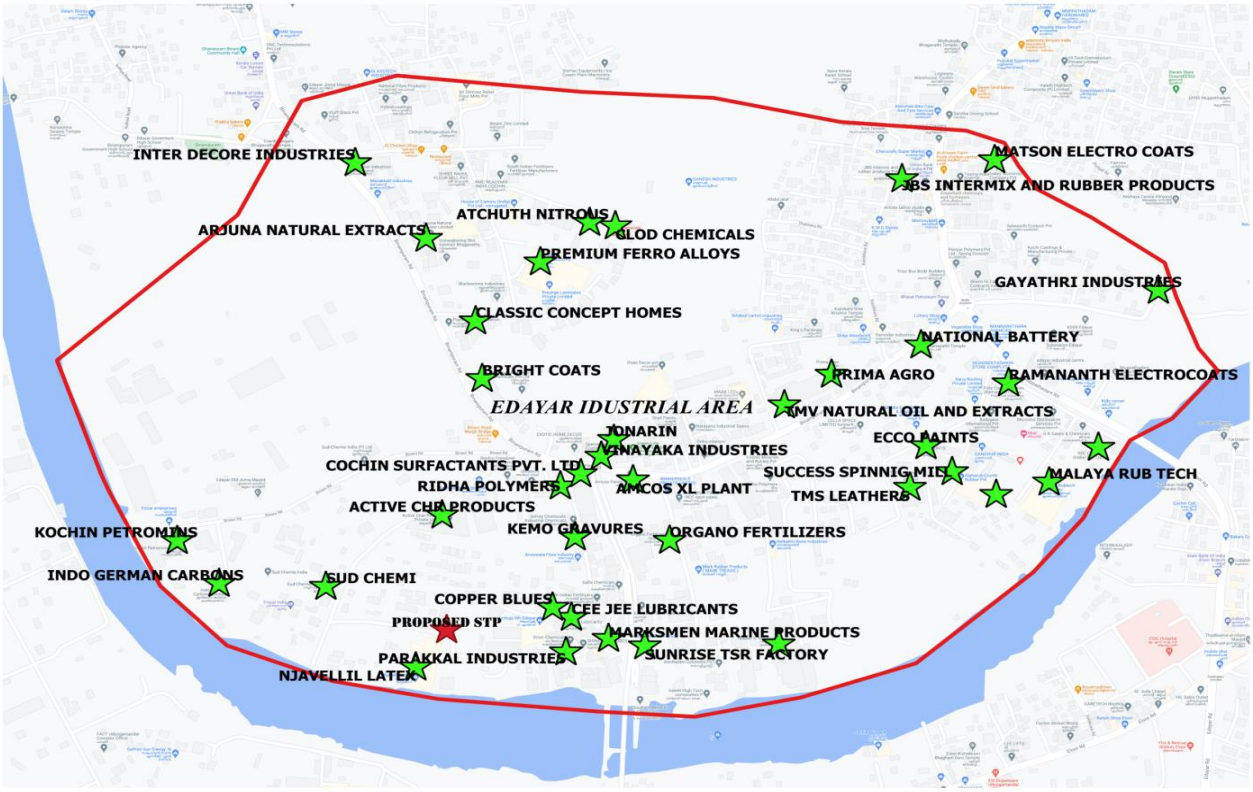

Fig-1.1 Edayar Industrial Area

There are various types of industries (large, medium and small scale units) in the Edayar Industrial Estate like Rubber industries, Urea Formaldehyde Resins units, Heavy metal Industries, Activated Carbon Industries, Electro plating units, Paint Industries, Natural extraction units, Used oil refining industries, Ready mix units, Battery Units, Automobile service station, Soda unit, Dye & Dye Intermediate Industry and Medical/cleaning chemical units etc. The wide spectra of pollutants that adversely affect the natural environmental quality of the water of the river include toxic and hazardous materials such as heavy metals, phenolic, hydrocarbons, ammonia, phosphates, domestic and untreated waste water etc. Industrial pollution poises the most serious threat to the river ecosystem.

1.3. BACKGROUND OF THE PROPOSAL

River Periyar has been performing a pivotal role in shaping the economic prospects of Kerala, as it helps in power generation, domestic water supply, irrigation, tourism, industrial production, collection of various inorganic resources and fisheries. However, it is gradually undergoing eco-degradation throughout its course of flow due to various anthropogenic stresses, which include indiscriminate deforestation, domestic-agricultural-industrial water pollution, excessive exploitation of resources, large scale mining, various interferences in the flow of water etc. The Periyar River between Eloor and Edayar in Kerala has been severely polluted by the alleged dumping of untreated toxic waste and effluents by the industries.

The process of industrialization in the Eloor-Edayar region started in the 1950s with the setting up of HIL in the area. In the early 1990s, anti- pollution demonstrations started in the area. In 1997, a supreme court – appointed High Power Committee was set up to examine all matters relating to hazardous waste and violation of environmental laws. In 2004, while hearing a petition filed in the same year, the Supreme Court took the KSPCB to task over the sorry state of river. In February 2017, a report was submitted in NGT to highlight how little had changed over the years.

Kerala State Pollution Control Board officials informed that many number of court cases regarding the pollution of rivers especially river Periyar are still outstanding. The plan for restoration of polluted river stretches is proposed to be

executed through a concept of regulation and enforcement of standards in conjunction with the available flow in rivers /streams and allocation of discharges with stipulated norms. Honorable NGT on O.A No. 673/2018 had directed that All States and Union Territories shall prepare action plans within two months for bringing all the polluted river stretches to be fit at least for bathing purposes (i.e BOD less than 3 mg/L and FC less than 500 MPN/100 ml) within six months from the date of finalization of the action plans. Govt. had constituted a District Level Technical Committee for preparing the draft action plan for the rejuvenation of River.

The implementation of the Common Effluent Treatment Facility Plant at Edayar Industrial Estate was brought to the notice of the Government and discussions are being held. In compliance with the order dated 5.11.2020 in OA no.395/2013 of the Hon NGT, the government has decided to establish a Common Effluent Treatment Plant (CETP) in Edayar Industrial Area for the prevention of pollution to river Periyar . The state river rejuvenation committee held a meeting on 13.3.2021 headed by Chief Secretary had decided to entrust the work of CETP, Edayar to Kerala Water Authority.In accordance with the decision KWA has agreed to prepare a DPR in a meeting held on 7.04.2021 by the Director of Industries and Commerce.

1.4 COMMON EFFLUENT TREATMENT PLANT (CETP)

If a common effluent treatment facility is provided for a cluster of process industries in an industrial estate or development area, the hardships of the entrepreneurs to tackle the effluent problem will be totally eliminated and they can concentrate more on the productivity of the units. Even though the total pollution caused by small industries is as much as the pollution due to big and medium size industries most of the small scale units are unable to provide treatment plants as the ratio of cost of effluent treatment plant to total project cost in a small scale industrial unit is much higher than that in a big industry. Also, regarding operating cost of effluent treatment plant, the amount to be spent per unit volume of effluent from a small industry is much more than that of a large/medium industry. Investing quite a fair amount in effluent treatment systems will affect the very existence of such units. A sole solution to this problem is setting up of common effluent treatment plant.

Industry considers pollution as a necessary evil and its control, being a non-productive process, a liability. This fact is particularly true in the case of small

industries whose resources may just be sufficient to set up and operate a production facility. It is an ordeal for them to bear the burden of establishing an effluent treatment plant and running the same. Moreover, effluent treatment is a critical process as any other manufacturing process, here the end-product to be purified water. As expert guidance is required for controlling the process, a polluting small industry cannot afford to employ experts for the sake of treating their effluent. Thus most of the small industries neglect the pollution control aspect of their operations. If detected, they face legal action from the statutory agencies; otherwise they would continue to pollute the environment.

The concept of common effluent treatment, by means of a collective effort, has assumed reasonable gravity only by providing cluster of small scale industrial units. Common Effluent Treatment Plant (CETP) not only help the industries in easier control of pollution, but also act as a step towards cleaner environment and service to the society at large. Small scale industries, by their very nature of job cannot benefit much from economies of scale and therefore the burden of maintain and running pollution-control equipment falls heavy on them.

The concerted approach of joint or common effluent treatment provisions has many advantages. Wastewater of individual industries often contains significant concentration of pollutants, and to reduce them by individual treatment up to the desired concentration, become techno economically difficult. The combined treatment provides a better and economical option because of the equalization and treatment taking place in the CETP. However, the neutralization has to be done in the premises of individual establishments from which the raw sewage is proposed to be collected through pipe to CETP. If the wastes from all industries to the cluster is collected together in one place and a well-planned treatment system is provided the total expenditure for effluent treatment can be reduced substantially. In this scenario, a suitable collection and transmission system has to be installed for collecting the effluents from each industry and then transmitting the same to the Common Effluent Treatment Plant. A common effluent treatment plant will increase the possibility of useful resources recoveries from the wastes. The recurring expenses for the operation and maintenance of Common Effluent Treatment Plant may be apportioned in proportion to the total pollution load send by each industry to the common effluent treatment plant.

CHAPTER-2
PROJECT AREA DETAILS

2.1PROFILE OF THE EDAYAR INDUSTRIAL BELT

The proposed Common Effluent Treatment Plant (CETP) in the Industrial Estate, Edayar is meant to cater to the pollution abatement requirements of a cluster of industries, which are projected to have different operational conditions. There are 336 industries functioning in this industrial belt. As per information received from the industrial department as well as KSPCB, there are 68 effluent generating industries. Industries generating effluent streams have different characteristics. This includes 2 Nos of large, 7 Nos of medium and 59 Nos of small scale industries. Moreover, industries department has informed that three numbers of major industries such as CMRL, Sud-Chemi and TMS leathers are having authorized discharge to river Periyar. While the entire major and most of the medium units have their own effluent treatment facilities. Even though most of the small and tiny units and some of the medium scale industries have their own arrangements for effluents treatment, its functionality needs to be studied well. Hence the proposed Common Effluent Treatment Plant will benefit a number of small scale industries those who have no adequate treatment facilities.

2.2 CATEGORIZATION OF INDUSTRIES

The criteria of categorization of industrial sectors based on the Pollution Index which is a function of the emissions (air pollutants), effluents (water pollutants), hazardous wastes generated and consumption of resources. The Pollution Index(PI) of any industrial sector is a number from 0 to 100 and the increasing value of PI denotes the increasing degree of pollution load from the industrial sector. The industries has been categoried and PCBs use the criteria of Red, Orange and Green categories for consent management and vigilance purposes for carrying out inspections to verify compliance to the stipulated standards. The details of categorization attached as Appendix 2.

- Industrial Sectors having Pollution Index score of 60 and above – Red category
- Industrial Sectors having Pollution Index score of 41 to 59 –Orange category
- Industrial Sectors having Pollution Index score of 21 to 40 –Green category

- Industrial Sectors having Pollution Index score incl.&upto 20 -White category .

2.3 EFFLUENT GENERATION

The wastewater generation in the project area varies from industry to industry, type of process adopted, quality of wastewater treatment and recycling of treated wastewater. Most of the industries functioning are chemical, electroplating, paint manufacturing, fertilizers, cattle feed etc.

At present there are about 336 industries existing in Edayar Industrial Development Area among which 68 numbers are generating trade effluents by list given from the industries department and later confirmed during the field visit by KWA officials. As per data collected from pollution control board the total quantity of water consumed in the Edayar Industrial area is approximately 4500 cum per day. It is come to know that the many industries are reusing the water recovered from effluent treatments for meeting their own demand. On analyzing the data received from the PCB which is tabulated as Appendix 4 arrived the effluent to CETP is around 0.37mld from small scale industries and 0.825mld from medium scale industries. Thus a total of around 1.195 mld trade effluent and sewage load around 0.35 mld presently expecting to be treated at the proposed CETP Edayar. At the same time, 3 companies which are authorized to discharge around 1.14mld of treated effluent to river Periyar.

2.4 EFFLUENT WATER QUALITY

Since the industries are different in their process, the effluent characteristics are also different. From preliminary data collection it is understood that effluents are highly heterogeneous in nature. Bone meal and rubber industries which are contributing highly organic effluents, thereby contributes high BOD and Ammoniacal Nitrogen. Some industries possess high COD to BOD ratio, presence of phenolic compound; solvents line Xylene, Toluene, and Formalin. Electroplating, paint and metallurgical industries contributing effluents containing pigments and heavy metals like Zn, Ni, Fe, Cr etc. Natural extractions units contain high COD contributing effluents like extracting solvents and oil and grease rich effluent. But some of the common parameters to be checked are pH, BOD, COD, Oil & Grease, TDS, TSS, Chloride, Conductivity etc.

2.5 NEED FOR A CETP

Edayar is situated on the banks of river Periyar which feeds drinking water to Kochi city, neighboring Panchayaths and Municipalities. The slope of land at this area is towards river Periyar and industries are disposing their treated/partially treated/untreated effluents to Periyar and thus making it polluted. Large scale fish and aquatic animal kills are often happening in Periyar with large amount of odour. Many time media have covered this and reported that Periyar is flowing in two colour at Edayar area. Various NGOs approached Hon'ble NGT stating that many studies by various agencies has proved that industrial effluents from Edayar is polluting Periyar at this stretch and the Government has ordered vide order dated 5.11.2020 in OA no.395/2013 to take necessary action for preventing pollution in river Periyar and has also decided to establish a Common Effluent Treatment Plant (CETP) in Edayar Industrial Area with only one out let for the prevention of pollution to river Periyar.

There are three industries in Edayar having authorized to discharge their treated effluents to river Periyar by the Pollution Control Board. In the limelight of Hon. Green Tribunal order to have a single discharge point of effluent to the river Periyar, the companies having authorized discharge to Periyar is also brought to the proposed CETP by providing delay pond for monitoring their standards.

Small scale industries are working with capital above 10 lakhs and below 200 lakhs. They are also generating trade effluents which require adequate treatment before discharging to water body or land. The investment for an ETP is not affordable to these small scale industries and the effluent generated per day may not be sufficient to operate an ETP. The solution for this problem is to collect effluents in a storage tank and to transport it to any treatment plant for safe disposal. The idea of CETP emerges in this situation. The CETP is having an initial investment and if planned in large scale capacity, even if initial capital increases, O&M charges will be reduced. The small and medium scale industries in the Edayar industrial area can treat their effluents in the proposed CETP and treated water can be safely disposed to water body with affordable charges for treatment.

CHAPTER 3
METHODOLOGY

3.1. DATA COLLECTION AND GROUPING

The information pertaining to the industries have been collected from all the available sources like Industrial Department, Kerala state pollution control board, journals, newspapers, internet, social media, interviews with local peoples etc. At the same time, prepared a questionnaire for data collection from each industrial units are attached as Appendix1. The industries are also visited for collecting the information regarding the effluent waste management in each unit.

The details of Industries from the KSPCB which are producing trade effluents with category, raw material used, products produced, water consumption, effluent quantity and existing ETP system for treatment of effluents are attached as Appendix 3.

The data's sorted and grouped the industries of similar nature as Rubber industries, Bone meal industries, Urea Formaldehyde Resins, Heavy metal Industries, Activated Carbon Industries, Electro plating unit, Paint Industries, Natural extraction units, used oil refining industries, Ready mix units, Battery Units, Automobile service station, Soda unit, Dye & Dye Intermediate Industry and Medical/cleaning chemical units. The industries belonging to each group is given below in Appendix-4

3.2. VALIDATION OF THE DATA

The visit to industries is being carried out for data analysis and validation. As a part of the validation, replies to the questionnaires have been collected from individual industries. In addition to these, interaction with industrial authorities are being conducted to explore the production activities, especially current ETP facilities and its functioning, characteristics of effluents and to know exact ground realities. The samples of effluents have collected and are being tested at the NABL accredited laboratories. The analysis report of samples is attached as Appendix 10.

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Fig-3.1 Raw Effluent Sample collection from Malaya Rubber Industry

Fig-3.2 Raw Effluent Sample collection from Alpha Rubber Industry

3.3 TREATABILITY

Preliminary treatability analysis of the industries indicates that the effluents are highly heterogeneous in nature and all of them can't be treated in one single stream. So, it is ideal to group the industries based on the similarities in the type of effluent. The effluent quantity of different steamed industries and expected characteristics of effluent are given in the Appendix-5 and Appendix-6 respectively.

After a detailed study regarding effluents from various industries, there is a need for one biological stream where water is treated by using Bacteria and Aeration and other sub-streams Aromatics & Chemicals Stream (ACS), Metallurgical stream (HMS) based on the inorganic nature of the effluent. This inference is derived from the COD to BOD ratio of the effluents under consideration as detailed above.

Fig-3.3 Treatability Analysis

3.4. PROCESS STREAMING

According to the characteristics of effluent, industries are grouped into three streams viz. Main/Biological Stream, Inorganic Stream and Aromatic and Chemical Stream. Each stream is treated independently and the final treated effluents are discharged to river Periyar.

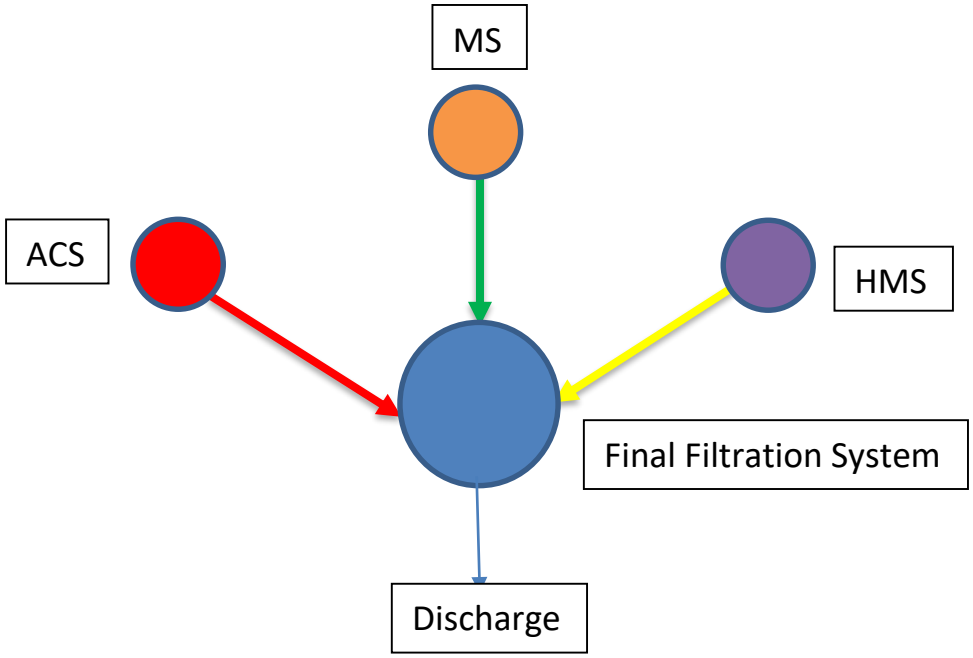


Fig-3.4 Flow Diagram of Effluent

3.4.1 Aromatics & Chemicals Stream

The aromatic and chemical stream grouped as same nature of effluent characteristics comprising of Urea formaldehyde group, natural extraction plants, medical and cleaning product industries and Oil Refining Companies. The same having the following characteristics like

- High COD to BOD ratio
- Presence of Formalin, Phenol from Urea Formaldehyde Companies
- Presence of Solvents like Xylene, Ether etc. from Natural Extract Plants.
- Harsh Cleaning Chemicals from Medical and cleaning product industries.
- Used Oil from Used Oil Refining Companies.

➢ **Treatment Mechanism**

- Aromatics and Chemicals are impossible to treat using biological method as they poison the bacteria and do not have enough BOD load to sustain the bacteria.
- Treatment of these effluents are done in Developed countries using 4th Generation filtration systems like Ceramic filtration and advanced oxidation systems.
- As concentration of COD is more in this stream, the effluent can be dealt with electro coagulation.
- The Chemical and aromatic streams should not be mixed with biological streams except in the last filtration stage.

3.4.2 Heavy Metal Stream (HMS)

Heavy metal streams are considered separately because heavy metals posses' serious risk to water bodies and Human health. The following industries may be classified under Heavy metal stream.

- Electroplating Industries with Effluents containing Zinc, Iron Etc.
- Battery Industries having Effluents containing lead.
- Paint Industries having Pigments and Solvents
- Metal Fabrication / Powder coating industries

➢ **Treatment Mechanism**

- Effluents containing heavy metals may be treated by multiple Coagulation and precipitation systems and with Membrane Filtration/ Ion Exchange systems.

The type of treatment is based on the concentration of heavy metals and their reverse solubility in the effluent and separate precipitation systems may be installed for removing individual heavy metals.

3.4.3 Main/Biological Stream (BS)

The biological stream comprising of Rubber industries, bone meal industries, activated carbon industries, service station and ready mix industries is considered to be the main stream where the following characteristics may be noted:

- COD to BOD ratio less than 2 mg/l

- High BOD stream from Rubber Industries, Bone Industries and marine products.
- Water from Service stations after pretreatment
- Water from Activated Carbon Industries

➢ **Treatment Mechanism**

- Water from Rubber and Bone industries have high BOD and Nutrient load. (Nitrate and Phosphorus).
- Activated sludge process which is generally 100 years old is generally used for this type of effluents. But the maintenance costs, Operational difficulty and construction costs are so high for ASP processes.
- Moving Bed Bio Reactor (MBBR) process is extremely simple for Biodegradable Effluent Treatment. Microorganisms convert a large mass of pollutants in effluent water. This process also produces a co-product: A vastly reduced, compact solid biomass.
- High Nitrogen and Ammonia content in these streams would require Nitrification and de nitrification systems to be installed adjacent to the MBBR/ ASP Process.

3.5. QUANTIFICATION AND CHARACTERIZATION OF EFFLUENTS

3.5.1 Quantity of Effluent

At present there are about 336 industries existing in Edayar Industrial Development Area among which 68 numbers are generating trade effluents by list given from the industries department. The effluent to CETP is expected around 0.37mld from small scale industries and 0.825mld from medium scale industries.At the same time, the 3 companies all together with a discharge quantity of 1.14 mld, having authorized discharge to Periyar after treatment is to be monitored in the proposing delay pond before discharge to river Periyar through a single outlet proposed from CETP. Due to the heterogeneous nature of effluents, the effluents are forced to streamline to CETP in 3 streams ie Biological stream, Inorganic stream and Aromatic stream.

In Biological stream considering all the companies (31 Nos.) grouped in this stream effluent quantity expected at present is 1.019 mld. Apart from that, sewage demand in the Edayar Industrial area forecasted to 0.35mld and 0.0136 mld (2 hours qty.) from TMS leathers in case of failure is also considered. In addition to this, expecting effluent quantity from future expansion of around

0.4176 mld also catered in this stream. Thus arrived effluent quantity of 1.8 mld is considered in this stream.

In Inorganic Stream around 16 Nos. of companies with a load of 0.0366 MLD is contributing trade effluents. Accidental demand if any from M/s Sud-Cheme and M/s CMRL with quantity 0.015438 mld and 0.012018 mld (35 minutes qty. for each) respectively also considered in this stream. Thus altogether 0.10065 mld load is catered in this stream.

In ACS around 16 Nos. of companies with a load of 0.0999 mld is contributing trade effluents.

Table-3.1 Effluent generation of Industries in the Project Area

Sl.No.	Name of Stream	Qty. of Effluent(lpd)
1	Main/Biological Stream	1800000
2	Inorganic/HMS Stream	100000
3	ACS	100000

3.5.2 Characterisation of Effluent

If C_1, C_2, C_3,…….$C_n$etc. Represent the concentration of each parameters such as pH, BOD, COD etc. and Q_1,Q_2,Q_3,……..Q_n represent the quantity of effluent generated, then the weighted average of each parameters in the effluent of each stream will be calculated by an empirical formula as follows.

Individual parameters to be treated in each stream = $\frac{\sum_{i=0}^{n} CiQi}{\sum_{i=0}^{n} Qi}$

The calculation of the individual parameter arrived in each stream is shown in Appendix-7.

3.5.2.1Aromatics & Chemicals Stream

The expected quantity of water to be treated in this stream is around 0.1 MLD. The effluent characteristics of this stream is tabulated as

Table-3.2 Effluent Characteristics of Industries in ACS

Sl.No.	Parameters	Expected influent characteristics into CETP (mg/l)	Unit
1	pH	6.55	
2	BOD	169	mg/l
3	COD	1933	mg/l
4	Oil & Grease	2.28	mg/l
5	TDS	2086	Mg/l
6	Hexa Cr	0.005	mg/l
7	Sulphide -s	20.57	mg/l
8	Flouride	0.113	mg/l
9	NO3 as N	0.012	mg/l
10	Conductivity	2075	µs

3.5.2.2 Heavy Metal Stream (HMS)

The expected quantity of water to be treated in this stream is around 0.1mld. The effluent characteristics of this stream is tabulated as

Table-3.3 Effluent Characteristics of Industries in HMS

Sl. No.	**Parameters**	**Expected Characteristics of Influent to CETP**	**Unit**
1	pH	3.41	
2	BOD	116	mg/l
3	COD	630	mg/l
4	TSS	163	mg/l
5	Oil&Grease	1.39	mg/l
6	TDS	1971	mg/l
7	Hexa Cr	0.007	mg/l
8	Sulphide –S	1.80	mg/l
9	Nickel	0.30	mg/l
10	Zinc	8.78	mg/l
11	Lead	0.30	mg/l

12	Flouride	4.40	mg/l
13	Phenolic compound	0.04	mg/l
14	Fe	15.96	mg/l
15	Cadmium	0.23	mg/l
16	Nitrate-N	1.88	mg/l
18	Copper	0.98	mg/l
19	Manganese as Mn	1.22	mg/l

3.5.2.3 Main/Biological Stream (BS)

The expected quantity of water to be treated in this stream is around 1.80 MLD. The effluent characteristics of this stream is tabulated as

Table-3.4 Effluent Characteristics of Industries in MS

Sl.No.	**Parameters**	**Expected influent characteristics into CETP (mg/l)**	**Units**
1	pH	7.26	
2	BOD	1830	mg/l
3	COD	5259	mg/l
4	TSS	266	mg/l
5	Oil&Greese	1.98	mg/l
6	TDS	2871	mg/l
7	Chloride	945	mg/l
8	Amm. Nitrogen	179.9	mg/l
9	Conductivity	4764	µs

CHAPTER-4

COMPREHENSIVE PROJECT PLANNING

4.1SURVEY OF PROJECT AREA

4.1.1 Topographic Survey

The proposed CETP (Common Effluent Treatment Plant) is to be constructed in the area where Periyar Chemicals is located, which is being closed presently. The Industries Department has agreed in principle to allot an area of about 2 acres in this plot for CETP.

The industries are located at variable distances and elevations all-round from the proposed CETP in Edayar Industrial area. The Edayar Industrial area assessed to be undulating with natural slope towards the river Periyar. Hence a detailed survey has to be conducted to identify the topography of the project area. The methods adopted for survey are Electronic Total Station Survey and Differential Global Positioning Survey.

Electronic Total Station Survey can be conducted to get the exact topography of the area. The out fall of effluent and location of ETPs of industries are in very congested and covered area. Hence number of shifting stations will be more in ETS which is time consuming and is very difficult. Thus DGPS Survey also utilized to cover the industries outlet point in the entire area. The length of roads, elevation, position of industry etc. is mapped in the survey.

The SPCB has issued a list of industries which have considerable quantity of liquid effluents (wastewater) which need to be piped to proposed CETP. Therefore, required to know the levels of the point at which they are discharging their liquid effluents. Survey conducted covered all the 68 effluent generating industries listed as well as the proposed CETP site.

4.1.2 Outcome of Survey

Locating all effluent generating industries, topographical survey of road layout and proposed route to CETP outlined as follows

- Exact layout of the roads, culverts, existing plots, and common structures etc. are obtained.
- Location of all Industries with co-ordinates.
- Exact shape of the total area, plots, dimensions, spot levels, levels of existing roads/streets/lanes, etc.
- Both spot level and contours have been indicated in separate layers.
- All adjoining road services to the industrial area also encompassed.
- Location of temporary bench mark with value is appended.

Apart from this, the proposed CETP also surveyed with ETS and a detailed map for 2 acres (allotted for CETP) is prepared. The spot levels with distances in layout are marked in the map. A detailed survey map has been prepared.

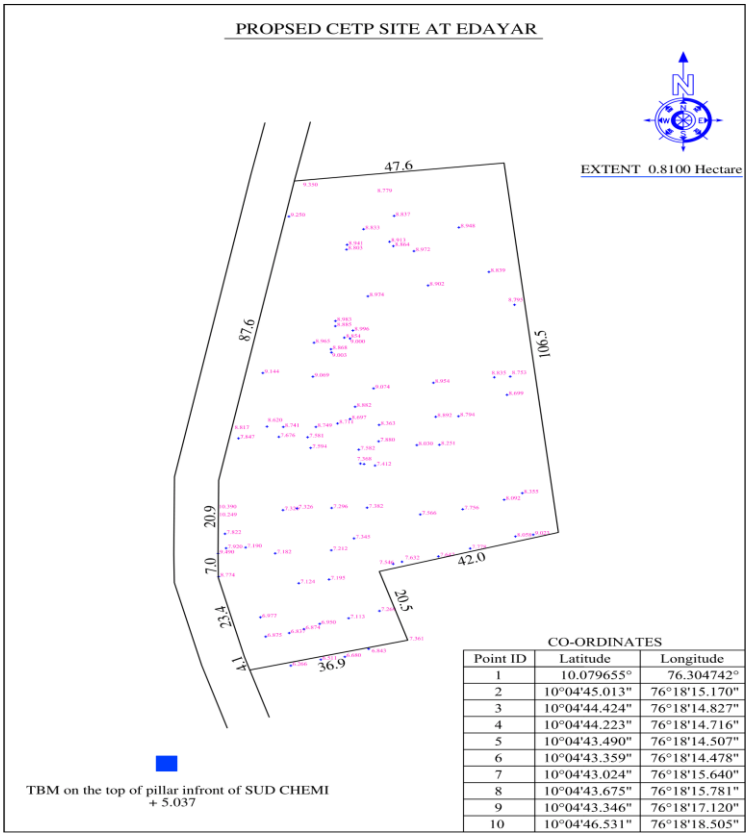


Fig-4.1 Site for Proposed CETP

4.2 FEASIBILITY OF SEWERAGE SYSTEM

Detailed contour survey has been carried covering the all industries located in the Edayar Industrial Area. Door to door inspection was conducted to collect the

details of number of employees working in day/night shift and those who are staying inside the premises. The quantum of sewage to be treated is assessed as 0.35 MLD and at least 5 no's of collection wells are to be constructed at different locations. To bring the sewage load to the collection wells, about 12.5 kms of pipeline ranging from 110 mm to 200 mm dia HDPE are required. Instead of constructing a separate Sewage Treatment Plant, the sewage load can be treated in main stream of the proposed CETP. If sewerage system is implemented, an approximate amount of Rs 20 crore will be needed for laying network, construction of collection wells and allied works. This cost is not included in the DPR.

4.3 COLLECTION AND CONVEYANCE SYSTEM

Industries having effluent discharge quantity more than 10000 litres/day can be conveyed to treatment plant using piped network system. With the available data about 14 industries are now listed for piped distribution network. As the generation of effluent quantity per day is small, it is expected to store effluents for some period and pumping is expected during a short period. Hence the size of pipe to be considered is higher. All pipes materials are proposed of HDPE PE-100 SDR 26. This includes three industries which are having authorized discharge points also. Authorized discharge pipe line of CMRL is passing through nearer to the proposed site of CETP and the effluent discharge line of Sud-Chemi can also be easily connected to the proposed network. Another authorized effluent discharge company TMS leathers can be connected by laying pipe line about 600 meters. The effluent discharge network can be designed based on the grouping of industries. The network design will be done on collecting the topographical details through DGPS survey at the Edayar Industrial Belt. The balance industries (57 Nos.) are now proposing to collect at their premises and there by conveying effluents by tanker lorry for treatment. The tank of lorry shall be lined with rubber to prevent corrosion and flow meter shall be attached to the inflow pipe of Lorries. It is calculated to manage with 1 No. tanker of capacity 10,000 liters (8 load/day),2 Nos. of tankers of capacity 5000 liters (10 load/day each) operating for biological stream.2 Nos. of tankers of capacity 5000 liters operating at 3 load/day and 5 load/day respectively for inorganic and ACS. Mode of conveyance can be scheduled based on the quantity and characteristics of effluent. Operating cost for the transportation is to be charged from the concerned industries based on the quantity of raw effluent to be transported.

Table-4.1 List of Industries Requires Piped Transportation of Effluents

Sl.No.	Name of Industry	Pipe Dia	Length	CF Pump
		mm	m	HP
1	Organo Fertilizers	75	1427	3
2	Alpha Golden Crump	90	1937	10
3	Arjuna Natural Extractions	90	1391	5
4	Classic Home Appliances	90	745	7.5
5	Rubber O Malabar	90	1112	3
6	SudCheme	90	311	3
7	TMS Leathers	90	1809	7.5
8	CMRL	110	804	5
9	Jnavally Latex	110	413	5
10	Prism Cement	110	1070	5
11	Sunrise TSR Factory	110	990	5
12	Premium Ferro Alloys Limited	110	957.5	3
13	Marksmen Marine Products (P) Ltd.	125	796	5
14	Malaya Rubber Industries	160	2891	15

Table-4.2 Requirement of Lorry Transportation of Effluents

Sl. No.	Name of Stream	Qty. of Effluent (kld)	Capacity of Truck (l)	No. of Loads per day
1	Main Stream	170	10000	8
			5000 x 2	10 x 2
2	Inorganic Stream	14.6	5000	3
3	ACS	22	5000	5

4.4 PRE-TREATMENT OF EFFLUENTS FROM INDIVIDUAL INDUSTRIES

In order to make the Common Effluent Treatment Plant technically viable, individual industries have to maintain certain standards before sending their effluents to the common treatment facility. For this purpose, pretreatment and neutralization at their premises may become necessary.

Based on the Hon'ble Supreme Court order all industries have to give preliminary treatment to the raw effluent and then only can be given to CETP. On validation of the effluent it is seen that some of the industries, the basic parameters are drastically higher which is not allowable to the CETP as per the above order. Hence the characteristics of general parameters and ammoniacal-nitrogen of the pre-treated effluent at the premises of industry are fixed as below.

Table 4.3 Effluent Parameters after Pre-Treatment at the premises of Industry

Sl.No.	Parameters		Expected influent characteristics into CETP (mg/l)	Units
1	pH		6.5-8	
2		BOD	4500-5000	mg/l
3		COD	7000-7500	mg/l
4		TSS	400-500	mg/l
5		Oil&Greese	10	mg/l
6		TDS	3000	mg/l
7		Ammoniacal Nitrogen	150	mg/l

4.5 SOIL INVESTIGATION

Soil investigation must be undertaken to ascertain the bearing capacity of the soil, its settlement rate and the position of the water table. It should provide an indication as to whether the site is suitable for the proposed construction, i.e. whether the soil and geological conditions will be able to provide the required support and stability. A soil report is generally prepared by geotechnical engineers or civil engineers following a soil survey.

One of the easiest methods is to dig trial pits and visual inspections carried out, then samples with minimum disturbance are collected for subsequent laboratory testing. Where possible, drilling should be undertaken as this enables one to obtain undisturbed samples from which settlement rate and bearing capacity may be obtained. For soils that loosen, such as sand and gravel, a plate-bearing test can be used to determine the bearing capacity of the soil insitu and designing of the static loads on spread footings. If the strength of the soil is not

adequate for the increased loading, it is necessary to improve on the foundations by introducing piles or enlarging the footing and reinforcing it betters to sustain the increased loading.

Soil investigation of the site was carried out by M/s Safe Consultancy, Thripunithura and detailed report was obtained with recommendations which are included in Appendix-8.

Fig-4.2 Soil Investigation

The major recommendations are as follows.

- Isolated footing can be used at a depth of 0.8-meter from existing ground level., with maximum lateral width of foundation is 1.4 m and column load of maximum 30 tons
- SBC of 20 ton/m2 can be taken for an isolated footing.
- Alternatively, raft foundation can be used at 1m depth from ground level. SBC of 12 ton/m2 can be used.
- Columns should be rigidly connected at plinth level in both X and Y axis
- Subgrade modulus of soil is 4870 kN/m2/m can taken
- Alternatively, for medium structure upto column load of 60 tons Auger pile can be used which should be resting on hard rock 12 to 18 m deep.
- Alternatively, forheavy structure DMC pile can be used which should be resting on hard rock, with socket length of 0.5 times diameter of pile

4.6 TREATMENT MECHANISM

4.6.1 Main/Biological Stream

The wastewater from similar industries are grouped and collected in an equalizing tank. The pH of effluent is corrected by adding HCl or NaOH. Suspended solids are allowed to settle, Primary Settling Tank (PST), MBBR, Nitrification and denitrification process followed by Secondary Settling Tank (SST) with addition of poly electrolyte. Generated sludge is removed continuously pumped to sludge thickener followed by screw press and finally disposed as solid waste to authorized solid waste managing units like KEIL. The out flowing water from SST is filtered in a pressure sand filter followed by activated carbon filter. Disinfection is done with Chlorine and stored in treated water tank, continuous monitoring and finally discharged to river Periyar in its downstream (below Regulator cum Bridge at Pathalam).

4.6.2 Aromatic and Chemical Stream

The characteristics of wastewater from these types industries are entirely different from other streams and are harmful to microorganisms in MBBR due to the presence of different solvents, formalin, dyes etc. The effluent is received in receiving chamber allowed to retain for one minute to settle grit particles and send to oil trap for removing oil and grease by belt type oil skimmers followed by equalization tank for and pH correction which is done by adding appropriate quantity of HCl/NaOH. It is then sent to primary clarifier and suspended particles are removed by adding poly electrolyte. BOD, COD is also reduced in this unit. Electrocoagulation system is adopted for further precipitation of colloidal size particles and to remove colour, suspended solids and reduction of BOD, COD, hardness and TDS. The dozing of Anionic polymer in flash mixer after EC will flocculate further suspended particles and easy separation of sludge from treated water in secondary clarifier. The overflow from SST is collected in filter feed tank and filtered through PSF and ACF. It is then stored in treated water sump followed by delay pond and finally disposed to river Periyar.

4.6.3 Inorganic or Heavy Metal Stream

The presence of heavy metals like Cadmium, Zinc, Iron etc. in the wastewater from these types industries and require separate treating before disposing. The effluent is received in receiving chamber with screening, allowed to retain for one minute to settle grit particles and send to oil trap for removing oil and grease by belt type oil skimmers followed by equalization tank for and pH correction which is done by adding appropriate quantity of HCl/NaOH. As the heavy metals having less solubility in higher pH, lime is added to boost pH (8-8.5) and anionic polyelectrolyte for agglomeration in flash mixer of 1st clarifier for chemical precipitation and settling. Lime and anionic polyelectrolyte are added to the overflow of 1st clarifier in slow mixing chamber of 2nd clarifier and pH is maintained between 9.5-10 and allowed to settle more heavy metals followed by further addition of lime and anionic polyelectrolyte at slow mixing chamber of 3rd clarifier to maintain pH between 11-11.5 for settling of maximum heavy metals. The overflow of 3rd clarifier is highly basic in nature and hence neutralized with ferric chloride which is a good coagulant and hence dissolved chemicals if any will be precipitated. The precipitated sludge is removed continuously and sent to screw press for making sludge cakes. As the treated effluent contains more TDS (>2100mg/l) it is treated with RO process to achieve standards. The treated effluent

is stored in treated water tank followed by delay pond. Finally treated water is disposed to river Periyar.

4.7 INCORPORATION OF COMPANIES HAVING AUTHORIZED DISCHARGE TO RIVER PERIYAR

As per the integrated consent, to operate issued by Kerala State Pollution Control Board, three industries viz. M/s CMRL, M/s TMS Leathers ltd, and M/s Sud-Chee are having authorized discharge of their treated effluent to river Periyar. The liquid waste characteristics of the three companies are as follows.

- **M/s CMRL**: In the effluent treatment plant, recovery tanks are provided for the recovery of titanium from ferrous chloride solution. The raw effluent after the recovery of titanium is taken to equalization tank and treated with lime in flash mixer. After chemical treatment the effluent is taken to slurry collection tank from where it is pumped to high rate thickener for solid separation. The overflow from the high rate thickener is settled in ageing tanks and taken to final polishing tank after pH correction. From the final polishing tank effluent is pumped into River Periyar through underground pipeline.

- **M/s SudChemie**: The Company generates 150 to 200 m3 per day of effluent which is discharged in to the Periyar River after treatment. The sludge generated from the effluent treatment plant containing Chromium, Zinc, Iron, Copper, and Aluminium etc is the hazardous waste (category 34.3 ETP sludge). Waste generation per 100 tons product is 600 kg and the maximum waste generation is 50 kg /day.

- **M/s TMS Leathers:** The generated sludge containing chromium @ 530 kg per month which is hazardous waste as scheduled 1: Item 30.1 and 30.2.The chromium sludge is stored in gunny bags in a roofed temporary shed. The sides are covered with plastic sheets. The waste water from soaking, fleshing and all other process is directed to ETP and solar evaporation ponds through drains inside the units. There are such five solar evaporation ponds in functioning condition

Their treated effluent is proposed to collect in separate delay ponds which will be constructed as part of the CETP with three hours of retention time. The real time monitoring facility will be provided for monitoring basic parameters and if they are not within the standard limits, intimation will be passed to concerned industries by instructing to stop discharging of their treated effluent which is not satisfying the tolerance limit and received quantity will be taken to respective streams of CETP and after achieving standard limits discharged to river Periyar. If the parameters are within the standard limits, it will be collected in the common delay pond and discharged to river Periyar through the single point outlet. If any of the industries fail to maintain the standard limits as per the ICO condition, penalty will be imposed based on the damages caused to the proposed CETP processes.

4.8 DISPOSAL OF EFFLUENT

As per the Environmental protection act 1986 and amendment Rules 2015, for each common effluent treatment plant, the quality of treated effluent characteristics of general parameters and ammonical nitrogen and heavy metals as per the design of proposed CETP as tabulated below.

Table 4.4 Parameters of Treated Effluent from CETP for Disposal to River Periyar

Sl.No.	Parameters	Max permissible value	Units
1	pH	6-9	
2	BOD	30	mg/l
3	COD	250	mg/l
4	TSS	100	mg/l
5	Oil&Grease	10	mg/l
6	TDS	2100	mg/l
7	Zinc	5	mg/l
8	Iron	3	mg/l
9	Copper	3	mg/l
10	Lead	0.1	mg/l
11	Hex Chromium	0.10	mg/l
12	Cadmium	0.05	mg/l
13	Chloride	1000	mg/l
14	Sulphate	1000	mg/l
15	Ammonical Nitrogen	50	mg/l

The treated effluents are collected in treated water tank/delay pond and its parameters are monitored continuously, and if it is within the safe limits, it will be disposed to river Periyar at the downstream of Pathalam Regulator cum bridge.

4.9 SOLID WASTE MANAGEMENT

Depending upon the characteristics of the wastes, different types of disposal methods can be used for hazardous and non-hazardous industrial wastes. The most predominant and widely practiced methods for wastes disposal are: (a) Landfill, (b) Incineration and (c) Composting.

The dewatered sludge cake obtained from screw press is proposing to be delivered to KEIL for recycling by suitable mode of transport twice a month. Concrete bays are using for storage of solids waste. Around 4 MT/day load is expecting to be generated from the three streams and stored separately depending on the characteristics of waste. The solid waste generated are stored for 15 days and conveyed by Lorries to KEIL for further management. Hazardous waste manifesto shall be filed before concerned authorities regularly. Necessary precautions will reduce and minimize hazards associated with manual handling of industrial wastes.

CHAPTER 5
PROCESS SELECTION

5.1 GENERAL

Being the heterogenous nature of effluents from the industries in Edayar Industrial belt, it is very difficult to handle the effluents in CETP as a single stream. The characteristics of certain effluent may hinder functionality of process required certain other nature of effluents. Hence in order to deal with diversity in the characteristics of effluent forced to streamline the process for different nature of effluents.

The proposed CETP is being planned implement for Edayar Industrial area is of 2.0MLD capacity. The various process involved in the CETP for treating the effluent for discharging with the stipulated standards to the river Periyar is given in flow chart as follows. At the same time, the companies having authorized discharge outlets to the river Periyar is also proposing to be collected in the delay ponds with continuous online monitoring system before mixing with the outflow of CETP.

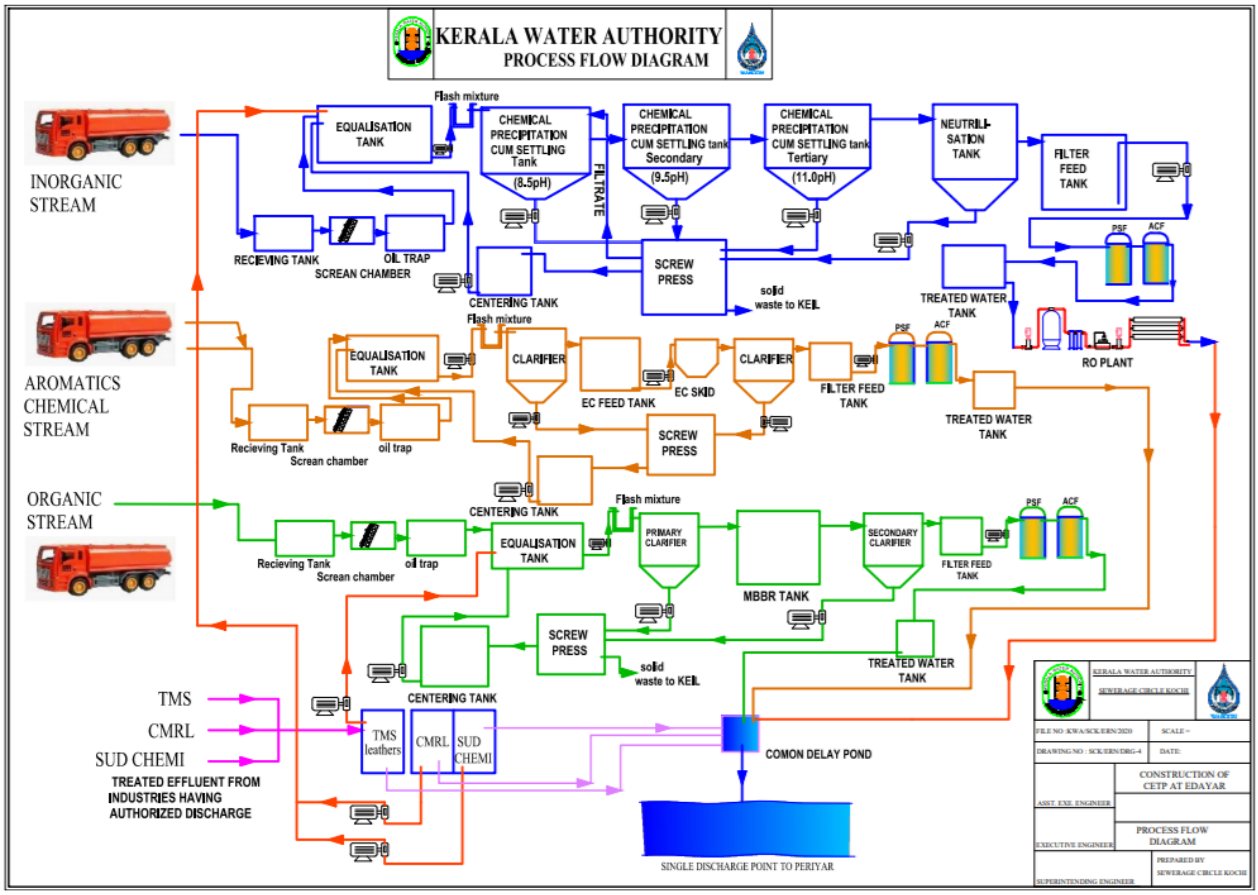


Fig-5.1 Flow Diagram

The effluents of industries are grouped into three categories viz. Biological/Main Stream, Aromatics and Chemical Stream and Heavy Metal Stream/Inorganic Stream. For each stream different methods of treatments are adopted. Fig 5.1 shows the total process flow diagram of the proposed CETP.

5.2 BIOLOGICAL/MAIN STREAM

The main stream is considered for the effluent quantity of 1.8 mld. This stream incorporated 31 industries. This stream is considered to be functioning continuously. Sewage demand of Edayar Industrial area of around 0.35mld is also catered in this stream. The characteristics of main stream effluent comprises of high BOD contributing from Rubber, Bone meal and Marine Industries. Similarly,Ammoniacial Nitrogen contribution is also too high. Hence for the smooth functioning of the stream pre-treatment is necessary at the source point for the companies having abnormal values other than the prefixed quantity of the parameters before conveyance to CETP. Even though, individual contribution of parameter from companies is high, collectively in the total mass of effluent in CETP, parameters concentration is getting reduced due to mixing of effluents ieBOD concentration is in the range 1800-2500mg/l, COD is in the range 5200-6000mg/l, TSS is in range 260-300 mg/l, oil and grease is 2-5 mg/l, TDS is in range 2800-3000mg/l and Ammoniacial Nitrogen is in range 150-180mg/l. Still, a factor of safety of 3 is considered in order to meet the fluctuations in characteristics of this stream.

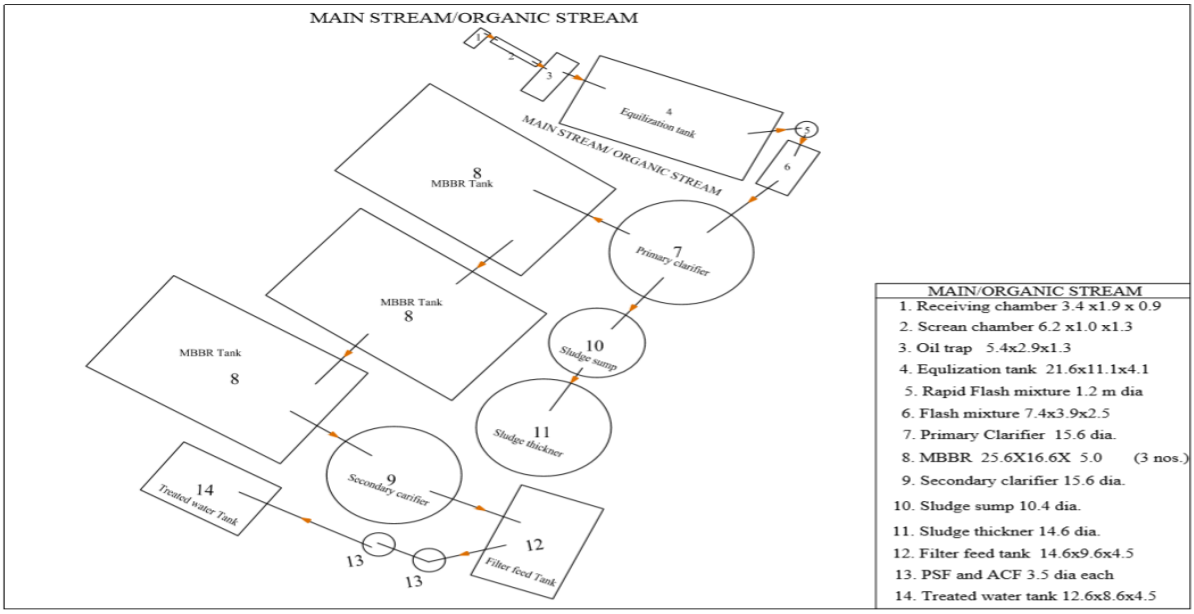


Fig-5.2 Flow Diagram of Units in Main Stream

Hydraulic flow diagram with various units involved in this biological treatment stream is attached .

5.2.1 Receiving Chamber with screens

The effluents are conveyed from industries using piped supply (8nos) as well as lorry conveyance. The same is receiving at the Receiving chamber, monitored, screened and routed to treatment stream.

The function of the bar screen is to prevent entry of solid particles/ articles above a certain size; such as plastic cups, paper dishes, polythene bags and cut pieces from waste water generation area into the CETP. (If these items are allowed to enter the CETP, they clog and damage the CETP pumps, and cause stoppage of the plant.) The screening is achieved by placing a screen made out of vertical bars, placed across the effluent flow. The gaps between the bars may vary between 6 and 25 mm. If this unit is left unattended for long periods of time, it will generate a significant amount of odor, it will also result in backing of effluent in the incoming pipelines and chambers. Bar screen racks are typically fabricated out of 50 mm x 10 mm bars either of epoxy-coated mild steel or stainless steel. A specified opening gap is kept between the bars. The wastewater output from this unit is taken to the oil & grease tank.

5.2.2 Oil and Grease Trap

The presence of oil and grease can have adverse effect on the biological treatment system. So it is very important to separate it from the main stream. The length of trap should be approximately 2 times its depth Residence time in the trap is optimally 5- 20 minutes. Surface area of the trap in m2 should be approximately 1.5 to 2 times the depth of trap in metres. The tank should have waterproof plastering inside and out. The end of the conditions without any problems of clogging, and treat industrial effluent incoming pipe is kept below the water level, so that the incoming water does not disturb (and break up) the upper floating layer of grease. The trapped material (both floating film of grease/ fat and the grit settled at bottom) must be collected frequently; otherwise the trap will fail to serve its fundamental purpose. Therefore, the trap must be engineered to facilitate frequent removal of these two layers. Large traps may be provided with vent pipes to release gases. Oil skimmer provided for skim out regularly.

5.2.3 Equalization tank

The equalization tank is the first collection tank in a CETP. Its main function is to act as buffer: To collect the incoming raw Effluent that comes at widely fluctuating rates, and pass it on to the rest of the CETP at a steady (average) flow rate. The equalization tank stores this effluent, and to maintain uniform characteristics of effluents from the different type and quantity of effluent from industries. To the constant outflow rate, it is easier to design the rest of the units of the CETP. The incoming effluent line is usually gravity-fed, and is likely to be at considerable depth below the ground level. The retention time considered around 8hrs to maintain uniformity in characteristics and overall dilution of the concentration. The tank may be of any shape, provided it permits placement of air diffusers for full floor coverage and uniform mixing over the entire floor area. The diffusers should be retrievable: Individual diffusers (or sets of diffusers) may be lifted out and cleaned for routine maintenance. This will reduce frequency of shut down of the Equalization tank for manual cleaning purposes. If membrane diffusers are used, they will fail frequently, due to the repeated cycles of expansion and contraction caused by fluctuating water levels in the equalization tank. Therefore, only coarse bubble diffusers must be used in the equalization tank. As a rule of thumb, the higher of the following two figures is taken as the air volume required per hour: 1.2-1.5 times the volume of the Equalization tank, or 2.5-3.0 m3/m2 of floor area. The number and placement of diffusers must be adequate to dispense the calculated amount of air in the tank. The capacity of the air blower must be adequate to deliver the required quantity of air to the equalization tank as well as all other aerated tanks it serves. This tank is most prone to odor generation, since it contains raw (untreated) effluent. It may also build up gas, which can be explosive Therefore it must have good ventilation.

5.2.4 Primary Settling Tank

As a unit operation, physical forces predominate in the removal of TSS in primary clarifiers. Perhaps it is on this account that many think of a primary clarifier as a constant-percentage TSS removal process. The process objective of primary clarifiers is to remove settleable TSS, whether these solids already exist in the raw wastewater or if they are precipitated solids generated as a result of chemical addition for enhanced suspended solids, phosphorus, or heavy metal removal. Despite the fact that primary clarifiers remove only settleable TSS,

performance historically has been quantified based on the removal efficiency of total suspended solids.

In removing settleable TSS, primary clarifiers fortuitously remove the COD (or BOD) associated with them. Because downstream biological processes are sized based on the amount of biodegradable material there is in the primary effluent, the performance of primary clarifiers also is often quantified based on

- The COD (or BOD) removal efficiency
- The non settleable TSS concentration,
- The influent TSS concentration,
- The settling characteristics of the settleable solids (indirectly quantified)
- The surface overflow rate,
- The soluble COD concentration (should be the same in the primary influent and effluent), and
- The ratio of COD (or BOD5) to TSS in the primary effluent.

The process objective of chemically enhanced primary treatment is to produce an effluent, with the addition of chemicals, lower in TSS and COD than the non-settleable TSS and COD, respectively, measured without the addition of chemicals. Although not specifically "enhanced primary treatment", chemical addition to primary clarifiers also is done to remove phosphorus for nutrient control, heavy metals to meet toxicity requirements, and hydrogen sulphide to lower odour emissions.

Chemical treatment of the effluent is to be done in Flash mixer. Adequate dosages of lime and coagulant are added to the effluent for the coagulation of suspended particles and precipitation of dissolved organics present in the raw effluent. The chemical precipitation process 90 to 95% reduction in suspended solids and 20 – 30 % reduction in BOD and COD will be achieved by this stage of treatment. Overflow from settling tank goes to the aeration tank. The sludge generated from the chemical treatment is taken to the sludge tanks and dewatered in Screw filter press.

5.2.5 MBBR Process

Moving Bed Bio Reactor (MBBR) Conceptually, the extremely simple process for Biodegradable Effluent Treatment is the main treatment process used in this stream. A small amount of microorganisms converts a large mass of polluted

water into clean water. This process also produces a co-product: A vastly reduced, compact solid biomass (the excess microorganisms produced by growth and multiplication of the original population of microorganisms). The micro-organism employed for the treatment of effluent can be anaerobic or aerobic. The anaerobic micro-organisms are those live in the absence of oxygen and the oxygen is a poison to them. The aerobic micro-organism is those living with oxygen and they need oxygen for survival. In the MBBR (Moving Bed Bio Reactor) technology, we provide moving inert materials in the aeration, so that the surface area increases and which allows more bacteria to grow and activate the process. In an MBBR process the sludge recycling and close watching of MLSS is not important. Proper selection of MBBR Media, aeration systems and retention time are important.

The biological growth is protected within engineered plastic carriers, which are carefully designed with high internal surface area. These bio-media are suspended and thoroughly mixed throughout the water phase with the help of aeration system. When communities of microorganisms grow on these specially designed bio-media, the micro-organism is more resistant to process disturbances compared to other types of biological treatment processes. With this technology it is possible to handle extremely high loading. Thus, this technology can be considerably more robust especially when compared to conventional technologies like activated sludge process. The wastewater is led to the reactor where biological growth within the internal structures of the bio-media enhances the digestion of pollutants. These pollutants that need to be removed in order to treat the wastewater are food for the micro-organisms. An aeration grid (coarse bubble diffusers) located at the bottom of the reactor supplies oxygen to the bio-media along with the mixing energy required to keep the media suspended and completely mix within the reactor. Treated water flows from reactor through a grid or a sieve, which retains the bio-media in the reactor. Specially engineered bio-media shall be with following details.

Bio-media Type: Wheel type
Material of construction: Polypropylene/ Polyethylene/PVC
Strainer: Polypropylene/PVC/FRP

The oxygen requirement is around 1.2 kg O2 /mg/l concentration of BOD removal. The aeration requirement in an MBBR process is taken as 5 times MBBR tank volume (thumb rule). The Aeration tank is generally of waterproof RCC

construction, designed as water-retaining structures as specified in relevant Indian codes. The shape of the tank is not very critical, as long as adequate floor coverage and uniform mixing can be achieved by proper placement of diffusers on the tank floor. The liquid depth may be between 2.5 - 4.5 m. However, there is a penalty to be paid in the form of higher (and more difficult) maintenance, costs of a higher pressure air blower, higher air temperatures and related problems. The diffusers must be retrievable, for regular cleaning and maintenance without having to empty the aeration tank. (Regular cleaning extends the life of the diffusers). It is necessary to ensure that the incoming sewage does not go to exit directly. To minimize this "short circuiting", raw sewage lift pumps must deliver the sewage at one end of the tank, and the outflow must be as far away from this point. Sufficient freeboard must be provided in the tank, so that even in the event of emergencies (such as blockage of pipe between aeration tank and settling tank, excessive foaming etc.) overflow from the aeration tank can be avoided for some time. Note that the freeboard only gives the CETP operator some additional time to react to an emergency, but it would not be able to prevent an overflow.

5.2.5.1Nitrification & Denitrification Tank

Nitrification is an aerobic process whereas denitrification process is an anaerobic process. For this purpose, two separate tanks are required – one open type and another closed type. The ammoniacal nitrogen is oxidized to nitrates using nitrifying bacteria in aerobic condition with the help of air supply by air blowers. The converted nitrates are further converted into free nitrogen using nitrogen fixing bacteria in anaerobic condition. The free nitrogen thus formed is released to atmosphere.

As ammoniacal nitrogen concentration is more in this stream 3 nos of MBBR Tank is proposing with the intension that normal BOD removal in first tank, nitrification process considered in 2^{nd} tank and de-nitrification is proposed in 3^{rd} tank. Nitrification process mainly required high rate of aeration of around 4.6kg of oxygen /mg/l concentration of NH_4 removal. After nitrification, feed effluent to 3^{rd} tank where anoxic process is taking place for de-nitrification process. In case of low concentration of NH_4 3^{rd} tank can be bypassed to secondary clarifier for settling and 2^{nd} tank can be operated with controlled rate of aeration.

5.2.5.2 Air Blowers

Aeration is the most critical component of a treatment system using the Moving Bed Bio Reactor. A well designed aeration system has a direct impact on the level of sewage treatment it achieves. An ample and evenly distributed oxygen supply in an aeration system is the key to rapid, economically-viable, and effective waste water treatment.

5.2.6 Secondary Clarifier

Secondary Clarifiers are built with mechanical means for continuous removal of solids being deposited by sedimentation. A clarifier is generally used to remove solid particulates or suspended solids from liquid for clarification and (or) thickening. Secondary Clarifier is a circular basin in which effluent from the MBBR process is held for a period of time during which the heavier biomass (microorganisms) settle to the bottom. There is no need for sludge recirculation in MBBR due to its high MLSS values. So secondary settling tanks are just used for removing excess settleable solids present in the effluent comes out from MBBR tanks.

5.2.7 Sludge Sump

Sludge sump is meant to collect the sludge from primary clarifier as well as secondary clarifier. Sludge sump is designed to have a hydraulic retention time of 6hrs. Sludge sump proposing to have circular shape.

5.2.8 Thickener Feed Pump

The major function of sludge thickener feed pump is to transfer the sludge from sludge sump to sludge thickener. Two numbers (1W+1SB) of non-clog, submersible pumps are provided with a discharge of 10.5cum/hr.

5.2.9 Sludge Thickener

Sludge thickening normally refers to the process of reducing the free water content of sludge or Thickening is a procedure used to increase the solids content of sludge by removing a portion of the liquid fraction. The thickened sludge will be having a consistency of 3% of total sludge. Sludge thickeners (Gravity Type) is provided. Thickened sludge is collected in a sludge sump for feeding the dewatering equipment.

5.2.10 Screw Press

Centrifugal thickening and dewatering of sludge is a high speed process that uses the force from rapid rotation of a cylindrical screw to separate wastewater solids from liquid. The centrifugal force in the decanters is utilized to separate the solids from the water. The use of organic flocculants, the polyelectrolytes, made it possible to coagulate the fines sludge particles to relatively large sludge floc in the centrifugal field so that reliable separation of solids and water could take place.

Two numbers of centrifuges (1W+1SB) are provided with a capacity of 0.84cum/hr. A dosing tank is provided for Poly Electrolyte dosing in centrifuge and thickener. Poly Electrolyte dosing is fixed as 2.0kg/1000kg for a sludge generation rate of 1037.5kg/day. Therefore, a dosing tank is designed with dimensions 0.75x0.75x1.5m.

5.2.11 Pressure Sand Filter & Activated carbon Filter

The pressure sand filter (PSF) is used as a tertiary treatment unit to trap the trace amounts of solids which escape the clarifier, and can typically handle up to 50 mg/l of solids in an economical manner. This unit is essentially a pressure vessel that is filled with graded media (sand and gravel). The water filtered with PSF is passed on to the next stage in the CETP chain: the Activated Carbon Filter. A good average design filtration rate is 12 m3/ m2/hr of filter cross-sectional area, and most filters used in CETP applications are designed on this basis. The Filter vessel is designed as a pressure vessel (it consists of a straight cylindrical shell, with convex dish-shaped ends welded to the top and bottom). A typical vessel is designed to withstand a pressure of 5 kg/cm2. In large filters, a manhole of > 0.6 m dia is provided at the top. A hand-hole of > 200 mm dia is provided at the bottom of the cylinder to facilitate removal of media from the vessel at the time of servicing. A set of pipes, valves, bypass line, backwash waste line etc. are also provided to facilitate operations such as filtration, bypass (during servicing), backwash etc. Pressure gauges are provided, to monitor the pressure drop across the filter. The shell height typically varies between 1.2 m to 1.5 m in small plants. Graded pebbles ranging from 0.5” to 1” are filled as bottom layers in the filter, up to a depth of nearly 0.5 -0.6 m. The top layers consist of the filtering sand media (Coarse and fine sand) to a depth of 0.6 – 0.7 m. A freeboard of nearly 0.3 m above the level of sand may be provided (to allow for expansion of sand during backwash). A great

majority of filters operate in the down flow mode (water flowing in top-to-bottom direction).

5.2.12 Disinfection system

The treated water is disinfected to destroy and render harmless disease-causing organisms, such as bacteria, viruses, etc. The most common methods of disinfection include Chlorination, Ozonation and UV radiation. Of these, Chlorine finds widespread application. The primary action of the chemical involves damaging the cell wall, resulting in cell lysis and death. In most ETPs, the common form of Chlorine used is Sodium Hypochlorite (Hypo) available commercially at 10-12 % strength, being safe, easy to handle and having a reasonable shelf life. Efficiency of disinfection is dependent both on the residual concentration of the chemical used, as well as the contact time, a factor measured as R x T. Generally, a contact time of 20-30 minutes is recommended to achieve over 99 % germicidal efficiencies. The Chlorine disinfection system consists of a Hypo-holding and an electronically metered dosing pump. Hypo solution of desired concentration is prepared in the tank. The dosing rate is set in the metering pump as per the desired Chlorine dose rate, typically 3-5 PPM. Hypo solution is dosed at the outlet of the ACF, online, so that Activated Carbon Filter an activated carbon filter, like the Pressure Sand Filter, is a tertiary treatment unit. It receives the water that is already filtered by the Pressure Sand Filter and improves multiple quality parameters of the water: BOD, COD, clarity (turbidity), colour and odour. This filter uses the adsorption action of activated carbon. Activated carbon is typically manufactured from coconut shell or charcoal, the “activation” process creating a highly porous material with a very large surface area. Organic pollutant molecules are physically adsorbed and held fast within the catacomb-like porous structure of the activated carbon. Granular activated carbon is typically used for this purpose. The water filtered by the Pressure Sand Filter enters the Activated Carbon Filter. Unlike in the case of the sand filter, trapped molecules in the carbon cannot be backwashed and got rid of. Hence, activated carbon in the filter has a finite capacity to adsorb and hold the pollutants, after which the carbon is said to be exhausted. The exhausted material is removed from the filter and disposed off: Fresh activated carbon is charged in the filter. Very precise design criteria are available for design of activated carbon columns (adsorption isotherms, kinetics of mass transfer between the liquid and solid phase, breakthrough curves etc.). For everyday

applications, however, the simplified rules used for the sand filter have been found to be adequate.

5.2.13 Treated Water Tank

Treated water from Activated Carbon filter is pumped in to the treated water tank. Hydraulic retention time of 4 hrs is given in the treated water tank. At the same in order to have single discharge to river Periyar the treated water is routed to common delay ponds.

5.3 AROMATICS AND CHEMICAL STREAM

This stream incorporated 16 industries. Aromatics and Chemicals are impossible to treat using biological method as they poison the bacteria and do not have enough BOD load to sustain the bacteria. The ACS stream is considered for the effluent quantity of 0.1 mld. This stream is considered to be batch process. The characteristics of ACS effluent is having high COD-BOD ratio. The effluent is mainly from natural extraction units, urea formaldehyde companies. Even though, individual contribution of parameter from companies is high, collectively in the total mass of effluent in CETP, parameters concentration is getting reduced due to mixing of effluents ie BOD concentration is in the range 160-180mg/l , COD is in the range 1900-2100mg/l, TSS is in range 160-200 mg/l, oil and grease is 2- 5 mg/l and TDS is in range 2000-2500mg/l .Still, a factor of safety of 3 is considered in order to meet the fluctuations in characteristics of this stream.

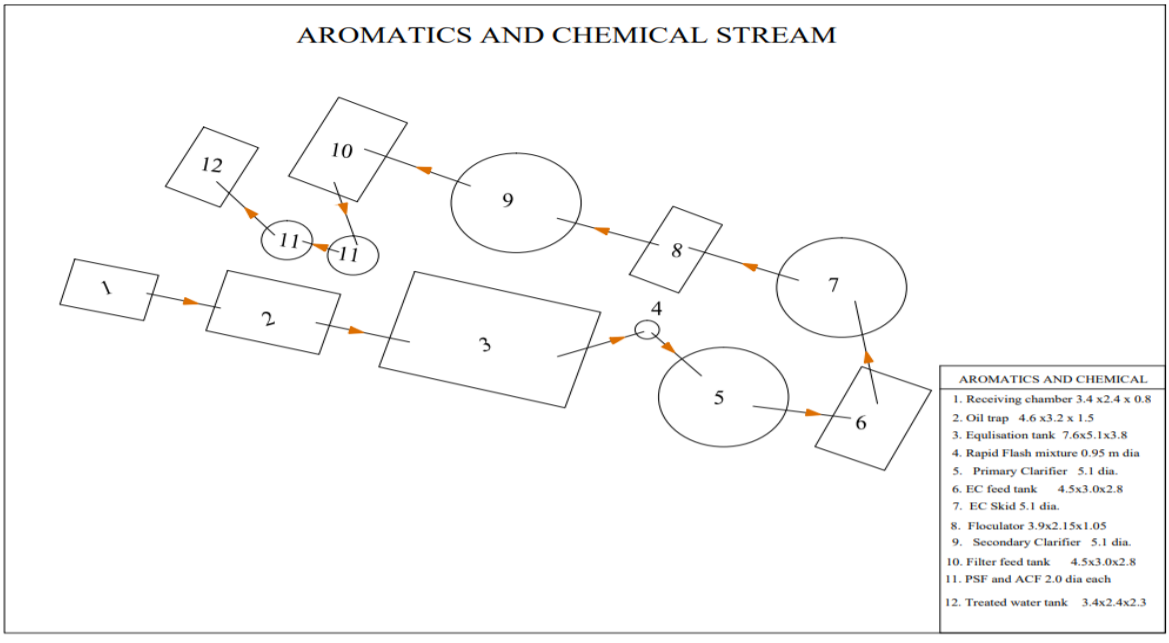


Fig-5.3 Flow Diagram of Units in ACS

Hydraulic flow diagram with various units involved in this ACS stream is attached.

The effluent generated in various units are collected in the existing collection tank of industries and after neutralization conveyed to the proposed CETP either through tanker lorries or pipe line system (2 Nos.) and will be subjected to the following process

5.3.1 Receiving/Screening chamber

The effluents conveyed by piped effluent supply as well as lorry are received in this chamber. The chamber is provided as 2 with centre partition. Large solid particles present in the effluent are removed by using bar screens provided in center partition wall. Non corrosive materials like stainless steel, FRP, etc. are provided as screens. Steel gratings are also provided in second chamber at outlet point.

5.3.2 Oil Removal

After screening, the effluent is entered in to the oil trap for the removal of oil and grease. Oil and grease removal can be done by either using oil skimmer or by providing gravity settling. In order to obtain best result skimmer is provided.

5.3.3 Collection cum Equalization

After oil removal and screening, the effluent is collected in a collection cum equalization tank. Considering the mixing of various raw effluent in the tanker Lorries, pH of the raw effluent will be monitored. Here the equalization process can be done either by re-circulating the raw effluent inside collection cum equalization tank using pumps or by providing small quantity of air using blowers or by adding sufficient amount of chemicals. As the treatment process is batch process detention time 20 hrs is to be taken.

5.3.4 Clarifiers

As a unit operation, physical forces predominate in the removal of TSS in primary clarifiers. The process objective of primary clarifiers is to remove settleable TSS, whether these solids already exist in the raw wastewater or if they are precipitated solids generated as a result of chemical addition for enhanced suspended solids, phosphorus, or heavy metal removal.

The process objective of chemically enhanced primary treatment is to produce an effluent, with the addition of chemicals, lower in TSS and COD than the non-settleable TSS and COD, respectively, measured without the addition of chemicals. Although not specifically "enhanced primary treatment", chemical addition to primary clarifiers also is done to remove phosphorus for nutrient control, heavy metals to meet toxicity requirements, and hydrogen sulfide to lower odor emissions.

Chemical treatment of the effluent is to be done in Flash mixer. Adequate dosages of lime and coagulant are added to the effluents for the coagulation of suspended particles and precipitation of dissolved organics present in the waste water. The sludge generated from the chemical treatment is taken to the sludge tanks and dewatered in Screw filter press.

5.3.5 Electro-coagulation system

The Electro-Coagulation System is designed to treat $5m^3$/hr of Effluent. The Effluent received by process house will be 100m3/day. The operating cycle of the plant shall be 20 hours. The Electro-Coagulation system will consist of EC Feed pump to pump the Effluent from the Equalization tank, Electro-Coagulation skid, Polymer Dosing System, Flash Mixer, Clarifier and Filtration System. The purpose of the Electro-Coagulation system is for the removal of Colour, Suspended solids, reduction of BOD, COD, Hardness and TDS. The Anionic Polymer Flocculent Dosing in the Flash Mixer after EC will flocculate the EC treated water for easy separation of Sludge. The effluent will be fed after EC to secondary Clarifier for settlement.Sludge separation and the Supernatant clear water is collected for further treatment. The Sludge from the Clarifier will be drained to the Filter press for sludge dewatering.

5.3.6 Pressure sand Filtration

Suspended particles present in the treated water are to be removed by Pressure sand filtration.

5.3.7 Activated Carbon Filtration

Colour or foul odour if remaining after treatment is to be eliminated by Activated Carbon Filtration.

5.3.8 Treated water tank

Treated water is collected in the tank with detention time of 2 hrs and routed to common delay pond for disposal.

5.4. HEAVY METAL STREAM (INORGANIC STREAM)

Inorganic stream contain Heavy metals are proposed to be treated separately because in order to precipitate different metals in different ranges of pH three consecutive chemical precipitation cum settling unit has to be needed. As such separate heavy metal (inorganic stream) is incorporated in the proposed CETP.
The following industries are included under Heavy Metal Stream.

- Electroplating Industries with Effluents containing Zinc, Iron Etc.
- Battery Industries having Effluents containing lead.
- Paint Industries having Pigments and Solvents
- Metal Fabrication / Powder coating industries

This stream incorporated 18 industries. The effluent generated by the industries is 36600l/day. The HMS stream is considered for the effluent quantity of 0.1 mld. In case of failure in the treatment process of M/s CMRL and M/s SUD CHEME is redirected to this stream for treatment.

5.4.1 Treatment Mechanism

- Effluents containing heavy metals are treated by multiple coagulation and precipitation and followed by Membrane Filtration/ Ion Exchange systems.
- The type of treatment is based on the concentration of heavy metals and their reverse solubility in the effluent

The most common used method to remove soluble metal ions from solution is to precipitate the ion as a metal hydroxide. The process is readily automated and controlled by a simple pH controller. By raising the pH value of a solution with a common alkaline material such as lime, or sodium hydroxide the corresponding metallic hydroxide compounds become insoluble and precipitate from solution. The curve showing the solubility of the common heavy metal ions and their respective solubility versus pH is shown below.

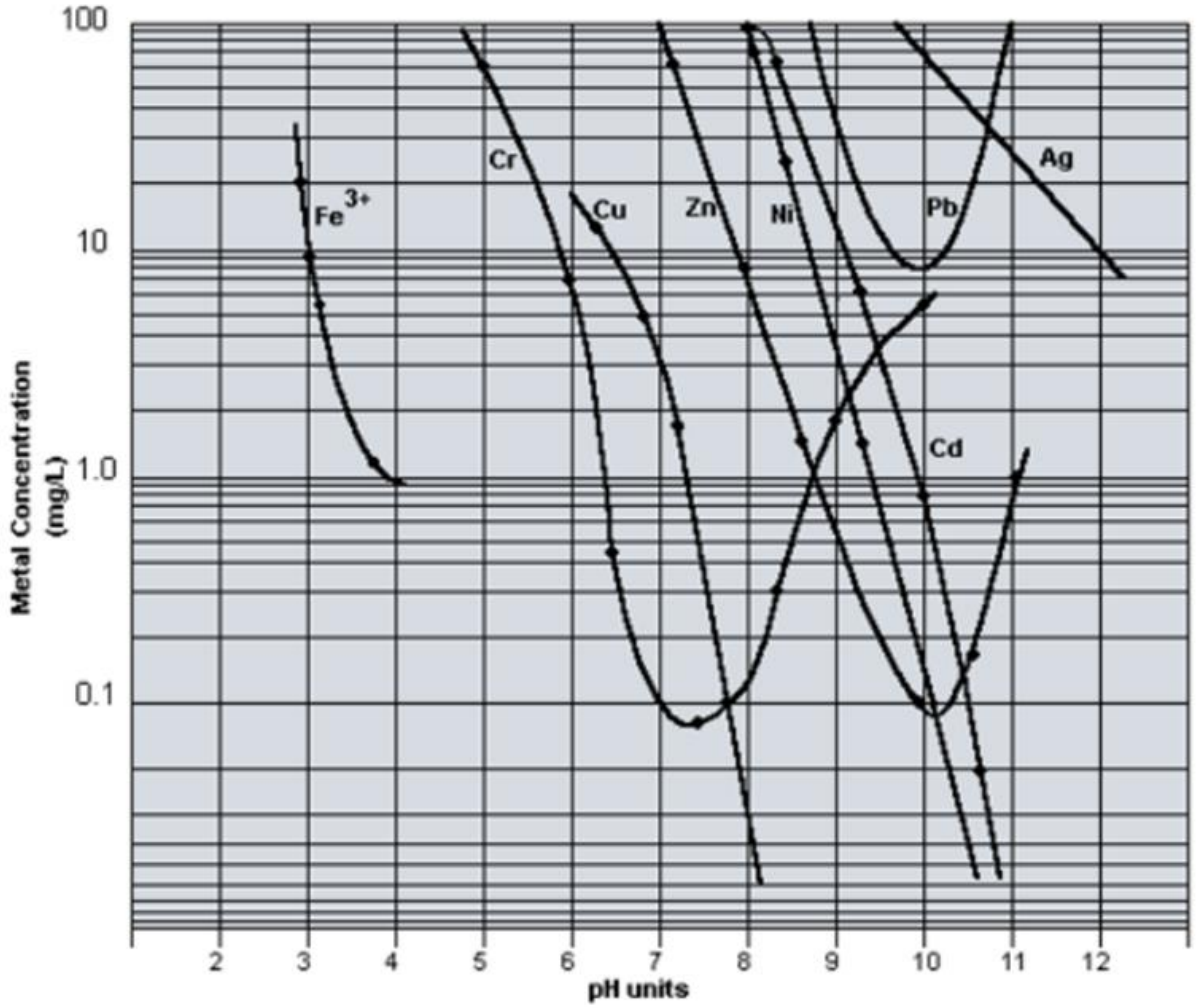


Fig-5.4- Solubility Vs pH Curve

5.4.2 Treatment Scheme

The effluent generated in various units are collected in the existing collection tank of industries and after neutralization conveyed to the proposed CETP either through tanker lorries or pipe line system (1 no) and will be subjected to the following process.

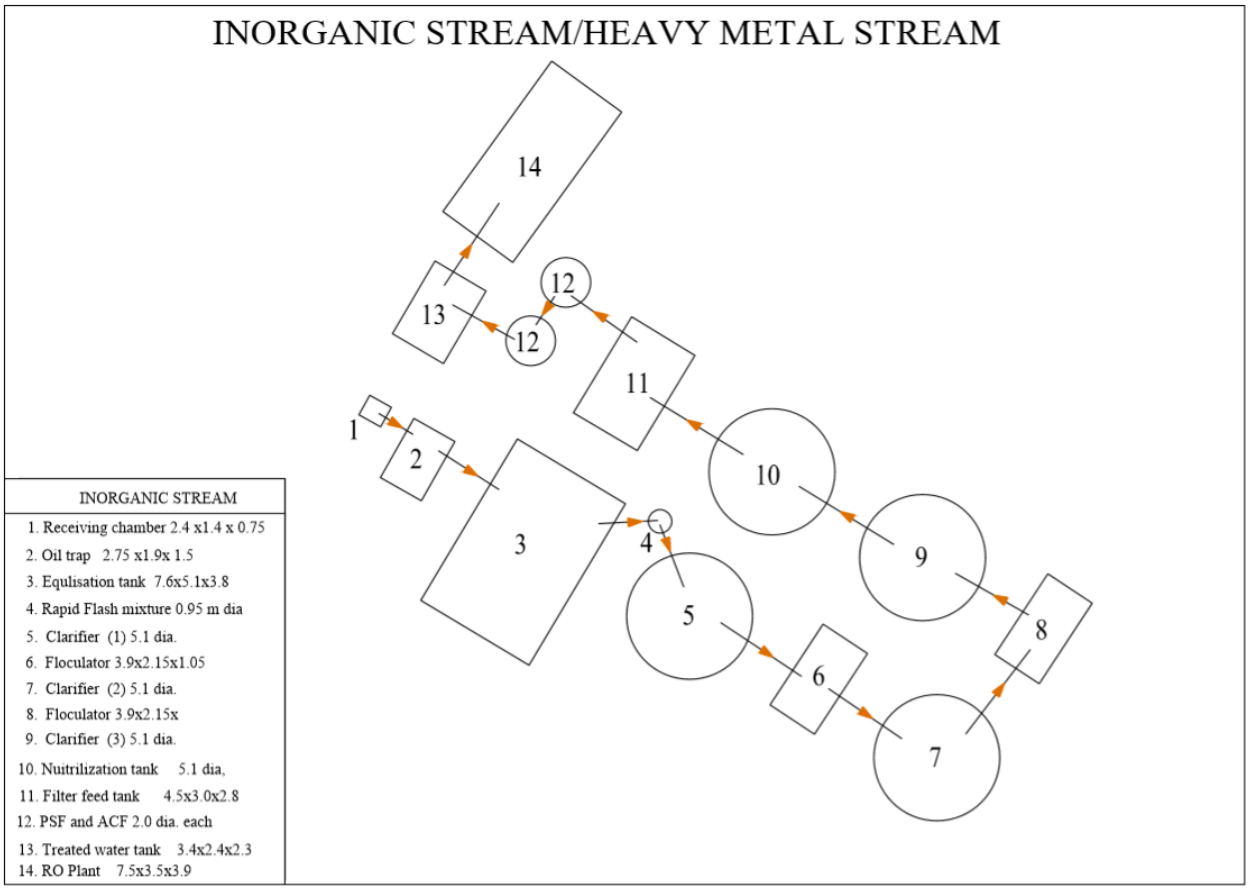


Fig-5.5 Flow Diagram of Units in HMS

Hydraulic flow diagram with various units involved in this ACS stream is attached.

5.4.2.1 Receiving/Screening Chamber

The effluents conveyed by piped effluent supply as well as lorry are received in this chamber. The chamber is provided as 2 with centre partition. Large solid particles present in the effluent are removed by using bar screens provided in center partition wall. Non corrosive materials like stainless steel, FRP, etc. are provided as screens. Steel gratings are also provided in second chamber at outlet point.

5.4.2.2 Oil Removal

After screening, the effluent is entered in to the oil trap for the removal of oil and grease. Oil and grease removal can be done by either using oil skimmer or by providing gravity settling. In order to obtain best result skimmer is provided.

5.4.2.3 Collection cum Equalization

After oil removal and screening, the effluent is collected in a collection cum equalization tank. Considering the mixing of various raw effluent in the tanker Lorries, p^H of the raw effluent will be monitored. Here the equalization process can be done either by re-circulating the raw effluent inside collection cum equalization tank using pumps or by providing small quantity of air using blowers or by adding sufficient amount of chemicals. As the treatment process is batch process detention time 20 hrs is to be taken.

5.4.2.4 Chemical precipitation cum settling

Effluents containing heavy metals are treated by 3 Stage Coagulation and precipitation.

- **1st Stage Clarification**
  From the equalization tank, neutralized effluent pumped to fist stage clarifier where pH is brought to 8.5 to 9.0 by adding lime followed by cationic type polyelectrolyte. The dosing of chemicals is controlled by pH sensing control valves. Quantity of lime to be added is 18 LPH of 10 w/v %. In this first stage clarification the metals Cu and Cr will be precipitated as its hydroxides. Sludge accumulated will be collected in sludge sump and then send to screw press.
- **2nd stage clarification**
  In this stage over flow from the1st stage reaches to this clarifier. where pH is brought to 10 to 10.5 by adding lime followed by cationic type polyelectrolyte. The dosing of chemicals is controlled by pH sensing control valves. Quantity of lime to be added is 21.50 LPH of 10 w/v %. In this stage precipitation of the metals such as Ni, Zn, Cd andPb as its hydroxides. Sludge accumulated will be collected in sludge sump and then send to screw press.
- **3rd stage clarification**
  In this stage over flow from the2nd stage reaches to this clarifier. where pH is brought to 11 to 11.5 by adding lime followed by cationic type polyelectrolyte. The dosing of chemicals is controlled by pH sensing control

valves. Quantity of lime to be added is 150 LPH of 10 w/v %.In this stage metals if any remaining after stage 1 and 2 will be precipitated and settled.Sludge accumulated will be collected in sludge sump and then send to screw press.

5.4.2.5 Neutralization Tank

Over flow from the 3rd stage clarifier which are having basic nature is to be neutralized using Coagulants like ferric chloride. Sludge formed during the neutralization will be settle down and send to screw press and over flow reaches to Filter feed tank.

5.4.2.6 Pressure Sand Filtration

In pressure sand filter suspended solids which are escaped from the neutralization tank is trapped and send to activated carbon filter

5.4.2.7 Activated Carbon Filtration

Colour or odour if any remaining after treatment the pressure sand filtration is to be eliminated by Activated Carbon Filtration

5.4.2.8 Treated water tank

Treated water is collected in the tank with retention time of 2 hrs and routed to common delay pond for disposal.

CHAPTER-6
PROCESS DESIGN

6.1 MAIN STREAM				
	Capacity: Average Flow		**1.8MLD**	
Sl No	**Description of Parameter**	**Value**	**Unit**	**Reference/Remarks**
a.	Quantity of Neutralised effluent	1800000	LPD	
		1800	Cum/day	
b.	Design Flow	1800	Cum/day	
	Working hours	20	Hr	
		90	Cum/hr	
		0.025	Cum/sec	

6.1.1 RAW EFFLUENT CHARACTERISTICS				
a.	pH	7.26		
b.	BOD	1830	ppm	
c.	COD	5259	ppm	
d.	TSS	266	ppm	
e.	Oil & Grease	1.98	ppm	
f.	AmmoniacalNitrogen (As N)	179.9	ppm	

6.1.2 TREATED EFFLUENT CHARACTERISTICS				
a.	pH	6-9		
b.	BOD	30	ppm	
c.	COD	250	ppm	
d.	TSS	100	ppm	
e.	AmmoniacalNitrogen (As N)	50	ppm	

6.1.3	**RECEIVING CUM GRIT CHAMBER**			
	Avg design flow	90	Cum/hr	
		0.025	Cum/Sec	
	Design flow	208	Cum/hr	Considering the pumped effluent and lorry unloading qty.
	Average Retention Time	45	Sec	
	Volume	2.6	Cum	
	Assumed Depth of flow	0.6	M	
	Area Required for Inlet chamber	4.33	Sq.m	
	Length of the tank	3	M	
	Breadth of the tank	1.5	M	
Provide the Dimensions of Receiving Chamber as 3.00 m x 1.5 m x 0.60 m SWD + 0.3 m Freeboard.				

6.1.4	**APPROACH CHANNEL**			
	Avg Design flow	0.058	Cum/Sec	
	No.of channel	2.000		
	Design flow	0.029	Cum/Sec	
	Horizontal velocity	0.75	m/sec.	
	Area required	0.039		
	width to depth ratio	1.5:1		
	Depth	0.160		
	Breadth	0.240		
Provide the Dimensions of approach channel as 0.3 m x 0.5 m depth including 0.3 m Freeboard and slope 1:350				

6.1.5	**MANUAL COARSE SCREEN CHANNEL in each Channel**			
	Design Flow	0.029	Cum/s	
	No. of screen	1	Nos.	(Working)
	Area required for screen	0.045		

	width of channel	0.3		
	water depth in channel	0.16		
	velocity at screen	0.64		
	Bar Thickness	10	Mm	
	Clear Bar Spacing	25	Mm	
	No of bars	8	no's.	
	inclination	45		
	effective width	0.22	M	
	effective area	0.0352		
	Velocity	0.8207		
	head loss	0.0191	M	<0.15m
	quantity of a screening	0.0015	m^3/ML	
	quantity produced	0.0150		cleaning at alternate days
	design of a perforated plate			
	width of the plate	0.3000		
	depth of pocket	0.2000		
	Length	0.8000		
	cs m^3	0.0480		>0.015
Provide the Dimensions of Manual Coarse Screen with 10*50mm square bars at 25mm spacing Channel as 1.8 m x 0.3 m x 0.5m including freeboard				

6.1.6	**FINE SCREEN CHANNEL in each Channel**			
	Design Flow	0.029	Cum/s	
	No. of screen	1	Nos. (Working)	
	Area required for screen	0.045		
	width of channel	0.3		
	water depth in channel	0.16		
	velocity at screen	0.64		
	Bar Thickness	10	Mm	

	Clear Bar Spacing	6	Mm	
	No of bars	18	no's.	
	inclination	70		
	effective width	0.12	M	
	effective area	0.0192		
	Velocity	1.5046		
	head loss	0.1350	M	<0.15m
	quantity of a screening	0.0015	m^3/ML	
	quantity produced	0.0150		cleaning at alternate days
	design of a perforated plate			
	width of the plate	0.3000		
	depth of pocket	0.2000		
	Length	0.8000		
	cs m^3	0.0480		>0.015
Provide the Dimensions of Fine Screen with 10*50mm square bars at 6mm spacing Channel as 1.5 m x 0.3 m x 0.5m including Freeboard				

6.1.7	**OIL & GREASE TRAP**			
	Average Design Flow	0.025	Cum/sec	
	Hydraulic Retention time	10	Mins	
	Volume of the Tank	15	Cum	
	Assume 500m^2 surface area for a waste water flow of 1m^3/sec			
	Area required	12.5	m^2	
	Length of the Tank	5	M	
	Breadth of the Tank	2.5	M	
	Depth	1	M	
Provide oil and grease trap of 5x2.5x1.30 including Freeboard				

6.1.8	**EQUALIZATION TANK**			
	Average Design Flow	0.025	Cum/sec	
	Hydraulic Retention time	8	hours	
	Volume of the Tank with 20% extra	864	Cum	
	Assumed Depth of Liquid column (SWD)	3.6	M	
	Area required for the equalization tank	240	Sq.m	
	Length of the Tank	21	M	
	Breadth of the Tank	10.5		
Provide the Dimension of Equalization Tank 21x10.50x3.6+0.50m Freeboard				

6.1.9	**RAPID FLASH MIXER**			
	Average Design Flow	0.03	Cum/sec	
	Hydraulic Retention time	30	Sec	
	Volume of the Tank	0.9	Cum	
	Height of the tank (assume)	1.5dia	M	
	Diameter of the tank	1	M	
	Height	1.5	M	
Provide Rapid Flash Mixer of 1m dia, 1.8m height including Freeboard				
6.1.10	**HORIZONTAL FLOW BAFFLED FLOCULATOR**			
	Average Design Flow	0.03	Cum/sec	
	Hydraulic Retention time	20	Mins	
	Volume of the Tank	36	Cum	
	Water depth	2	M	
	Velocity	0.1	M	
	Thickness of baffle	0.2	M	
	Length of the baffle	2	M	

	No. of baffle's on one side	3	Nos.	
	Total no. of flow channels	6	Nos.	
	Spacing between the baffle's	1	M	
	Clear distance between end of the baffle and wall	1.5	M	
	Total lenth of the floculator	7	M	
	Breadth	3.5	M	
	Volume	45	Cum	
	Actual detention time	1500	>20mins	
Provide Horizontal flow baffled floculator of 7m x3.5m x2.5m height including Freeboard				

6.1.11	**PRIMARY CLARIFIER**			
	Average Design Flow	108	Cum/hr	
	Retention Period	6	Hrs	
	Volume of Tank	648	Cum	
	Assumed Depth	3.7	M	
	Area of Each Tank	175.14	sq.m	
	Propose a Circular Tank			
	Diameter of theTank	15	M	
	Solid concentration	9500	mg/l	
	Sludge quantity	14774.4	kg/d	Assuming 60% removal
	Density of water	998.2		
	Specific gravity	1.03		
	% of solids	6		
	volume of sludge	239.50	m^3/d	
	Assuming 3hrs of storage			
	Sludge Pocket	31.5	m^3	
Provide the Dimension of 1No PRIMARY CLARIFIER Dia as 15 m ϕ x 3.7 m SWD + 0.5 m Freeboard				

6.1.12	**MOVING BED BIO REACTOR (MBBR)**			
	Average Design Flow	90	Cum/hr	
	BOD of incoming	4486	mg/l	20% removal in PS
	TSS of Incoming	445	mg/l	60% removal in PS
	BOD required after treatment	5%		95% removal
	BOD to be removed	4037	mg/l	
	Total applied BOD	9205.27	kg/d	
	Specific surface area of the media	1200	m^2/m^3	
	Protected surface area	1008	m^2/m^3	
	BOD loading rate	5	$kg/m^3/d$	
	Media of organic loading	0.004960317	$kgBOD/m^2/d$	
	Quantity of media required	1546.49	m^3	
	The required volume of reactant	5154.95	m^3	Considering 30% fill of media
	Volume of reactor	1718.32	m^3	Considering 3 reactors for removal of BOD including nitrification and denitrification.
	Water depth	4.5	M	
	Breadth	16	M	
	Length	25	M	
	Retention time	60	Hrs	Normal aeration, nitrification &denitrification
	Retention time	40	Hrs	Normal aeration two MBBR tank in series operation
	Aeration			

	Oxygen required to remove BOD	1.2	kg/kgofBOD	
	Oxygen required	11046	kg/d	
	Weight of oxygen in 1kg of air	0.232		
	Density of air	1.201		
	Oxygen transferred efficiency	0.17		
	Air required/day	39645		
	Factor of safety	0.25		
	Air required/day	291506		
	Oxygen required to remove ammoniacal nitrogen	4.6	Kg	
	Concentration of Ammoniacal nitrogen in inflow	459	mg/l	
	Applied ammponiacal load	991		
	Oxygen required to remove A-NH4	4560.62		
	Air required/day	16367.91	m^3/d	
		120352.29	m^3/d	Considering oxygen transfer efficiency 17% and factor of safety 25%
Provide the Dimension of Moving Bed Bio Reactor (MBBR) 3 no's. 25m x 16m x4.5m SWD + 0.5 m Freeboard				

6.1.13	**SECONDARY CLARIFIER**			
	Average Design Flow	108	Cum/hr	
	Retention Period	3.5	Hrs	
	Volume of Tank	378	Cum	
	Assumed Depth	2.5	M	
	Area of Each Tank	151.20	sq.m	
	Propose a Circular Tank			

	Diameter of theTank	14	M	
	Solid concentration	9500	mg/l	
	sludge quantity	9849.6	kg/d	Assuming 60% removal
	Density of water	998.2		
	specific gravity	1.03		
	% of solids	6		
	volume of sludge	159.67	m^3/d	
	Assuming 3hrs of storage			
	Sludge Pocket	20.33	m^3	
Provide the Dimension of 1No PRIMARY CLARIFIER Dia as 15 m ϕ x 2.5 m SWD + 0.5 m Freeboard				

6.1.14	**FILTER FEED TANK**			
	Average Design Flow	0.025	Cum/sec	
	Hydraulic Retention time	5	hours	
	Volume of the Tank with 20% extra	450	Cum	
	Assumed Depth of Liquid column (SWD)	4	M	
	Area required for the equalization tank	112.5	Sq.m	
	Length of the Tank	14	M	
	Breadth of the Tank	9		
Provide the Dimension of Filter feed Tank 14x9x4+0.50m Freeboard				

6.1.15	**CLEAR WATER TANK**			
	Average Design Flow	0.025	Cum/sec	
	Hydraulic Retention time	4	hours	
	Volume of the Tank with 20% extra	360	Cum	
	Assumed Depth of Liquid column (SWD)	3.6	M	

	Area required for the equalization tank	100	Sq.m	
	Length of the Tank	14	M	
	Breadth of the Tank	9		
Provide the Dimension of Clear water Tank 12x8x3.6+0.50m Freeboard				

6.1.16	**SLUDGE SUMP**			
	Primary sludge			
	TSS sludge	444.6	mg/l	
	BOD	1121.4	mg/l	
	Sludge generated	3382.56	kg/d	
	Secondary sludge			
	BOD sludge	1937.78	kg/d	20% sludge generated
	Total	5320.34	kg/d	
	Density of water	998.2		
	specific gravity	1.03		
	% of solids	0.8		
	volume of sludge	646.84	m^3/d	
		26.95	Cum/hr	
	HRT	6	Hrs	
	Volume of tank	161.7091347	Cum	
	side water depth	2.1	M	
	Diameter	10	M	
Provide the sludge sump dia 10m x 2.1m height +0.50m Freeboard				

6.1.17	**SLUDGE THICKENER (GRAVITY TYPE)**			
	Total sludge	5320.34	kg/d	
	Solids loading rate	40.00	kg/sqm/day	
	Thickening area required	133.01	Sqm	
	Area of distribution chamber	10.00	%	
	Area required	1463.09	Sqm	

	provide dia	14.00	M	
	volume of sludge	646.84	m^3/d	
	side water depth	4.50		
	Actual volume	692.37	Cum	
Provide the sludge thickener dia 14m x 4.5m height +0.50m Freeboard				

6.1.18	**COMMON DELAY POND**			
	Average Design Flow	0.0347	Cum/sec	
	Hydraulic Retention time	1	hours	
	Volume of the Tank	125	Cum	
	Assumed Depth of Liquid column (SWD)	3.0	M	
	Area required for the equalization tank	41.67	Sq.m	
	Length of the Tank	5.3	M	
	Breadth of the Tank	7.95	M	
Provide the Dimension of Common Delay Pond 7.95x5.3x3+0.50m Freeboard				

6.2 INORGANIC STREAM				
6.2.1	**Capacity: Average Flow**		**0.1MLD**	
Sl. No.	**Description of Parameter**	**Value**	**Unit**	**Reference/Remarks**
a.	Quantity of Neutralised effluent	100000	LPD	
		100	Cum/day	
b.	Design Flow	100	Cum/day	
	Working hours	20	hr	
		5	Cum/hr	
		0.001389	Cum/sec	

6.2.2 Raw Effluent Characteristics				
Sl. No.	**Parameters**	**Expected Characteristics of Influent to CETP**	**Unit**	**Remarks**
1	pH	3.41		
2	BOD	116	mg/l	
3	COD	630	mg/l	
4	TSS	163	mg/l	
5	Oil&Grease	1.39	mg/l	
6	TDS	1971	mg/l	
7	Hexa Cr	0.007	mg/l	
8	Total Cr	15.48	mg/l	
9	Sulphide –S	1.80	mg/l	
10	Nickel	0.30	mg/l	
11	Zinc	8.78	mg/l	
12	Lead	0.30	mg/l	
13	Flouride	4.40	mg/l	
14	Phenolic compound	0.04	mg/l	
15	Fe	15.96	mg/l	
16	Cadmium	0.23	mg/l	
17	Nitrate-N	1.88	mg/l	
18	Copper	0.98	mg/l	
19	Manganese as Mn	1.22	mg/l	

6.2.3 Treated Effluent Characteristics				
Sl. No.	**Parameters**	**Characteristics of treated effluent**	**Unit**	**Remarks**
1	pH	6-9		
2	BOD	30	mg/l	
3	COD	250	mg/l	
4	TSS	100	mg/l	
5	Oil&Grease	10	mg/l	

6	TDS	2100	mg/l	
7	Hexa Cr	0.10	mg/l	
8	Total Cr	1.0	mg/l	
9	Sulphide –S	2.0	mg/l	
10	Nickel	3.0	mg/l	
11	Zinc	5.0	mg/l	
12	Lead	0.10	mg/l	
13	Flouride	2.0	mg/l	
14	Phenolic compound	1.0	mg/l	
15	Fe	3.0	mg/l	
16	Cadmium	0.05	mg/l	
17	Nitrate-N	10.00	mg/l	
18	Copper	3.0	mg/l	
19	Manganese as Mn	2.0	mg/l	

6.2.4	**RECEIVING CUM GRIT CHAMBER**			
	Avg design flow	5	Cum/hr	
		0.025	Cum/Sec	
	Design flow	30	Cum/hr	Considering the pumped effluent and lorry unloading qty.
	Average Retention Time	120	sec	
	Volume	1	Cum	
	Assumed Depth of flow	0.45	m	
	Area Required for Inlet chamber	2.22	Sq.m	
	Length of the tank	2.2	m	
	Breadth of the tank	1.2	m	
Provide the Dimensions of Receiving Chamber as 2.2 m x 1.2 m x 0.45 m SWD + 0.3 m Freeboard with centre partition for providing vertical screen bars.				

6.2.5	**OIL & GREASE TRAP**			
	Average Design Flow	30.00000	Cum/hr	
	Hydraulic Retention time	10	mins	

	Volume of the Tank	5	Cum	
	Assume 500m^2 surface area for a waste water flow of 1m^3/sec			
	Area required	4.167	m^2	
	Length of the Tank	2.55	m	
	Breadth of the Tank	1.7	m	
	Depth	1.2	m	
Provide oil and grease trap of 2.55*1.7*1.50 including Freeboard				

6.2.6	**EQUALIZATION TANK**			
	Average Design Flow	0.00139	Cum/sec	
	Hydraulic Retention time	20	hours	
	Volume of the Tank with 20% extra	100	Cum	
	Assumed Depth of Liquid column (SWD)	3.5	m	
	Area required for the equalization tank	28.57	Sq.m	
	Length of the Tank	7	m	
	Breadth of the Tank	4.5		
Provide the Dimension of Equalization Tank 7*4.50*3.5+0.30m Freeboard				

6.2.7	**RAPID FLASH MIXER**			
	Average Design Flow	0.00139	Cum/sec	
	Hydraulic Retention time	30	sec	
	Volume of the Tank	0.0417	Cum	
	Height of the tank (assume)	1.5dia	m	
	Diameter of the tank	0.75	m	
	Height	1.2	m	
Provide Rapid Flash Mixer of 0.75m dia, 1.2m height including Freeboard				

6.2.8	**HORIZONTAL FLOW BAFFLED FLOCULATOR**			
	Average Design Flow	0.001389	Cum/sec	
	Hydraulic Retention time	30	mins	
	Volume of the Tank	2.5	Cum	
	Water depth	0.75	m	

	Velocity	0.1	m	
	Thickness of baffle	0.1	m	
	Length of the baffle	1	m	
	No. of baffle's on one side	3	Nos.	
	Total no. of flow channels	6	Nos.	
	Spacing between the baffle's	0.5	m	
	Clear distance between end of the baffle and wall	0.75	m	
	Total length of the floculator	3.5	m	
	Breadth	1.75	m	
	Volume	4.3125	cum	
	Actual detention time	51.75	>30mins	
Provide Horizontal flow baffled floculator of 3.5m*1.75m*1.05m height including Freeboard.				

6.2.9	**CLARIFIER 1**			
	Average Design Flow	5	Cum/hr	
	Retention Period	8	hrs	
	Volume of Tank	40	Cum	
	Assumed Depth	3	m	
	Area of Each Tank	13.33	sq.m	
	Propose a Circular Tank			
	Diameter of theTank	4.5	m	
	TSS	687.6	mg/l	FS-2,60% removal
	TDS	3503.64	mg/l	FS-2,30% removal
	Total concentration	4191.24	mg/l	
	Say	4200.00	mg/l	
	Sludge generated	1814.4	kg/d	
	lime added	40	kg/d	
	Total sludge generated	1854.4	kg/d	
	Density of water	998.2		
	specific gravity	1.2		
	% of solids	6		
	volume of sludge	25.80	m^3/d	
	Assuming 2hours of storage			

	Sludge Pocket	2.333	m^3	
Provide the Dimension of CLARIFIER Dia as 4.5 m ϕ x 3m SWD + 1.0m for percipation sludge +0.5 m Freeboard +sludge pocket 1.0m depth				

6.2.10	**CLARIFIER 2**			
	Average Design Flow	5	Cum/hr	
	Retention Period	8	hrs	
	Volume of Tank	40	Cum	
	Assumed Depth	3	m	
	Area of Each Tank	13.33	sq.m	
	Propose a Circular Tank			
	Diameter of theTank	4.5	m	
	TSS	458.4	mg/l	FS-2,40% removal
	TDS	4671.52	mg/l	FS-2,40% removal
	Total concentration	5129.92	mg/l	
		5200		
	Sludge generated	2246.4	kg/d	
	lime added	50	kg/d	
	Total sludge generated	2296.4	kg/d	
	Density of water	998.2		
	specific gravity	1.23		
	% of solids	6		
	volume of sludge	31.17	m^3/d	
	Assuming 2hrs of storage			
	Sludge Pocket	2.8	m^3	
Provide the Dimension of CLARIFIER Dia as 4.5 m ϕ x 3m SWD + 1.0m for percipation sludge +0.5 m Freeboard +sludge pocket 1.2m depth.				

6.2.11	**CLARIFIER 3**			
	Average Design Flow	5	Cum/hr	
	Retention Period	8	hrs	
	Volume of Tank	40	Cum	
	Assumed Depth	3	m	
	Area of Each Tank	13.33	sq.m	

	Propose a Circular Tank			
	Diameter of theTank	4.5	m	
	TDS	3503.64	mg/l	FS-2,30% removal
	Say	3510	mg/l	
	Sludge generated	1516.32	kg/d	
	lime added	390	kg/d	
	Total sludge generated	1906.32	kg/d	
	Density of water	998.2		
	specific gravity	1.32		
	% of solids	6		
	volume of sludge	24.11	m^3/d	
	Assuming 2hrs of storage			
	Sludge Pocket	2.33	m^3	
Provide the Dimension of CLARIFIER Dia as 4.5 m ϕ x 3m SWD + 1.0m for percipation sludge +0.5 m Freeboard +sludge pocket 1.0m depth.				

6.2.12	**NUETRALISATION TANK**			
	Average Design Flow	5	Cum/hr	
	Retention Period	8	hrs	
	Volume of Tank	40	Cum	
	Assumed Depth	3	m	
	Area of Each Tank	13.33	sq.m	
	Propose a Circular Tank			
	Diameter of theTank	4.5	m	
	Provide the Dimension of nuetralisation tank Dia as 4.5 m ϕ x 3m SWD +0.5 m Freeboard +sludge pocket 1.0m depth.			
6.2.13	**FILTER FEED TANK**			
	Average Design Flow	0.001389	Cum/sec	
	Hydraulic Retention time	4	hours	
	Volume of the Tank with 20% extra	20	Cum	
	Assumed Depth of Liquid column (SWD)	2.5	m	
	Area required for the equalization tank	8	Sq.m	
	Length of the Tank	4	m	
	Breadth of the Tank	2.5	m	
	Provide the Dimension of Filter feed Tank 4*2.5*2.5+0.3m Freeboard			

6.2.14	**TREATED WATER TANK**			
	Average Design Flow	0.00139	Cum/sec	
	Hydraulic Retention time	2	hours	
	Volume of the Tank with 20% extra	10	Cum	
	Assumed Depth of Liquid column (SWD)	2	m	
	Area required for the equalization tank	5	Sq.m	
	Length of the Tank	3	m	
	Breadth of the Tank	2	m	
Provide the Dimension of Clear water Tank 3*2*2+0.30m Freeboard				

6.3 AROMATICS &CHEMICAL STREAM				
	Capacity: Average Flow		**0.1MLD**	
Sl No	**Description of Parameter**	**Value**	**Unit**	**Reference/Remarks**
a.	Quantity of Neutralised effluent	100000	LPD	
		100	Cum/day	
b.	Design Flow	100	Cum/day	
	Working hours	20	hr	
		5	Cum/hr	
		0.00138889	Cum/sec	

6.3.1 RAW WATER EFFLUENT CHARACTERISTICS

Sl.No.	Parameters	Max permissible value	Units	Remarks
1	pH	6.55		
2	BOD	169	mg/l	
3	COD	1933	mg/l	
4	TSS	173	mg/l	
5	Oil&Grease	3.0	mg/l	
6	TDS	2086	mg/l	
7	Hexa Chromium	0.005	mg/l	
8	Sulphide as S	20.6	mg/l	
9	Flouride	0.113	mg/l	

6.3.2TREATED WATER EFFLUENT CHARACTERISTICS

Sl.No.	Parameters	Max permissible value	Units	Remarks
1	pH	6-9		
2	BOD	30	mg/l	
3	COD	250	mg/l	
4	TSS	100	mg/l	
5	Oil&Grease	10	mg/l	
6	TDS	2100	mg/l	
7	Hexa chromium	0.10	mg/l	
8	Sulphide as S	1.0	mg/l	
9	Flouride	2.0	mg/l	

6.3.3	**RECEIVING CUM GRIT CHAMBER**			
	Avg design flow	5	Cum/hr	
		0.025	Cum/Sec	
	Design flow	83	Cum/hr	Considering the pumped effluent and lorry unloading qty.
	Average Retention Time	120	sec	
	Volume	2.77	Cum	
	Assumed Depth of flow	0.5	m	
	Area Required for Inlet chamber	5.53	Sq.m	
	Length of the tank	3	m	
	Breadth of the tank	2	m	
Provide the Dimensions of Receiving Chamber as 3 m x 2 m x 0.5 m SWD + 0.3 m Freeboard with centre partition for providing vertical screen bars.				

6.3.4	**OIL & GREASE TRAP**			
	Average Design Flow	83.00000	Cum/hr	
	Hydraulic Retention time	10	mins	
	Volume of the Tank	13.8333333	Cum	

	Assume 500m^2 surface area for a waste water flow of 1m^3/sec			
	Area required	11.528	m^2	
	Length of the Tank	4.2	m	
	Breadth of the Tank	2.8	m	
	Depth	1.2	m	
Provide oil and grease trap of 4.2*2.8*1.50 including Freeboard				

6.3.5	**EQUALIZATION TANK**			
	Average Design Flow	0.00139	Cum/sec	
	Hydraulic Retention time	20	Hours	
	Volume of the Tank with 20% extra	100	Cum	
	Assumed Depth of Liquid column (SWD)	3.5	M	
	Area required for the equalization tank	28.57	Sq.m	
	Length of the Tank	7	m	
	Breadth of the Tank	4.5		
Provide the Dimension of Equalization Tank 7*4.50*3.5+0.30m Freeboard				

6.3.6	**RAPID FLASH MIXER**			
	Average Design Flow	0.00139	Cum/sec	
	Hydraulic Retention time	30	sec	
	Volume of the Tank	0.0417	Cum	
	Height of the tank (assume)	1.5dia	m	
	Diameter of the tank	0.75	m	
	Height	1.2	m	
Provide Rapid Flash Mixer of 0.75m dia, 1.2m height including Freeboard				

6.3.7	**HORIZONTAL FLOW BAFFLED FLOCULATOR**			
	Average Design Flow	0.00138889	Cum/sec	
	Hydraulic Retention time	30	mins	
	Volume of the Tank	2.5	Cum	
	Water depth	0.75	m	
	Velocity	0.1	m	
	Thickness of baffle	0.1	m	
	Length of the baffle	1	m	

	No. of baffle's on one side	3	Nos.	
	Total no. of flow channels	6	Nos.	
	Spacing between the baffle's	0.5	m	
	Clear distance between end of the baffle and wall	0.75	m	
	Total length of the floculator	3.5	m	
	Breadth	1.75	m	
	Volume	4.3125	cum	
	Actual detention time	51.75	>30mins	
Provide Horizontal flow baffled flocculant of 3.5m*1.75m*1.05m height including Freeboard.				

6.3.8	**PRIMARY CLARIFIER**			
	Average Design Flow	5	Cum/hr	
	Retention Period	8	hrs	
	Volume of Tank	40	Cum	
	Assumed Depth	3	m	
	Area of Each Tank	13.33	sq.m	
	Propose a Circular Tank			
	Diameter of theTank	4.5	m	
	TSS	192	mg/l	
	TDS	1318	mg/l	
	Total concentration	1510	mg/l	FS-2,60% removal
	Sludge generated	782.784	kg/d	
	Lime added	20	kg/d	
	Total sludge generated	802.784	kg/d	
	Density of water	998.2		
	Specific gravity	1.2		
	% of solids	6		
	Volume of sludge	11.17	m^3/d	
	Assuming 2hrs of storage			
	Sludge Pocket	2.333	m^3	
Provide the Dimension of CLARIFIER Dia as 4.5 m ϕ x 3m SWD +0.5 m Freeboard +sludge pocket 1.0m depth				

6.3.9	**EC FEED TANK**			
	Average Design Flow	0.00138889	Cum/sec	
	Hydraulic Retention time	4	hours	
	Volume of the Tank with 20% extra	20	Cum	

	Assumed Depth of Liquid column (SWD)	2.5	m	
	Area required for the equalization tank	8	Sq.m	
	Length of the Tank	4	m	
	Breadth of the Tank	2.5	m	
	Provide the Dimension of EC feed Tank 4*2.5*2.5+0.3m Freeboard			

6.3.10	**SECONDARY CLARIFIER**			
	Average Design Flow	5	Cum/hr	
	Retention Period	8	hrs	
	Volume of Tank	40	Cum	
	Assumed Depth	3	m	
	Area of Each Tank	13.33	sq.m	
	Propose a Circular Tank			
	Diameter of theTank	4.5	m	
	Provide the Dimension of CLARIFIER Dia as 4.5 m ϕ x 3m SWD + 1.0m for percipation sludge +0.5 m Freeboard +sludge pocket 1.0m depth.			

6.3.11	**FILTER FEED TANK**			
	Average Design Flow	0	Cum/sec	
	Hydraulic Retention time	4	hours	
	Volume of the Tank with 20% extra	0	Cum	
	Assumed Depth of Liquid column (SWD)	2.5	m	
	Area required for the equalization tank	0	Sq.m	
	Length of the Tank	4	m	
	Breadth of the Tank	2.5	m	
Provide the Dimension of Filter feed Tank 4*2.5*2.5+0.3m Freeboard				

6.3.12	**TREATED WATER TANK**			
	Average Design Flow	0.00139	Cum/sec	
	Hydraulic Retention time	2	hours	
	Volume of the Tank with 20% extra	10	Cum	
	Assumed Depth of Liquid column (SWD)	2	m	

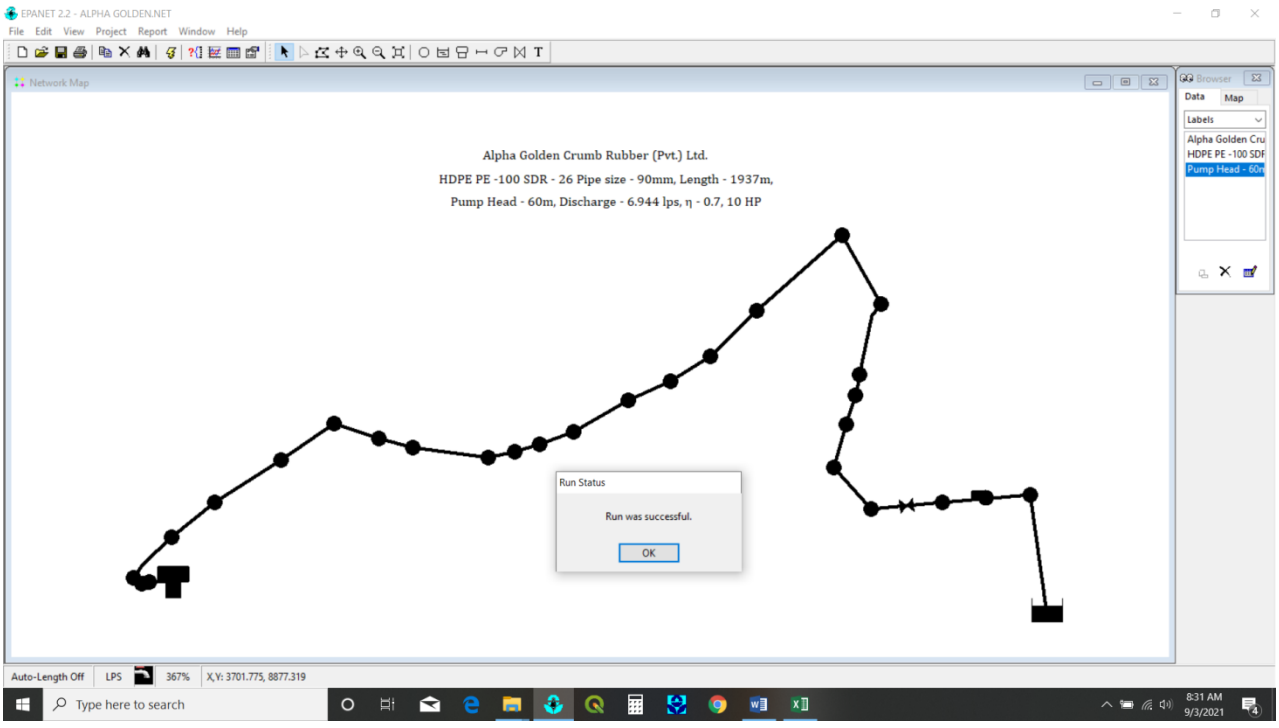
	Area required for the equalization tank	5	Sq.m	
	Length of the Tank	3	m	
	Breadth of the Tank	2	m	
Provide the Dimension of Clear water Tank 3*2*2+0.30m Freeboard				

The detailed structural design of each civil component and proto type CETP have to be carried out before execution.

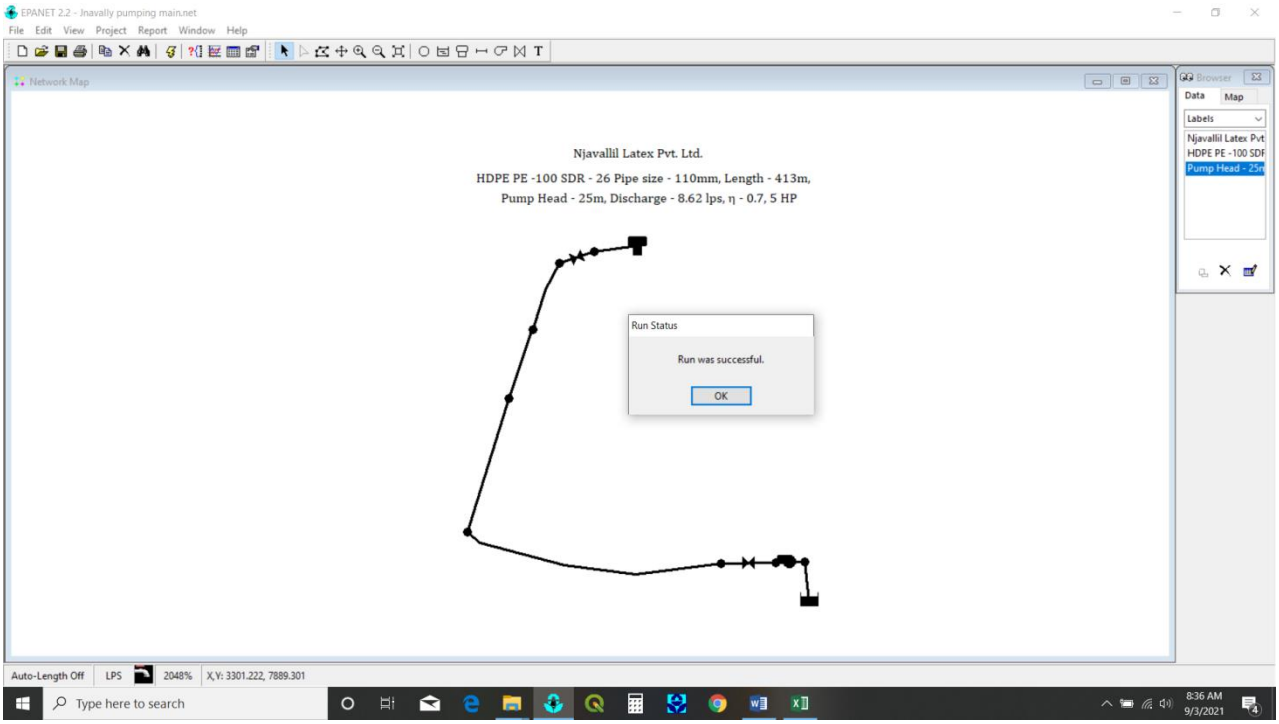
6.4 DESIGN OF PIPED NETWORK TO TRANSFER EFFLUENT FROM INDUSTRIES TO CETP

At present there are 336 industries are functioning in Edayar industrial area. It is understood that out of these industries, 68 Nos. are generating trade effluent. On further investigation, only 13 Nos. of industries are generating considerable amount of trade effluents (greater than or equal to 10 kLD). It is decided to convey effluents of these industries through pipes and effluents of the rest of industries are conveying through lorry transport. Industries are grouped into three categories and their piped networks are done separately with EPANET software and analysis reports are given in Appendix 8.

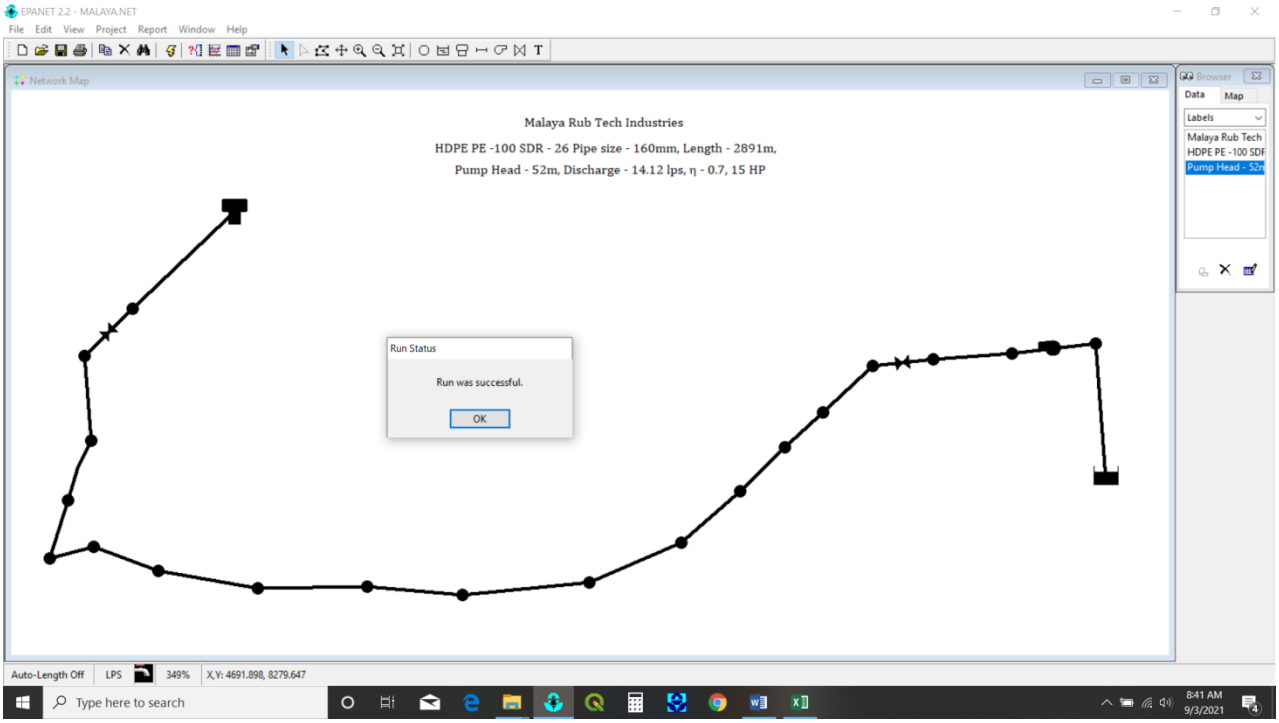
6.4.1 Alpha Golden Crumb Rubber (Pvt.) Ltd.



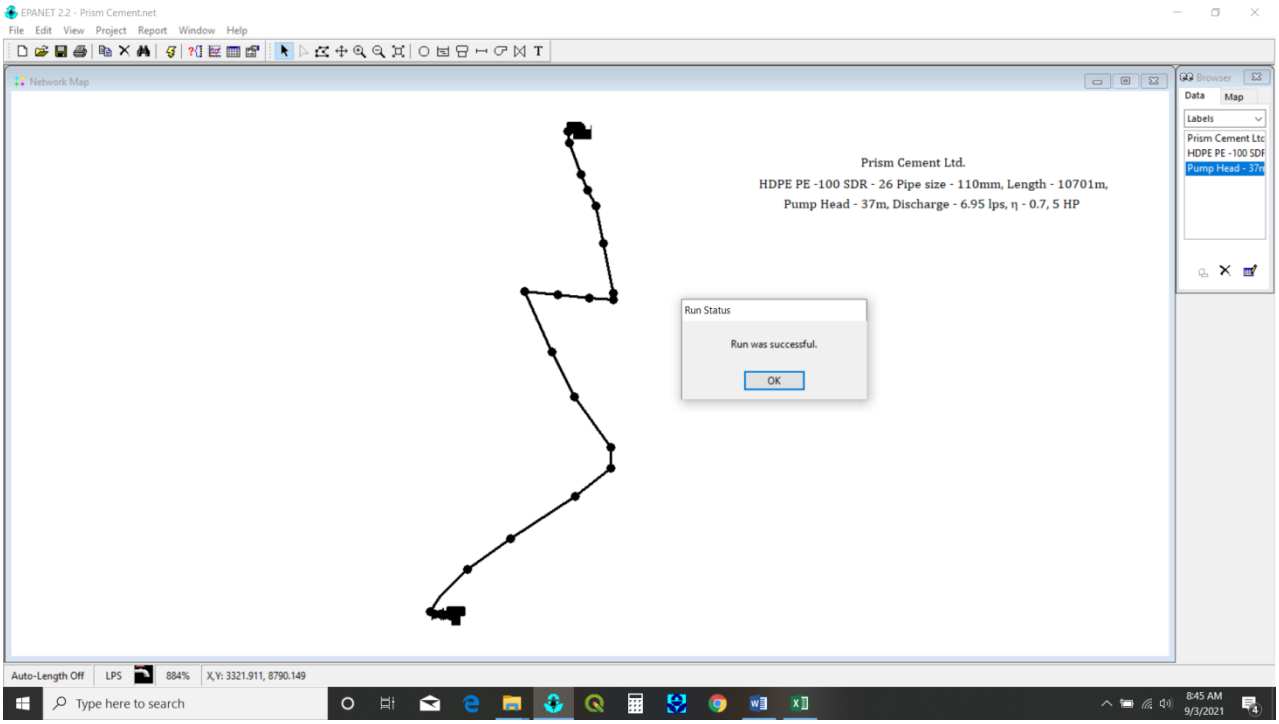
6.4.2 Njavallil Latex Pvt. Ltd.



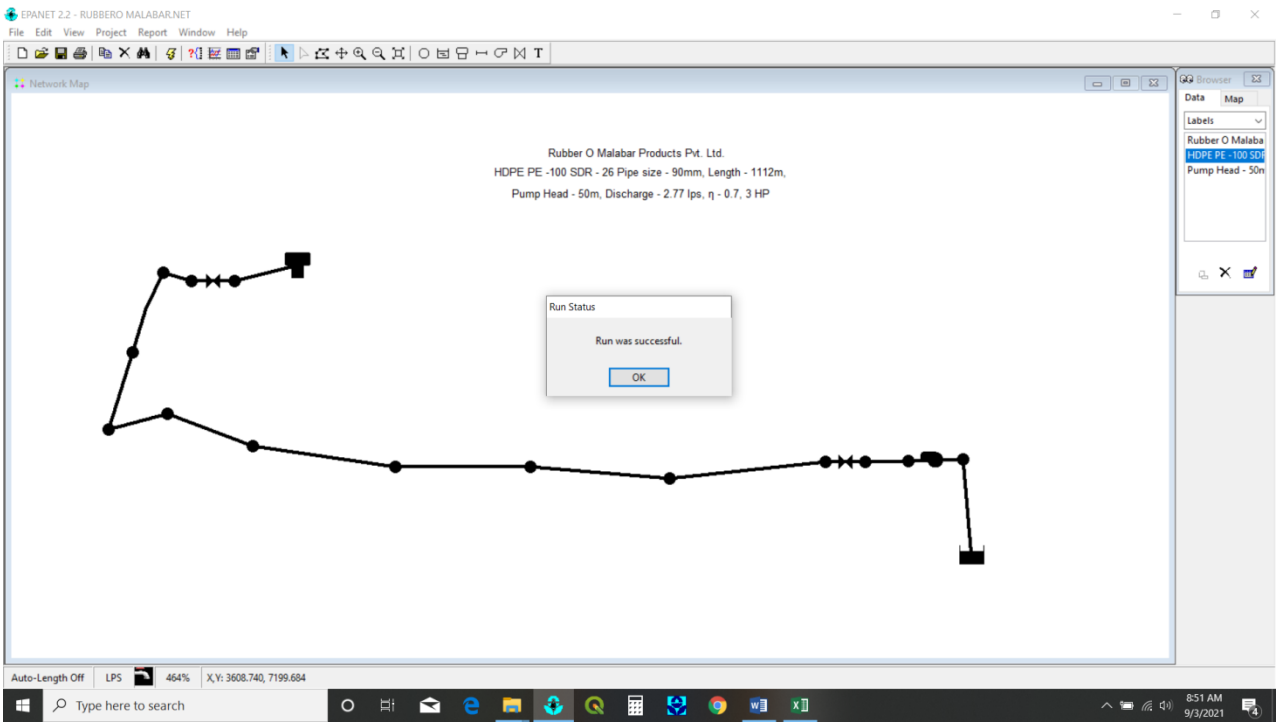
6.4.3 Malaya Rub Tech Industries



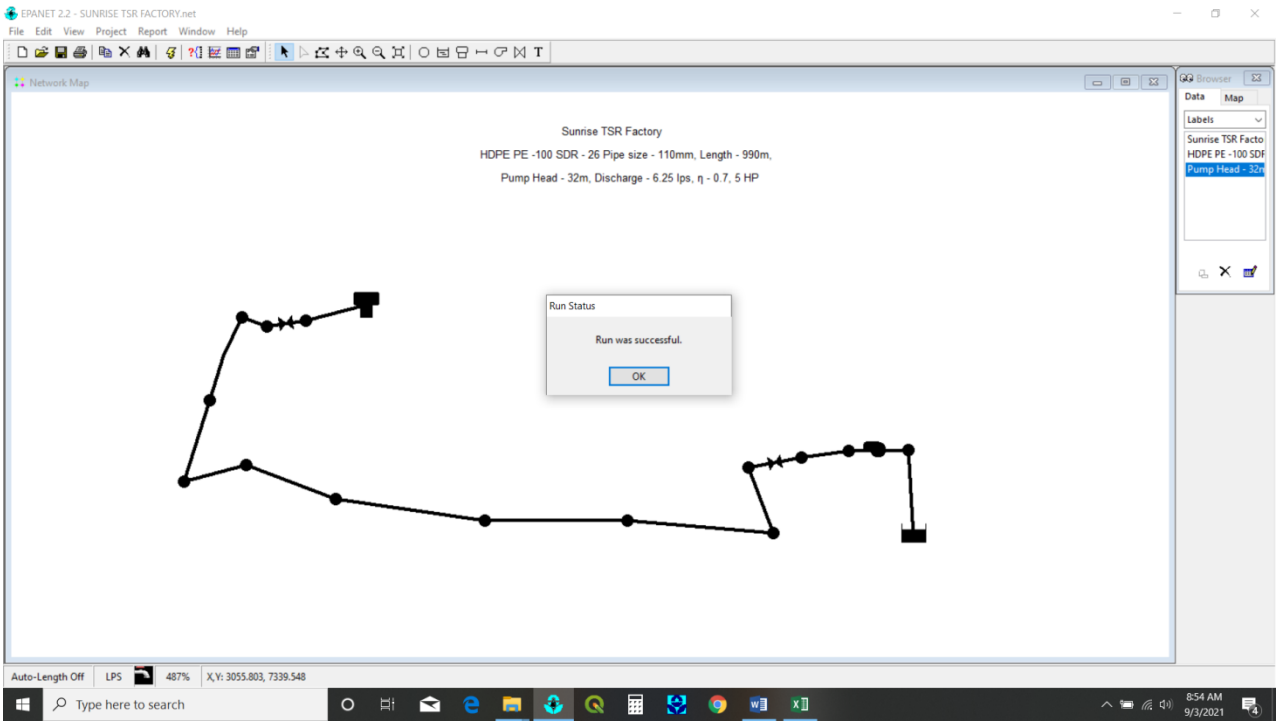
6.4.4 Prism Cement Ltd.



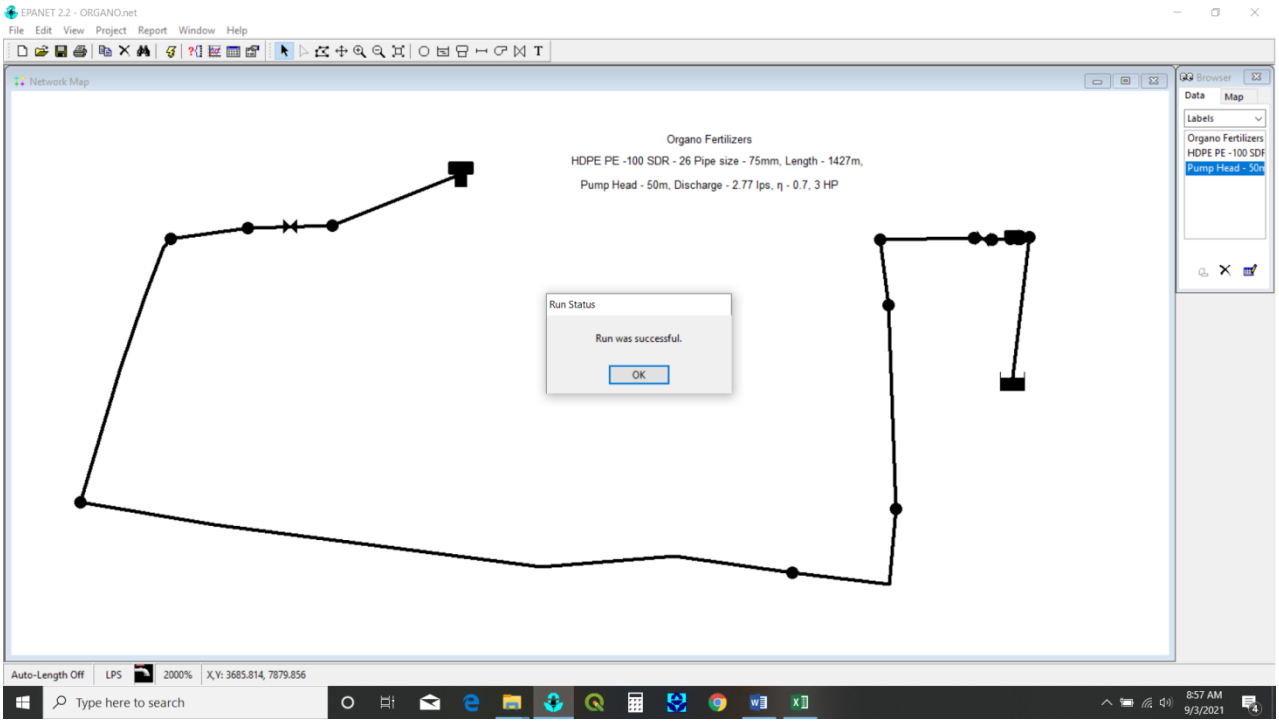
6.4.5 Rubber O Malabar



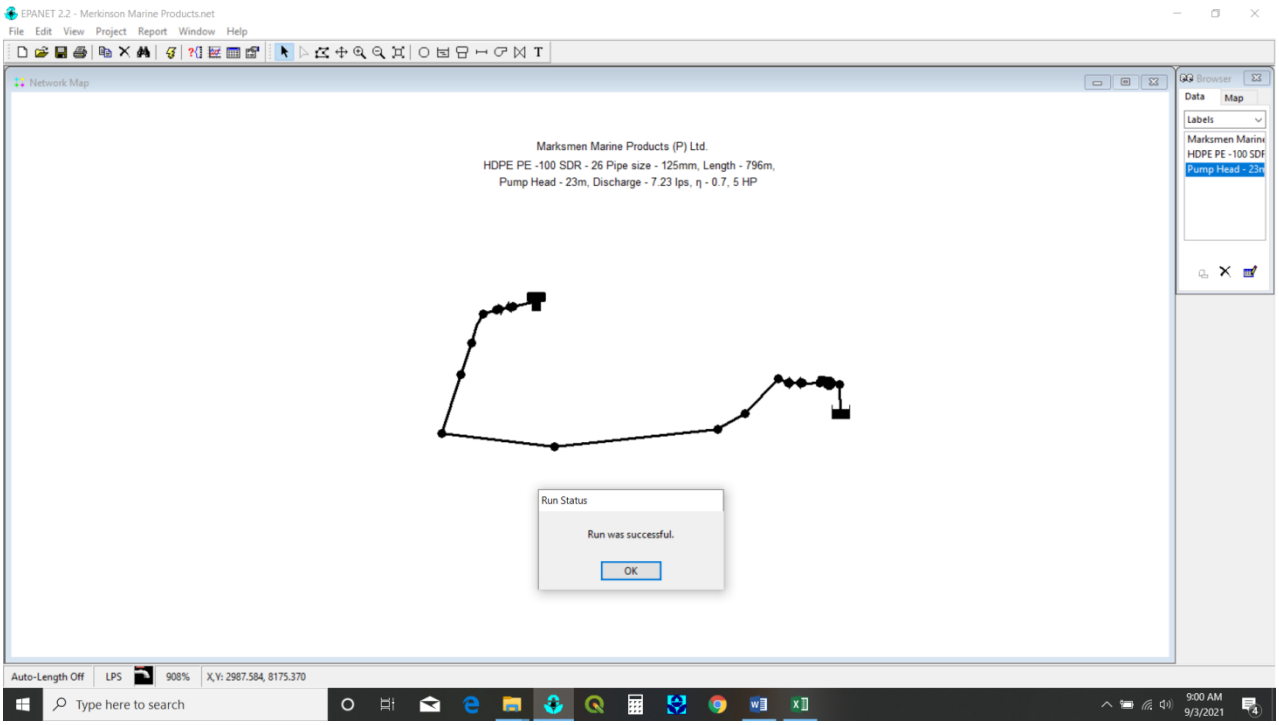
6.4.6 Sunrise TSR Factory



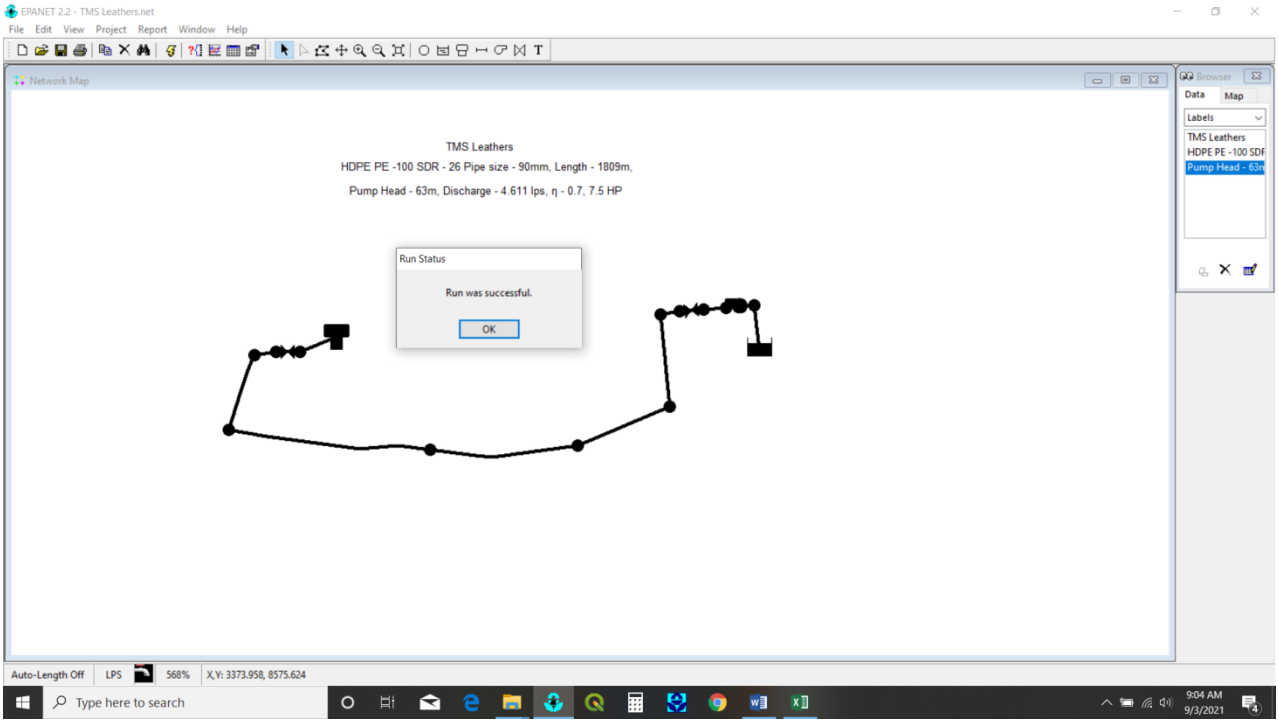
6.4.7 Organo Fertilizers Ltd.



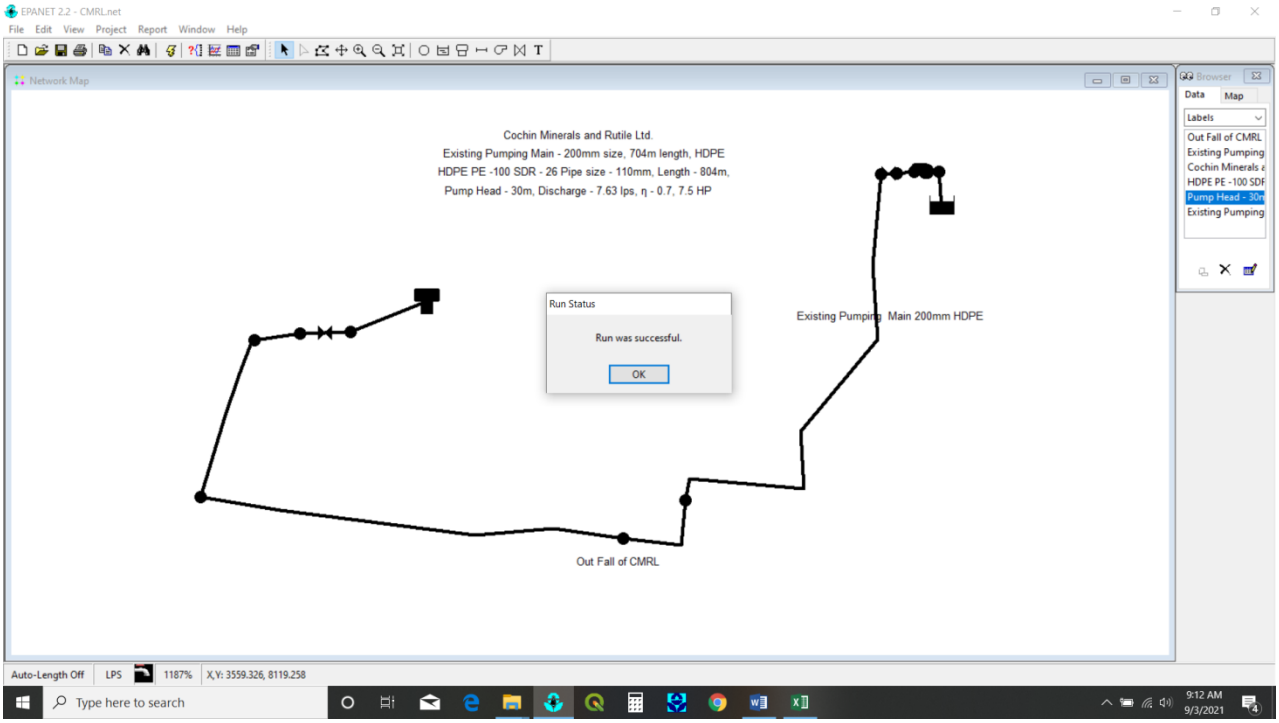
6.4.8 Marksmen Marine Products (P) Ltd.



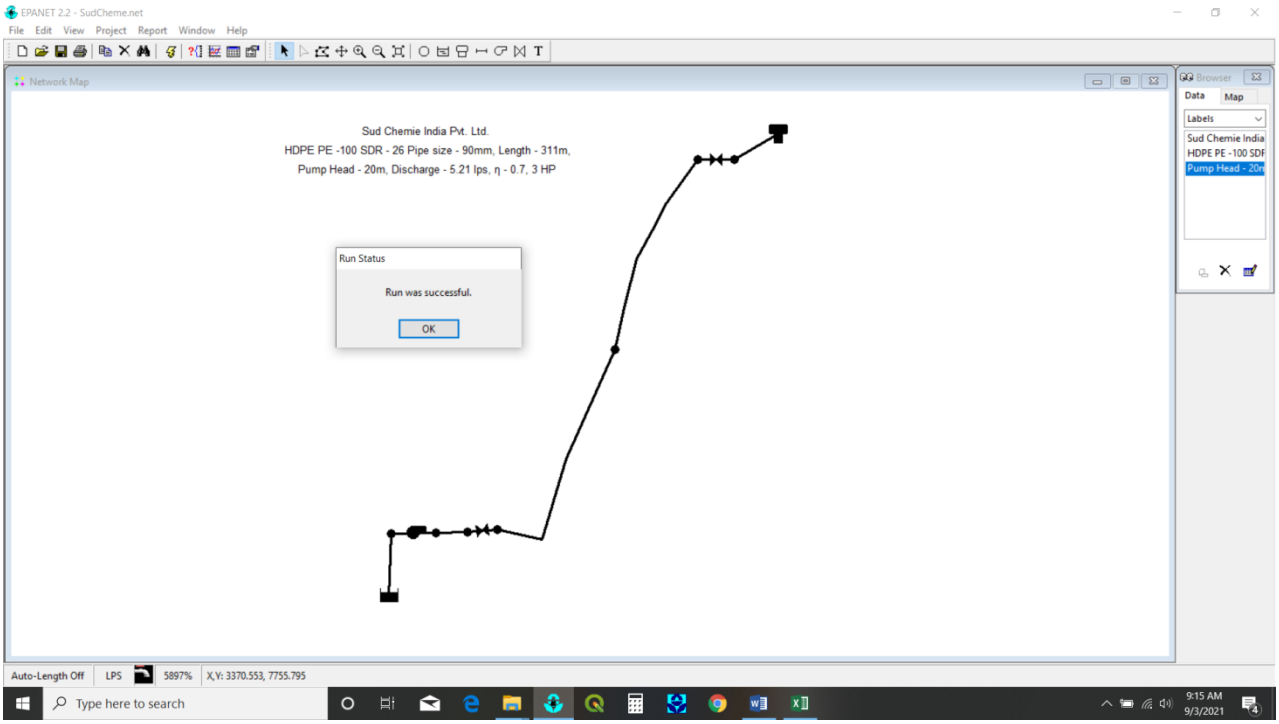
6.4.9 TMS Leathers



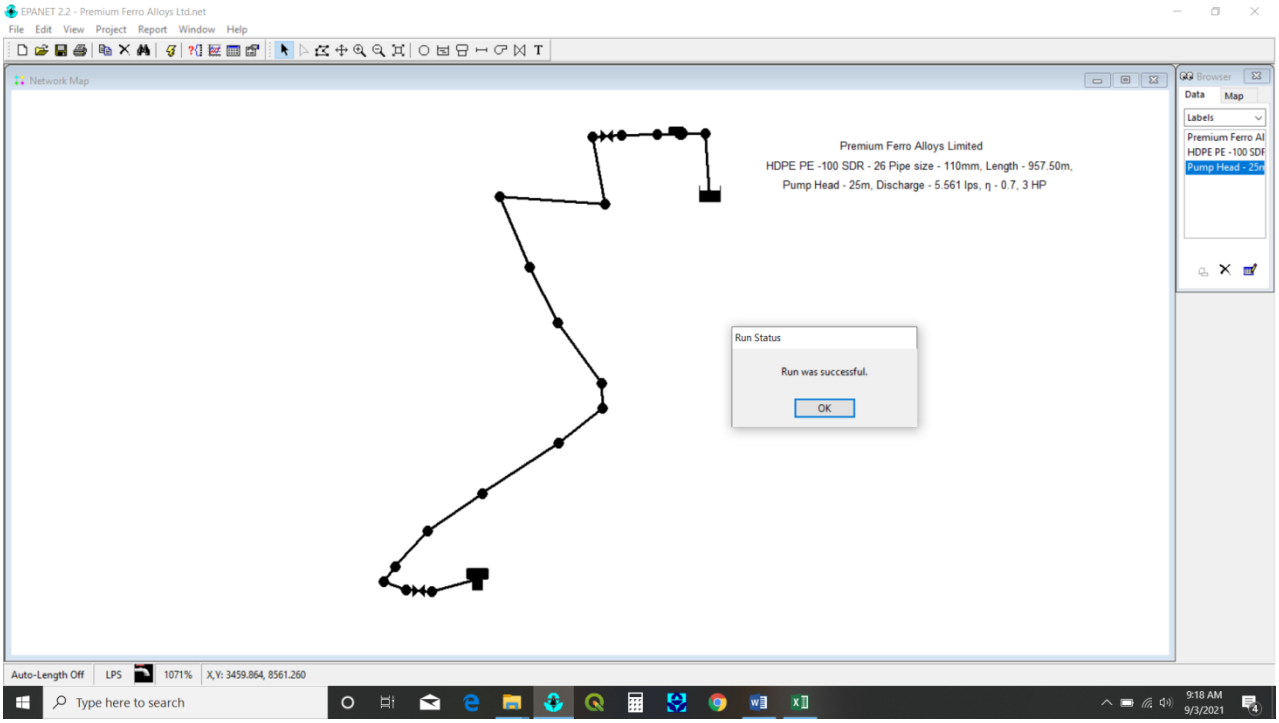
6.4.10 Cochin Metals and Rutiles Ltd.



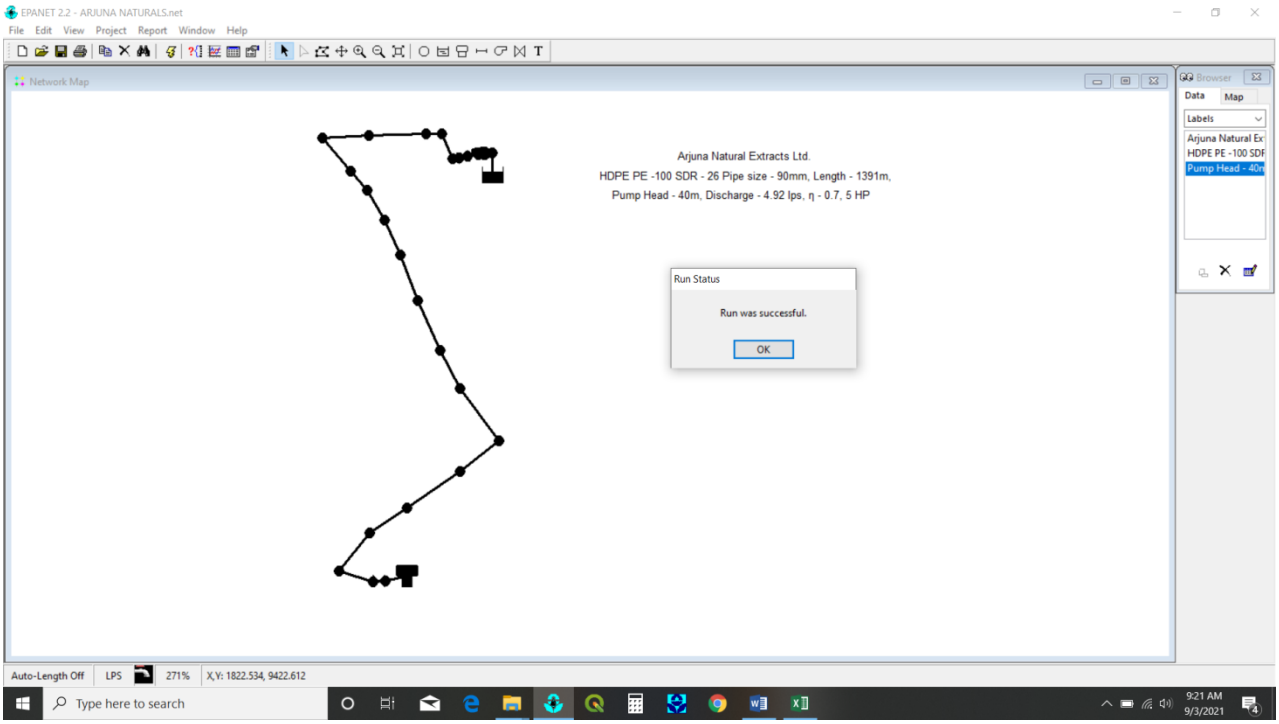
6.4.11 SudChemei India Pvt. Ltd.



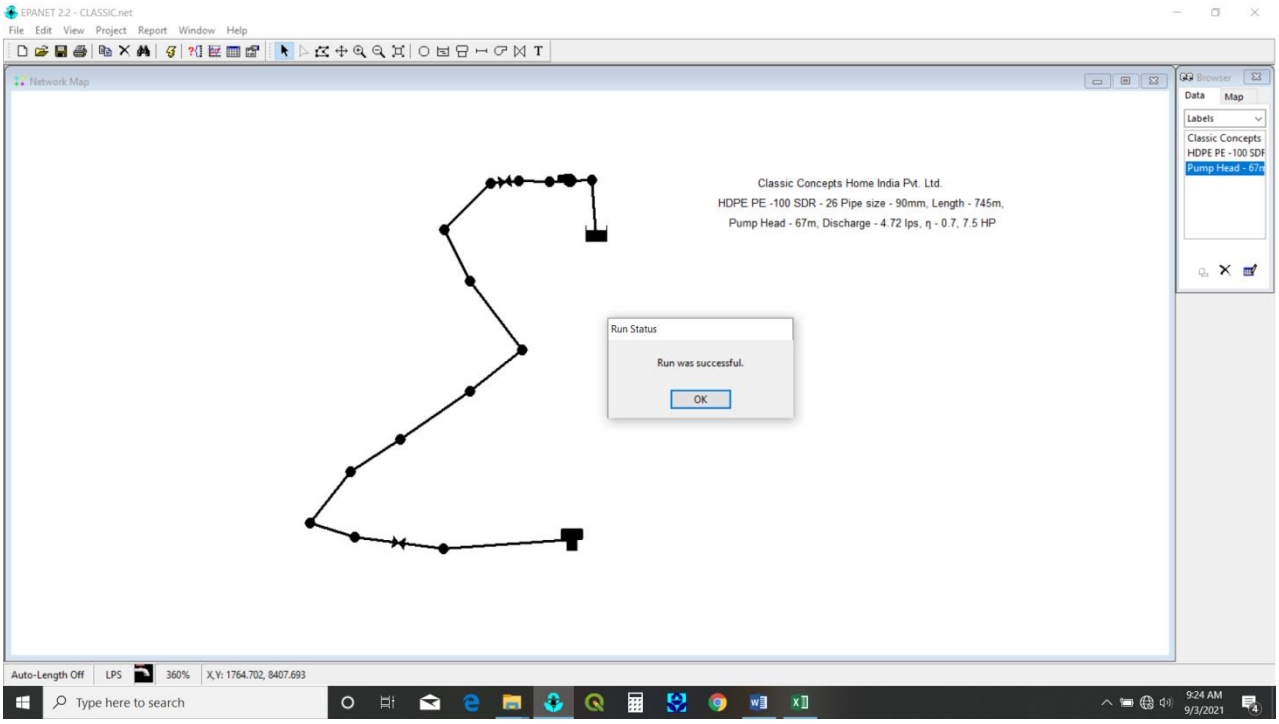
6.4.12 Premium Ferro Alloys Ltd.



6.4.12 Arjuna Natural Extracts Ltd.



6.4.13 Classic Home Applies Ltd.



6.5 ELECTROMECHANICAL&INSTRUMENTATION EQUIPMENT

Common Items

1. Real Time TOC (Total Organic Carbon) meter – 17 Nos.
Real Time pH sensors – 17 Nos.
Real Time Conductivity Meter –17 Nos.
pH sensing pneumatic control valve – 17 Nos.
Ultrasonic Flow meters – 17 Nos.
For Lorry Transport
Portable Type
TOC (Total Organic Carbon) meter – 5 Nos.
pH meter – 5 Nos.
Conductivity Meter – 5 Nos.
Flow meter (Ultra Sonic, clamp on type) - 5 Nos
2. Instrumentation Air Compressor (10HP) – 2 Nos.
3. Induce draught cooling tower – 1No.
4. Common Delay Pond – Pump to transfer treated effluent to river (1W+1S) - 2 Nos.
5. Chemical House
Fork lift (2-3T, Voltas/Godrej/Komatsu) – 1 No.
Hoist (500kg capacity) – 1 No.
6. Fire & Safety Equipment – 1Set.
PPE Kits - 20 Nos.
7. Laboratory Equipment - 1 Unit

Organic Stream/Biological Stream

1. Screen Chamber
(a) Coarse Screen – Manual Cleaning - 2Nos.
(b) Fine Screen – Mechanical cleaning - 2Nos.
2. Oil Trap
Oil Skimmer –1 No.
5 LPH Single Belt, Single Scrapper
Belt Width -100mm
Belt material – PU Transparent

Belt Depth 1500 mm
Motor Power – 25 W
Supply Voltage: 415 V AC

3. Equalization Tank

Real Time pH Sensor	– 1 No.
pH sensing pneumatic control valve (Each for HCl and NaOH)	– 2 Nos.
Fine bubble disc (150mm OD) diffuser 5-8 m^3/h Fine Bubble Disc diffuser with 150 mm OD PTFE with ABS Body	
Level controlled VFD effluent Transfer Pump 125 m^3/hr at 10 m head (1W+1S) 3 phase / 50 Hz P - Type Impeller Submersible Effluent Transfer PumpSS316 Impeller	– 2Nos.
Flow meter (Magnetic/Ultrasonic type) 200mm	– 1 No.

4. Flash Mixing Chamber

Pneumatic control valves	– 3 Nos.
Agitator& accessories,	
Agitator motor (0.5HP)	– 1 No.

5. Primary Settling Tank

Rake motor (2HP)	– 1 No.
Lifting Motor (2HP)	– 1 No.
Worm type gear box (1:70)	– 1 No.
Bridge with sludge scrapper	– 1 No.
Center bearing	– 1 No.
Underflow/Sludge Transfer Pump (variable frequency drive Type) .(1w +1s)	– 2 No.
Underflow holding Tank	
Flow meter (Magnetic/Ultrasonic type)	– 1 No.
Flow control valve	- 1 No.
Level sensor in Underflow holding Tank	– 1 No.

6. Moving Bed Bio Reactor (MBBR) Tank

MBBR Media – 1550 m^3
Size: Ø25x4 mm
Hole Numbers: 64
Efficient Surface Area-1200m^2/m^3

Density :0.96-0.98 gm/cc
Packing Numbers: >2,10,000 / m^3
Porosity :> 85%
Membrane Forming Time : 3-15 days
Lifespan :> 15 Years
BOD Oxidation Efficiency :2500 – 20,000 ppm
COD Oxidation Efficiency :2500 – 25000 ppm
Applicable Temperature :5-60 ° C

6.1 Air Blower with included Accessories – 20 Nos.
Tri Lobe Positive Displacement Blower
Lubrication: Oil splash lubricated at gear end.
Grease lubricated at drive end.
Seals: Single lip seals for air blowers and exhausters.
Flow rate: 9758 m^3/hr
Casing: Close grained cast iron. Ribbed for strength.
Head-plates: Close grained cast iron. Machined for accurate bearing location and impeller alignment.
Rotors: Cast iron with pressed-in steel shafts.
Gears: Ground and hardened alloy steel spur gears.
Bearings: Anti-friction bearings, retained at gear end to allow accurate setting of gear end clearance between head-plate and impellers.

6.2 Air Blower Motor – 20 Nos.
3 Phase Induction motor, Speed - 1500 rpm,
Foot mounted, 25 HP/18.74 kW, Cast Iron Body

6.3 Screen for preventing MBBR media flowing form tank – 3 Nos.

6.4 Control valve – 3 Nos. (Alum, Lime &Poly Electrolyte)

7. Secondary Settling Tank

Rake motor – 1 No.
Lifting Motor – 1 No.
Worm type gear box – 1 No.
Bridge with sludge scrapper – 1 No.
Center bearing – 1 No.
Underflow/Sludge Transfer Pump
(variable frequency drive) (1W+1S) – 2 Nos.

Underflow holding Tank

Flow meter (Magnetic/Ultrasonic type) – 1 No.

Underflow pneumatic control valve – 1 No.

Level sensor in Underflow holding Tank – 1 No.

8. Filter Feed Tank

Filter Feed Pump (1W+1S) – 2 Nos.

Φ3.5 m x 1.5 m height

3 Phase Level sensing VFD Centrifugal Pump,

100 m^3/hr @ 3 bar pressure, Cast Iron Body

SS 304/SS316 impeller.

9. Pressure Sand Filter – 1 No.

3.5 m x 1.5 m height

(Maximum Pressure – 300 PSI)

With all accessories including MS pipe Manifolds,

SS304 EPDM Butterfly valves (5 Nos),

Distributor and VacuumGauge, Graded Sand, Silex

andPebbles filling 60%of the total volume.

10.Activated Carbon Filter – 1 No.

Φ3.5 m x 1.5 m height (Maximum

Pressure – 300 PSI) with all accessories

including MS pipe Manifolds, SS304

EPDM Butterfly valves (5 Nos), Distributor

and VacuumGauge. Activated CarbonIV 900

(50%) and Supporting Sand media (10%)

13. Sludge Sump

Mixer(Φ10m x 2m) – 1 No.

Agitator (Shaft, blade, gear box, motor) – 2 Nos.

Sludge pump (ODS) (1W+1S) – 2 Nos.

Dozing control valve (Poly Elecrolyte) – 1 No.

Rapid mixing Chamber – 1No.

14. Sludge Thickner

Scraper, bridge, lifting and rake motor – 1No.

Under flow pump (ODS) (1W+1S) – 2 Nos.

Rake motor (5HP) – 1 No.

Lifting Motor – 1 No.

Worm type gear box – 1 No.

Bridge with sludge scrapper – 1 No.

Center bearing – 1 No.

15.Treated water tank

Pump for pumping treated water to delay pond – 1No.
70 m^3/h at 10 m head (1W+1S)
3 phase / 50 Hz P - Type Impeller Submersible
Treated water Transfer Pump SS316 Impeller

16.Delay Pond

Pump for pumping treated water from delay pond to river – 1No.
Pump for re-circulating treated water to equalization tank if parameters are not achieved (TMS Leathers) – 1 No.
5 m^3/h at 10 m head (1W+1S)
3 phase / 50 Hz P - Type Impeller Submersible

Inorganic Stream (HMS)

1. Screen Chamber

(a) Coarse Screen
(b) Fine Screen
Stainless steel make, 10mm spacing between bars

2. Oil Trap

Oil Skimmer – 1 No.
2 LPH Single Belt, Single Scrapper
Belt Width -100mm
Belt material – PU Transparent
Belt Depth 1500 mm
Motor Power – 25 W
Supply Voltage: 415 V AC

3. Equalization Tank

Real Time pH Sensor – 1 No.
pH sensing pneumatic control valve – 2 Nos.
(Each for HCl and NaOH)
Level controlled VFD effluent Transfer Pump – 1No.
Three Phase 440V, 50Hz, 2.0HPPower ,
CI impeller with cast iron casing, Maximum flow rate,
30m^3/h, Delivery up to 30 meter, 7 meter suction lift,

Permanent split capacitor (CSR) incorporated with thermal cut out relay (Motor Protector).Suction Dia 32mm, Delivery Dia 32mm**Make: Crompton/Kirloskar**	
Flow meter (Magnetic/Ultrasonic type) 150mm	– 1 No.
4. Flash Mixing Chamber	
Pneumatic control valves	– 2 Nos.
Agitator, Agitator motor	– 1 No.
Motor-3 phase AC 1 HP 1440 rpm squirrel cage induction motor, SS316 blade and shaft, dia-750mm.	
5. 1st Settling Tank	
pH sensing pneumatic control valve	– 2 Nos.
Rake motor	– 1 No.
Lifting Motor	– 1 No.
Worm type gear box	– 1 No.
Bridge with sludge scrapper	– 1 No.
Center bearing	– 1 No.
Underflow/Sludge Transfer Pump (variable frequency drive .(1w +1s)	– 2 Nos.
Underflow holding Tank – Flow meter (Magnetic/Ultrasonic type) 150mm	– 1 No.
Flow control valve 150mm	- 1 No.
6. 2nd Settling Tank	
pH sensing pneumatic control valve	– 2 Nos.
Rake motor	– 1 No.
Lifting Motor	– 1 No.
Worm type gear box	– 1 No.
Bridge with sludge scrapper	– 1 No.
Center bearing	– 1 No.
Underflow/Sludge Transfer Pump (variable frequency Drive) (1W+1S)	– 2 Nos.
Underflow holding Tank – Flow meter (Magnetic/Ultrasonic type)	– 1 No.
Underflow pneumatic control valve	– 1 No.

7. 3rd Settling Tank

pH sensing pneumatic control valve	– 2 Nos.
Rake motor	– 1 No.
Lifting Motor	– 1 No.
Worm type gear box	– 1 No.
Bridge with sludge scrapper	– 1 No.
Center bearing	– 1 No.
Underflow/Sludge Transfer Pump (variable frequency Drive) (1W+1S)	– 2 Nos.
Underflow holding Tank – Flow meter (Magnetic/Ultrasonic type)	– 1 No.
Underflow pneumatic control valve	– 1 No.

8. Neutralization Tank

pH sensing pneumatic control valve	– 1 No.
Rake motor	– 1 No.
Lifting Motor	– 1 No.
Worm type gear box	– 1 No.
Bridge with sludge scrapper	– 1 No.
Center bearing	– 1 No.
Underflow/Sludge Transfer Pump (variable frequency Drive) (1W+1S)	– 2 Nos.
Underflow holding Tank – Flow meter (Magnetic/Ultrasonic type)	– 1 No.
Underflow pneumatic control valve	– 1 No.

9. Filter Feed Tank (Φ3.5 m x 1.5 m height)

Filter Feed Pump – 1 Nos.

3 Phase VFD Centrifugal Pump, 5 m^3/hr @ 3 bar pressure, Cast Iron BodySS 304/SS316 impeller.

10. Pressure Sand Filter – 1 No.

900mm Diameter x 1829mm HOS, Material of construction RP10mm Thickness Shell, Thickness Dish, Normal Flow 10m^3/Hr, Max Operating Pressure 10kg/cm^2, Operating Pressure 3 kg/cm^2, Media used Pebbles and graded sand, xylex Back wash duration 10minutes. Pressure drop across each unit 0.6kg/cm2, 900mm Diameter x 1829mm

HOS, Material of Accessories include
(Multi port valve 65NB size, trainer assembly
Pressure gauge, Pressure releaser Valve)
Make: **Pentair**/Aventura

11.Activated Carbon Filter – 1 No.

900mm Diameter x 1829mm HOS, Material of construction RP, 5mm Thickness Shell, 6mm Thickness Dish, Normal Flow 10m^3/Hr, Max Operating Pressure 10kg/cm^2, Operating Pressure 3 kg/cm^2, Media used Pebbles and graded sand, Activated carbon 1050 grade Back wash duration 10minutes. Pressure drop across each unit 0.5kg/cm2, 150mm Top and Bottom Opening, Accessories include (Multi port valve 65NB size, Strainer assembly Pressure gauge, Pressure releaser Valve)
Make: **Pentair**/Aventura

12.RO Unit – 1 No.

13.Delay Pond

Pump for pumping treated water from delay pond to river – 2Nos.
5 m^3/h at 10 m head (1W+1S)
3 phase / 50 Hz P - Type Impeller Submersible

Pump for transfer treated water to equalization tank if parameters are not achieved – 2 Nos.
(CMRL, SudChemi)
5 m^3/h at 10 m head (1W+1S)
3 phase / 50 Hz P - Type Impeller Submersible

Aromatic and Chemical Stream

1. Screen Chamber

(c) Coarse Screen

(d) Fine Screen

Stainless steel make, 10mm spacing between bars

2. Oil Trap

Oil Skimmer – 1 No.

2 LPH Single Belt, Single Scrapper
Belt Width -100mm
Belt material – PU Transparent
Belt Depth 1500 mm
Motor Power – 25 W
Supply Voltage: 415 V AC

3. Equalization Tank

Real Time pH Sensor – 1 No.

pH sensing pneumatic control valve – 2 Nos.
(Each for HCl and NaOH)

Level controlled VFD effluent Transfer Pump – 1No.
Three Phase 440V, 50Hz, 2.0HPPower ,
CI impeller with cast iron casing, Maximum flow rate,
30m^3/h, Delivery up to 30 meter, 7 meter suction lift,
Permanent split capacitor (CSR) incorporated with thermal
cut out relay (Motor Protector).Suction Dia 32mm, Delivery
Dia 32mm**Make: Crompton/Kirloskar**

Flow meter (Magnetic/Ultrasonic type) 150mm – 1 No.

4. Flash Mixing Chamber

Pneumatic control valves – 2 Nos.

Agitator, Agitator motor – 1 No.
Motor-3 phase AC 1 HP 1440 rpm squirrel
cage induction motor, SS316 blade and shaft,
dia-750mm.

5. Primary Clarifier

pH sensing pneumatic control valve – 2 Nos.

Rake motor – 1 No.

Lifting Motor – 1 No.

Worm type gear box	– 1 No.
Bridge with sludge scrapper	– 1 No.
Center bearing	– 1 No.
Underflow/Sludge Transfer Pump (variable frequency drive .(1w +1s)	– 2 Nos.
Underflow holding Tank – Flow meter (Magnetic/Ultrasonic type) 150mm	– 1 No.
Flow control valve 150mm	– 1 No.

6. Electro Coagulation Feed Tank

EC Feed Pump – 2 Nos.

Capacity	5 m^3/hr
Power	2 HP
Head	18m
Type	Self-Priming
Pump Specification	Suitable for a wide range of duties Non-return valve mounted Oil bath for the mechanical seal (preventing seal from running dry)
Material of construction	Pump casing: Cast Iron Impeller :Cast Iron

7. Electro Coagulation

7.1 Skid – 1No.

Flow Rate	: 5 m^3/hr
Material of construction of skid	: PP H
Thickness of Skid	: 15 mm
Size of the EC Skid	: 500 mm x 2000mm x 1600mm ht
Size of electrode	: 400 mm x 600mm x 4 - 180 Nos

Material of construction of electrode	: Mild Steel
Type of operation	: Automatic with pneumatic valves by PLC
Automatic Function	: Auto Polarity Reversing , : Auto Acid Cleaning, : Auto Air Pulse : EC Skid Trip, : Alarms, : Flow adjustment, : Voltage & Current adjustment
No of pneumatic valves	: 8 nos -1 Set
Material of construction of pneumatic valves	PP with actuator
Size	: 50.80mm and 76.20mm
BRAND	: WIT, India
Pipelines	: Assorted
MOC	: PP H Sch 80
Accessories	:Pipe line Flanges, Elbows etc.,
Electrode Holding Strip	: Assorted
MOC	: PPH
Electrode Mounting Plate	: Assorted
MOC	: PPH
IRON plate weight	: 1500 / kgs /Skid
Power supply	: 75 amps, 400 voltage DC each skid

7.2Acid Cleaning System for EC – 1 No.

7.3EC PPCleaning Pump – 1 No.

Capacity	2 m^3/hr
Pressure	3 BAR
Type	Centrifugal

Power	1 HP
MOC	PP
BRAND	Antico

8. Secondary Settling Tank

pH sensing pneumatic control valve	– 1 No.
Rake motor	– 1 No.
Lifting Motor	– 1 No.
Worm type gear box	– 1 No.
Bridge with sludge scrapper	– 1 No.
Center bearing	– 1 No.
Underflow/Sludge Transfer Pump (variable frequency Drive) (1W+1S)	– 2 Nos.
Underflow holding Tank – Flow meter (Magnetic/Ultrasonic type)	– 1 No.
Underflow pneumatic control valve	– 1 No.

9. Filter Feed Tank (Φ3.5 m x 1.5 m height)

Filter Feed Pump (1W+1S) – 2 Nos.

3 Phase VFD Centrifugal Pump, 5 m^3/hr @ 3 bar pressure, Cast Iron BodySS 304/SS316 impeller.

10.Pressure Sand Filter – 1 No.

900mm Diameter x 1829mm HOS, Material of construction RP10mm Thickness Shell, Thickness Dish, Normal Flow 10m^3/Hr, Max Operating Pressure 10kg/cm^2, Operating Pressure 3 kg/cm^2, Media used Pebbles and graded sand, xylex Back wash duration 10minutes. Pressure drop across each unit 0.6kg/cm2, 900mm Diameter x 1829mm HOS, Material of Accessories include (Multi port valve 65NB size, trainer assembly Pressure gauge, Pressure releaser Valve)
Make: **Pentair**/Aventura

11.Activated Carbon Filter – 1 No.

900mm Diameter x 1829mm HOS, Material of construction RP, 5mm Thickness Shell, 6mm Thickness Dish, Normal Flow 10m^3/Hr, Max Operating Pressure 10kg/cm^2, Operating

Pressure 3 kg/cm^2, Media used Pebbles and graded sand, Activated carbon 1050 grade Back wash duration 10minutes. Pressure drop across each unit 0.5kg/cm2, 150mm Top and Bottom Opening, Accessories include (Multi port valve 65NB size, Strainer assembly Pressure gauge, Pressure releaser Valve) Make: **Pentair**/Aventura

14. Treated Water Tank

Pump for pumping treated water to common delay pond and to river – 2Nos.
5 m^3/h at 10 m head (1W+1S)
3 phase / 50 Hz P - Type Impeller Submersible

6.6 CHEMICAL REQUIREMENTS

6.6.1 Main/Biological Stream (BS)

6.6.1.1 Equalisation Tank

pH – 7.0
Quantity of 10% w/v caustic soda solution needed in 1000ml effluent for precipitation – 1ml
Effluent Flow rate –100 m^3/hr
Caustic soda solution required for 5m^3 effluent = 1 x 100000/1000
= 100L
Caustic soda powder in 20L 10% caustic soda solution = 10 Kg
Process time 20 hrs
Total caustic soda required per day in Clarifier-1 = 20 x 10= 200 kg

6.6.1.2 Primary Settling Tank

1m^3 Effluent requires 600g-1kg 10% w/v Lime solution
800g-1.25kg 10% w/v Alum solution
100m^3/hr Effluent requires60-100kg/hr 10% Lime solution
80-125kg/hr 10% Alum solution
Process time 20hrs
Lime Required = 20x100 = 2000kg
Alum Required =20x125=2500kg
Specific Gravity 1.2

6.6.1.3 Secondary Settling Tank

1m^3 Effluent requires 600g-1kg 10% w/v Lime solution
800g-1.25kg 10% w/v Alum solution
100m^3/hr Effluent requires60-100kg/hr 10% Lime solution
80-125kg/hr 10% Alum solution
Process time 20hrs

Lime Required	= 20x100 = 2000 kg
Alum Required	=20x125=2500 kg
Specific Gravity	=1.2

6.6.1.4 Tertiary Settling Tank

100m^3/hr Effluent requires 250-400g polyelectrolyte 100L solution
Process Time 20hrs

PolyElectrolyte required	= 20x0.4=8kg

6.6.1.5 Overall Chemical Quantity consumption per day

Total Caustic Soda	= 200kg
Total Lime @Rs.30/kg	= 4000kg
Total Alum @Rs.40/kg	= 5000kg
Total Polyelectrolyte @Rs.400/kg	= 8kg

6.6.2 Aromatics and Chemical Stream (ACS)

6.6.2.1 Equalisation Tank

pH	–7.0
Quantity of 10% w/v caustic soda solution needed in 1000ml effluent for precipitation	–1ml
Effluent Flow rate	–5 m^3/hr
Caustic soda solution required for 5m^3 effluent	– 1 x 5000/1000= 5L
Caustic soda powder in 20L 10% caustic soda solution	– 0.5 kg

Process time 20 hrs

Total caustic soda required per day in clarifier-1 –20 x 0.5= 10 kg

6.6.2.2 Clarifier 1

Precipitation pH –8.5

Quantity of 10% w/v lime solution needed in 1000ml effluent for precipitation – 3.6ml

Effluent Flow rate –5 m^3/hr

Lime solution required for 5m^3 effluent – 2 x 5000/1000 = 10L

Lime powder in 10L 10% lime solution – 1 kg

Process time 20 hrs

Total lime required per day in clarifier-1 – 20 x 1= 20 kg

Specific Gravity –1.2

6.6.2.3 Flocculant : Cationic polyelectrolyte in settling tanks

5m^3/hr solution requires 5L polyelectrolyte solution

1L polyelectrolyte solution contains 4g polyelectrolyte

5L solution contains – 5x4= 20g

Process time 20hrs

Total polyelectrolyte in 1 clarifier – 20x20= 400g

6.6.3 Heavy Metal or Inorganic Stream

6.6.3.1 Equalisation Tank

pH –7.0

Quantity of 10% w/v caustic soda solution needed in 1000ml effluent for precipitation – 3.2ml

Effluent Flow rate –5 m^3/hr

Caustic soda solution required for 5m^3 effluent – 3.2 x 5000/1000= 16L

Consider 20L

Caustic soda powder in 20L 10% caustic soda solution – 2 kg

Process time 20 hrs

Total caustic soda required per day
in clarifier-1 – 20 x 2= 40 kg

6.6.3.2 Clarifier-1

Precipitation pH 8.5
Quantity of 10% w/v lime solution needed
in 1000ml effluent for precipitation – 3.6ml
Effluent Flow rate –5 m^3/hr
Lime solution required for 5m^3 effluent – 3.6 x 5000/1000= 18L
Consider 20L
Lime powder in 20L 10% lime solution – 2 kg
Process time 20 hrs
Total lime required per day in clarifier 1 –20 x 2= 40 kg
Specific Gravity – 1.2

6.6.3.3 Clarifier-2

Precipitation pH - 9.5
Quantity of 10% w/v lime solution needed
in 1000ml effluent for precipitation – 4.3ml
Effluent Flow rate –5 m^3/h
Lime solution required for 5m^3 effluent – 4.3 x 5000/1000= 21.5L
Consider 25L
Lime powder in 25L 10% lime solution – 2.5 kg
Process time 20 hrs
Total lime required per day in clarifier 1 – 20 x 2.5= 50 kg
Specific Gravity – 1.23

6.6.3.4 Clarifier-3

Precipitation pH – 11.0
Quantity of 10% w/v lime solution needed
in 1000ml effluent for precipitation – 30ml
Effluent Flow rate –5 m^3/hr
Lime solution required for 5m^3 effluent – 30 x 5000/1000= 150L
Consider 150L
Lime powder in 150L 10% lime solution – 15 kg
Process time 20 hrs
Total lime required per day in clarifier 1 – 20 x 15= 300 kg
Total Lime Required in 3 clarifiers = 40+50+300= 390kg
Specific Gravity – 1.32

Consider 400Kg Maximum

6.6.3.5 Flocculent:

Cationic polyelectrolyte in all clarifiers

$5m^3/h$ solution requires 5L polyelectrolyte solution

1L polyelectrolyte solution contains 4g polyelectrolyte

5L solution contains – 5x4= 20g

Process time 20hrs

Total polyelectrolyte in 1 clarifier – 20x20= 400g

Total polyelectrolyte in all clarifiers – 3x400= 1200g

6.6.3.6 Neutralization Tank

For neutralisation 1ml of 10% w/v $FeCl_3$ needed in 1000ml effluent

$FeCl_3$ solution needed for $5m^3$ effluent = 1x5000/1000 = 5L

Process time 20hrs

Total $FeCl_3$ solution needed = 20x5= 100L

Total $FeCl_3$ required = 10L

6.7 POWER REQUIREMENTS

The CETP is dealing with effluents which contains more suspended solids and dissolved solids and hence most of the units are placed above ground level to deal with large quantity of sludge. Therefore the hydraulic flow of effluent through the units in CETP is proposed mainly by pumping with suitable pump sets which are electrically operated. As the main treatment process involved in the CETP is MBBR which is aerobic in nature, and provided more retention time in equalization tank leads to usage of more air blowers. Also most of the instrumentation equipment are pneumatically operated, instrument air compressors are required. Plant lighting, draft fans, room fans, air conditioners etc are also require considerable electric power. The total power requirement for running CETP is 500 HP/256 kW and the installed capacity is 500HP/260kW. The single largest motor capacity is 25HP (Air blower). As per the rules of Kerala State Electrical Inspectorate, HT connection and an indoor type 3 phase transformer having a capacity of 500 kVA and for making uninterrupted power supply, a Diesel-Generator set having 250 KVA capacity is proposed.

CHAPTER-7
ESTIMATION AND COSTING

The estimate of the work has been prepared based on the DSR 2018.
The detailed estimate and costing have been attached as Appendix 9.

ABSTRACT OF ESTIMATE FOR 2MLD CETP AT EDAYAR		
A	**CONVEYANCE SYSTEM**	
	Pumping main, pump sets and allied components	30499482
B	**CETP CIVIL WORKS**	
	MAIN STREAM	
1	Site Clearing, Levelling & Shifting of Materials	660914
2	Receiving Chamber, Screen Channel & Oil trap	682993
3	Equalisation Tank	12117884
4	Flash mixture	3722038
5	Primary Clarifier	13154755
4	MBBR - 01	20440162
5	Nitrification Tank	20440162
6	De-Nitrification Tank	22096204
7	Secondary Clarifier	11708235
8	Sludge Sump	2106817
9	Sludge Thickener	11684842
10	Delay pond I & II	2535272
11	Filter Feed Tank	7178228
12	Treated Water tank	5178944

INORGANIC STREAM		
1	Receiving Chamber, Screen Channel & Oil trap	468238
2	Equalisation Tank	2665990
3	Flash mixture	463122
4	1st stage Clarifier	2347974
5	2nd stage Clarifier	2487976
6	3rd stage Clarifier	2627972
7	Neutralisation Tank	3759535
8	Filter Feed Tank	594819
9	Treated Water tank	266496

AROMATICS &CHEMICAL STREAM		
1	Receiving Chamber, Screen Channel & Oil trap	659144
2	Equalisation Tank	2435046
3	Flash mixture	258766
4	1st stage Clarifier	3543384
5	EC Feed Tank	724772
6	Secondary Clarifier	3836105
7	Filter Feed Tank	572301
8	Treated Water tank	280283
9	Transformer Housing, Control Room & Laboratory Building,Chemical storage, chemical preparation, laboratory ,chlorine storage, screw press room	16800000
10	Construction of Generator and Electric room	3024547
11	Setting up of chemical & microbiological lab	3831165
12	RO unit room, platform for motors and blowers	1996400
13	Internal Roads, Walkways & Storm Water Drain	11005851
14	Furnitures& Laboratory Items	1120000
	SUB TOTAL	199477336
C	**MECHANICAL WORKS**	
1	Electromechanical Equipment	104117504
D	**ELETRICAL WORKS**	
1	ELECTRICAL CONNECTIONS & SUBSTATION	6720000
2	POWER DIESEL CHARGES FOR ONE YEAR	6720000
	SUB TOTAL	13440000
F	**MISCELLANEOUS**	
1	MISCELLANEOUS WORKS - CONSTRUCTION OF COMPOUND WALL, DIGGING OF TUBE WELL/OPEN WELL,ETC	6720000
2	PROVIDING SOLAR PANEL SYSTEM	6720000
3	CONTINGENCIES & UNFORSEEN IF ANY	14025676
	SUB TOTAL	24640000
	TOTAL (A+B+C+D+E+F)	**375000000**

CHAPTER 8

OPERATION & MAINTENANCE TENTATIVE COST

O & M Requirement Identification

A CETP installation needs to equip itself with proper protocol for O & M. The first step in preparation for O & M is preparing inventory of maintenance requirements. This inventory is generally included in the Operation & Maintenance (O&M) Manual written down for the installation by the contractor who designs and builds the installation. He on completion of the work hands over this manual to the Principal for whom he builds the installation.

The following sections of the O & M Manual would lay down the maintenance requirements:

1. Maintenance of Equipment: This section provides schedules that list periodic maintenance requirements for the various equipment's and also includes record keeping forms as necessary. A list of equipment suppliers and service representatives along with telephones to be also given therein. Also, the manufacturer's O&M requirement to be provided in this section. The CETP maintenance staff / the Operation & Maintenance contractor should particularly review this section of the O&M Manual.

2. Storeroom and Spare Parts Inventory: It includes a list of critical replacement parts that may have long delivery times associated with them. Contact details of manufacturer's or dealers of various equipment used in the installation, who are located nearby is helpful in seeking recommendations/ guidance. This section also indicates where the spares are to be stored. To optimize spare parts inventory, the CETP Staff/ O&M Contractor can make/ procure computerized maintenance software programs to help keep track of spares, supplies and lubricants.

3. Manufacturer's O&M Literature. In the O& M manual, cut-sheets and other manufacturer's literature are also contained.

CETP staff and O&M Contractor should familiarize itself with all these documents to ensure proper planning and execution of O&M activities.

In case these documents are not available the same should be prepared based on study of the plant, process, equipment's, past experience, and interaction with manufacturer's/suppliers.

ETP O & M Staff Requirements

The manpower requirement for CETP O & M can broadly be listed as follows:

- **Plant Manager:** is an individual with environmental engineering or science background with experience of at least three years on similar plant(s). He must have thorough understanding of unit operations and application of microbiology and environmental chemistry in the effluent/ sewage treatment. He should be able to take decisions to divert / bypass/ distribute the flow in the event of disruptions / breakdown of mechanical or electrical equipment until resumption is in place and repairs / replacements are successfully carried out. He should understand and be able to plan a forecast and use of chemicals / nutrients for the plant operations and the laboratory. He should be well versed in working out dosages of chemicals and nutrients based on the raw effluent quality and change it as the treatment progresses and results start forthcoming. As CETP Manager, he should prepare a weekly roster of duties for each individual and broadly lay down in writing the duties and responsibilities of each category of staff. He should ensure that the staff on plant should get rotated in various shifts during each month. Needless to mention that he is the backbone of CETP operation.

- **Plant Operator(s):** comprise a team of qualified / trained operators who work in shifts in operating and maintaining screens, grit removal devices, pumps, aerators, valves, etc. in directing the effluent and settled sludge to various units for / after treatment. They should be able to sense troubles and act as ears and eyes of the Plant manager. They should also assist the electrical / mechanical maintenance technician(s) in carrying out the preventive and breakdown maintenance tasks.

- **Electrical / Mechanical Technician (s):** form team of qualified maintenance technicians with the ability and experience of diagnosing health of equipment and motors with the aim of taking these on for preventive maintenance, assigning causes and reasons for faults and ultimate failure, quickly carrying out minor repairs / replacements by reaching, removing, stripping / opening, repairing, assembling of routine electrical and mechanical machines / equipment including piping and valves.

- **Laboratory Analyst:** is a qualified individual who has knowledge of water and waste water chemistry and is trained in preparation of laboratory chemicals, use of laboratory instruments, collection and preservation of water / waste water samples and analysis for various environmental parameters such as pH, SS, BOD, COD, TDS etc.

- **Labour / Helpers:** In addition to the above trades, labour / helpers are required to assist the above individuals and upkeep and maintenance of the various units, structures, areas, floors, rooms, equipment, tanks, vessels, beds etc. and removal, loading, haulage/carriage of wastes, screenings, stores and chemicals and other such material as the need be.

It is essential that each CETP staff shall be well trained in related tasks and be equipped in resources such as tools, spares and tackles.

CETP O & M skills are acquired mostly through on-job training. Trainees usually start as attendants or operators-in-training and learn their skills on the job under the direction of an experienced operator. They learn by observing and doing routine tasks such as recording meter readings, taking samples of liquid waste and sludge, and performing simple maintenance and repair work on pumps, electric motors, valves, and other plant equipment. CETP Operators need mechanical aptitude and should have knowledge of basic mathematics, chemistry, and biology. They must have the ability to apply data to formulas prescribing treatment requirements, flow levels, and concentration levels.

CETP operation is a team work. It requires proper team selection, training need assessment, training, on-job moulding, laboratory and statistical analysis for

Since it is not feasible to position a Repair/Maintenance Shop at the site to carry out major overhauls / repairs to electrical and mechanical equipment, it is essential to identify back-up workshop facilities. A good CETP operating contractor may have his own central resources in place within workable co-ordinates which will help to carry out such heavy repairs and maintenance or he may have agreement to move such resources, own or from trade, to the site with matching capability to establish temporarily for completion of task. This should be taken in to account if CETP operation is to be outsourced

CETP Staff Competency

1.Plant Manager:

a) A Post-graduate in Environmental Sciences or a Graduate Environmental Engineer / Chemical Engineer with one year experience or a Diploma in Environmental / Chemical Engineering/ Graduate in Environmental Sciences /Microbiology with three years experience in an in Maintenance or Design of CETP

b) Should be physically fit and mentally alert.

c) Should accept tasks allotted by higher offices and complete these without any further guidance as also have own initiative to find, assign and super-vise tasks to his own subordinates to achieve goals assigned to him by the organization.

d) Should have worked / trained on the operation of a Sewage / Effluent Treatment Plant for at least one year.

e) Should have attended and participated in a training /refresher course in Effluent Treatment Design/Operation.

2. Plant Operator (s):

a) Should be at least a High School Pass with sciences and be physically fit and mentally alert.

b) Should have attended and passed an ITI trade in mechanical or electrical.

c) Should accept assigned tasks willingly and complete these without any further guidance as also have initiative to find work and willingly under-take it on his own for the betterment / achievement of organizational goals.

d) Should have attended training / refresher course for personnel working on a Common Effluent Treatment Plant operation.

e) Should have at-least one year experience in the operation of Pumps and Valves at a Pumping Installation.

3. Electrical / Mechanical Technician (s):

a) Should be at least an SSC Pass with Sciences and be physically fit and mentally alert.

b) Should accept assigned tasks willingly and complete these without any further guidance as also have initiative to find work and willingly under-take it on his own for the achievement of organizational goals.

c) Should have attended and passed an diploma in the Electrical / Mechanical Engineering.

d) Should have attended a training / refresher cadre for personnel working on Common Effluent Treatment Plant.Should have at least

one year experience in the operation as well as maintenance of Pumps, Motors, Switch gears, Reduction Gears, Valves and Pipes at a Common Effluent Treatment Plant or at a sewage treatment plant .

4. **Labour /Helper:**

a) Should at least be Class VII pass and be physically fit and mentally alert.

b) Should accept assigned tasks willingly and complete these without supervision and further guidance.

5. Laboratory Analyst:

a) Should be at least B.Sc. with Chemistry with three years analytical experience or M.Sc. with Chemistry with one year analytical experience.

b) Should have attended a training / refresher cadre for Laboratory Analysts for working on Effluent Treatment Plant laboratory.

c) Should be able to draw an Analysis Program for collection and analysis of daily, weekly and monthly samples and follow it and report results as per time schedule thus agreed upon.

d) Draw out a program to undertake performance studies from time to time and have it approved from the higher offices through his plant manager before execution.

e) Be responsive and prepared to undertake additional responsibility of the Plant Manager when the incumbent is away for short durations.

f) Be bold to report deficiencies in treatment as shown by effluent quality analysed at the Laboratory.

CETP Staff Training

Training can be imparted at CETP site by academic/research institutions, by in-house experts, or by sending staff to courses offered by professional bodies. However, experience shows that the best options is training by experienced CETP operating agency. Such training will be rich in the terms of practical hints, case-studies, and participants will find it easier to communicate with the faculty.

Training courses may be run for 6 to 10 working days at a stretch with residential facilities for batches of 10 – 12 individuals at a time. Shorter courses may be arranged for senior engineers from industry/municipal bodies.

The emphasis in training should be on the following aspects:

1. The Course should commence with a quick visit to the Common Effluent Treatment Plant where the participants are made conversant with the units / processes that shall be dealt with subsequently in the course syllabus.

2. Introduction of,

    a) Various unit operations and processes (Separation by Screening, Floatation, Settling / Sedimentation, Filtration, Neutralization, Coagulation, Flocculation, Absorption, Adsorption, Chemical Reactions, Oxidation/Reduction, Dissolution, Ion exchange, Chlorination)

    b) Operation of Units such as Screens (Coarse / Fine Bar screens, Manual / Mechanically operated), Sumps and Pumping Stations including Pumps,

Motors and Panels (Centrifugal Horizontal / Vertical Turbine), Valves (Sluice gates, Non return, Reflux), Pipes/Specials and Pipe Joints, Grit Removal Units. Primary Sedimentation / Settling tanks, Scraping Mechanisms, Sludge withdrawal, Sludge Sumps, Sludge Pumps, Aeration tanks and Aerators, Secondary Settling Tanks, Secondary Sludge Sumps, Pumps, Sludge Thickeners, Sludge Digesters, Gas Production, Sludge handling and Drying.

c) Maintenance of Pumps and Motors, Electrical Panels (Starters, Meters (Energy, Voltage, Amperage, Power factor), Manual or Electrically Operated Trolley Gantry, Blow out Fuses, Valves, Gates, Scraping Bridge Trolley, Aerators, Reduction Gears, Open Air Weather Casings for Motors, Sprocket wheels and Chains for Mechanical Grit and Screen removing devices.

d) Introduction to Quality aspects of Raw and Treated Effluent and the importance of each of the quality parameters and corresponding unit operation / process that plays a part in influencing quality parameters.

3. Identification of flaws and troubles with treatment and its trouble shooting where it is not due to inbuilt flaws in design / design criteria, such as bulking of sludge in the lower layers and floating of sludge lumps in a settling tank, foul smelling in an Aeration Tank, heading up in the Settling Tanks or Aeration tanks, passing of undue flocs in the settled effluent from settling tanks, disruption of operation by failure of main power supply and malfunctioning of scraping mechanism in the clarifiers.

4. Undertaking segregation of a motor and pump from the manifold at suction and delivery, its disconnection from the panel, hauling up of both pump and motor to the maintenance platform, dissembling of the pump, replacement of shaft / impeller, reassembly of the pump, check motor for its characteristics, haul back to the mounting location, couple up / connect

the pump and motor and reconnect power and rejoin with suction and delivery manifold.

5. Undertaking replacement of a mechanical surface aerator in an Aeration Tank and undertake replacement of a Reduction Gear Assembly including its maintenance.

6. Removing and Replacing of a Sluice Gate Valve from a mains and undertaking maintenance of the Sluice Gate Valve.

7. Maintaining a Power Factor, methodology and upkeep of the Power Factor Battery Bank.

8. The role of each of the category of tradesmen on site in bringing the final effluent quality better than the discharge standards.

A separate laboratory training course should be run for only Laboratory Analysts for a period of 6 Working days. It may include:

a) Introduction to items at Serials 1 & 2 above.

b) Importance of quality and plant performance parameters e.g. pH, TS, SS, TDS, BOD, COD, DO, Temperature, MLSS, MLVSS and SVI including methods of determination.

c) A three day regular analysis program in which the participants in pairs are given a sample of effluent for analysis for pH, TS, SS, TDS, BOD, COD, DO, Tempera-ture and a sample of Aeration Tank discharge for determination of MLSS, MLVSS and SVI. The results should be discussed and candidates should be encour-aged to express their views as to how these can further be improved.

d) Preparing sampling schedule (locations, numbers, frequency, grab/continuous), sample preservation methods, statistical tools

Daily training must be followed by a Quiz Test for all cadres before the close of the day and the participants be evaluated based on the outcome of the course results. The participants be presented "Participation Certificates" at the end of the course. This serves as an excellent incentive.

GUIDELINES FOR SAFETY IN CETP OPERATION

Hazard Identification

Common Effluent treatment plant operators work both indoors and outdoors and are exposed to noise from machinery and to unpleasant odours. Operators' work is physically demanding and work is often is performed in unclean locations. Moreover, plants operate 24 hours a day, 7 days a week; therefore, operators work one of three 8-hour shifts, including weekends and holidays, on a rotational basis. Operators may be required to work overtime.

Also, ETP operators are exposed to a variety of hazardous chemical agents, contained in the effluents and to the reagents used in the waste water processing, or generated during the waste waters treatment. These chemical agents may cause acute poisoning, chemical accidents (e.g., skin burns, injury to the eyes, etc.) damage to the respiratory system, allergies, dermatitis, chronic diseases, etc.

Occupational safety and health (OSH) considerations are becoming integral part of modern day operations. In view of this it is necessary to identify hazards and devise preventive and remedial measures to mitigate OSH risks in CETP operation.

The hazards in CETP O & M are listed below:

1. Slips and falls on floors made slippery by water, aqueous solutions or solvents.

2. Blows and contusions caused by falling heavy articles, including containers of chemical reagents, e.g., from overhead conveyers, or by contact with moving machinery or vehicles.

3. Falls into ponds, pits, clarifiers or tanks causing injuries or drowning.

4. Hazards related to entry into confined spaces - suffocation due to oxygen deficiency, poisoning (e.g. by hydrogen sulphide), etc.

5. Burns, by steam or hot vapours, by splashes of hot plating baths, solvents and other liquids, by contact with hot surfaces (e.g., annealing ovens), etc.

6. Electric shock caused by contact with faulty electrical equipment, cables, etc.

7. Cuts and pricks by sharp tools sharp edges of articles to be plated sharp deposits on jigs, etc.

8. Injuries (especially of eyes) caused by flying particles, in particular from rotating brush cleaning or wheel grinding.

9. Fire and explosions due to the formation and release of flammable gases during processing (e.g., methane, hydrogen).

10. Vigorous chemical reactions caused by uncontrolled mixing of chemicals (e.g., if water is mixed with concentrated sulphuric acid) during the preparation of reagents for wastewater treatment.

11. Acute poisoning caused by various chemicals present in the wastes, used as reagents (e.g., gaseous chlorine), or released during the treatment; a particular hazard is caused by the possible release of a number of

poisonous gases, e.g., hydrogen-cyanide (from metal plating or heat treatment wastes upon acidification), hydrogen-sulphide, etc.

12. Acute intoxication caused by erroneous drinking of untreated wastewater.

13. Poisoning by phosgene, which may be formed if a worker smokes in the presence of chlorinated-solvent vapours, or if welding or other flames or arcs are used.

14. Chemical burns by corrosive liquids Damage to eyes by splashes of irritating or corrosive liquids.

15. Diseases caused by infectious agents (bacteria, viruses, protozoa, helminthes and fungi – see appendix) present in the raw domestic wastewater (mainly from human origin) and in agricultural wastes.

Dos and Don'ts in CETP Operation for Safety

1. Use safety shoes or boots with non-slip soles.
2. Wear personal protective equipment and chemical resistant clothing to avoid exposure of skin or eyes to corrosive and/or polluted solids, liquids, gases or vapours.

3. Do NOT mix chemicals without the supervision of a qualified chemist or safety professional.

4. Obey all safety-instructions regarding the storage, transport, handling or pouring of chemicals.

5. Check electrical equipment for safety before use; verify that all electric cables are properly insulated; take faulty or suspect electrical equipment to a qualified electricity technician for testing and repair.

6. Wear safety goggles in all cases where the eyes may be exposed to dust, flying particles, or splashes of harmful liquids.

7. Wear respirator, or gas mask, when exposed to harmful aerosols, dusts, vapours or gases.

8. Take extreme care when handling highly corrosive agents such as liquid or gaseous chlorine, concentrated acids or alkalis, or when toxic gases may be emitted from the reagents, etc.

9. Obey all safety instructions concerning entry into confined spaces, e.g., check atmosphere for oxygen or for poisonous gases, use respiratory protection equipment if needed, have a co-worker stand guard in case of need for help, etc.

10. Do not smoke, eat or drink in areas where chemical or biological contamination may be expected.

11. Use non-latex gloves if sensitivity to latex has been diagnosed.

12. All workers should undergo periodic examinations by occupational physician to reveal early symptoms of possible chronic effects or allergies.

13. Learn and use safe lifting and moving techniques for heavy or awkward loads such as containers of chemicals; use mechanical aids to assist in lifting.

Personnel Protective Equipment (PPE) for CETP O & M

While planning the list of PPE, the following types of situations should be catered for

1. Impact / Penetration / Compression while doing maintenance tasks

2. Chemical Handling

3. Heat/cold and wetting

4. Harmful dust

5. Oxygen deficiency

6. Obnoxious odours of decomposing matter

7. Hydrogen Sulphide presence

8. Light (optical) radiation

9. Biological exposure from raw / treated effluents and sludge handling

10. Noise of machines and vibrations.

11. Electric shock

12. Rain / Storm

General List of PPE:

1. Safety Boots with non-skid soles and Steel Toes.

2. Electrical Hazard safety Toe shoes

3. Gas Masks and Face Shields

4. Oxygen meters for ascertaining type of atmosphere in a confined area.

5. Single-use Ear Plugs / Ear-muffs

6. Safety Goggles

7. Helmets / Hard Hats

8. Latex Rubber/ Butyl Rubber/ Fabric / Chemical Resistant Gloves

9. Overall Clothing

10. Aprons for laboratory Personnel

11. Safety Belts

12. First Aid Box

13. Fire extinguishers

14. Respiratory Protective mask with man pack cylinders

Safe Handling of Chemicals

Since handling of chlorine and corrosive chemicals form part of many ETPs, special attention should be given to safe handling of these chemicals.

Safe Handling of Chlorine

Pure chlorine comes in two forms: gas and liquid. Chlorine gas is easily liquefied under pressure. Typically, a commercial cylinder contains liquefied gas under pressure. Chlorine gas has a disagreeable, sharp, pungent, penetrating

odour. In airborne concentrations above 1000 parts per million (ppm) it has a greenish-yellow colour. In smaller concentrations it is colourless. Chlorine gas is 2½ times heavier than air and tends to flow downhill and pool in lower areas. Wind and weather, however, will cause a chlorine gas cloud to disperse, spreading it in all directions, even uphill.

Liquid chlorine is a transparent, amber-coloured, oily fluid that is 1½ times heavier than water. Liquid chlorine has a high compression ratio. The ratio of liquid to gas is 1 to 460, which means that 1 L of liquid chlorine expands to form 460 L of pure chlorine gas. The maximum allowable concentration of chlorine a person can be exposed to in an eight-hour period is 0.5 ppm,

Chlorine gas is mainly used as a disinfectant in:

1. Swimming pools
2. Water treatment plants
3. Sewage treatment
4. Community water supplies, including water used for irrigation

Chlorine is also used in:

1. Pulp and paper industries
2. Pool chemical products
3. Cleaning products
4. Mining processes
5. Bleach manufacturing
6. Plastics manufacturing

Chlorine is corrosive. It can burn moist body surfaces such as the eyes, nose, throat, lungs, and wet skin because it forms harmful acids when it reacts with moisture. **Repeated exposure to chlorine does not produce an immunity or tolerance.** Long term exposure to low concentrations of chlorine may cause a gradual decrease in lung efficiency. A single exposure to a high concentration can cause the same effect.

Safety in Handling of Corrosive substances such as Acids,

Alkalis General Chemicals used in Effluent Treatment:

1. Neutralization / pH correction: Hydrochloric acid, Sodium Hydroxide / Lime
2. Coagulant / Settling Aids: Aluminium Sulphate, Ferric Aluminium Sulphate, Ferric Sulphate, Ferric Chloride, these may be independent or in combination with Poly Electrolytes (Polymers).
3. For Specific Ion removal, chemicals required as per chemistry of treatment.
4. Nutrients: Urea, Di-ammonium Phosphate
5. Disinfectant: Chlorine, Bleaching Powder (Sodium Hypo-chlorite), Ozone
6. Adsorption / Absorption: Activated Carbon
7. Ion Exchange – based on the specific ion to be removed.

Few Examples of Corrosive Substances used in CETP

1. Sulphuric acid
2. Chromic acid
3. Stannic chloride
4. Ammonium bi-fluoride

5. Bromine

6. Ammonium hydroxide

General Characteristics of CETP Chemicals

1. Acids and Alkalis fall into the category of Corrosive chemicals. Corrosives are most commonly acids and alkalis, but many other materials can be severely damaging to living tissue.

2. Corrosives can cause visible destruction or irreversible alterations at the site of contact. Inhalation of the vapour or mist can cause severe bronchial irritation. Corrosives are particularly damaging to the skin and eyes.

3. Certain substances considered non-corrosive in their natural dry state are corrosive when wet such as when in contact with moist skin or mucus membranes. Examples of these materials are lithium chloride, halogen fluorides, and alkyl iodide.

4. Sulphuric acid is a very strong dehydrating agent and nitric acid is a strong oxidizing agent. Dehydrating agents can cause severe burns to the eyes due to their affinity for water.

Use and Storage of Corrosives

Always store acids separately from bases. Also, store acids in acid storage cabinets away from flammables since many acids are also strong oxidizers.

2. Do not work with corrosives unless an emergency shower and continuous flow eyewash are available.

3. Add acid to water, but never add water to acid. This is to prevent splashing from the acid due to the generation of excessive heat as the two substances mix.

4. Never store corrosives above eye level. Store on a low shelf or cabinet.

5. It is a good practice to store corrosives in a tray or bucket to contain any leakage.

6. When possible, purchase corrosives in containers that are coated with a protective plastic film that will minimize the danger to personnel if the container is dropped.

7. Store corrosives in a wooden cabinet or one that has a corrosion-resistant lining. Corrosives stored in an ordinary metal cabinet will quickly damage it. If the cabinet supports that hold up the shelves become corroded, the result could be serious. Acids should be stored in acid storage cabinets specially designed to hold them and Nitric acid should be stored in a separate cabinet or compartment

Use and Storage of Hydrofluoric Acid

1. Hydrofluoric acid is extremely hazardous and deserves special mention. Hydrofluoric acid can cause severe burns and inhalation of anhydrous hydrogen fluoride can be fatal. Initial skin contact with hydrofluoric acid may not produce any symptoms.

2. Only persons fully trained in the hazards of hydrofluoric acid should use it.

3. Always use hydrofluoric acid in a properly functioning fume hood. Be sure to wear personal protective clothing!

4. If you suspect that you have come in direct contact with hydrofluoric acid: wash the area with water for at least 15 minutes, remove clothing, and then promptly seek medical attention. If hydrogen fluoride vapours are inhaled, move the people immediately to an uncontaminated atmosphere (if safe to do so), keep the person warm, and seek prompt medical attention.

5. Never store hydrofluoric acid in a glass container because it is incompatible with glass.

6. Store hydrofluoric acid separately in an acid storage cabinet and keep only that amount necessary in the lab.

7. Creams for treatment of hydrofluoric acid exposure are commercially available.

Health Hazards Associated with Corrosives:

1. All corrosives possess the property of being severely damaging to living tissues and also attack other materials such as metal.

2. Skin contact with alkali metal hydroxides, e.g., sodium hydroxide and potassium hydroxide, is more dangerous than with strong acids. Contact with alkali metal hydroxides normally causes deeper tissue damage because there is less pain than with an acid exposure. The exposed person may not wash it off thoroughly enough or seek prompt medical attention.

3. All hydrogen halides (HF, HCl, HBr and HI) are acids that are serious respiratory irritants and also cause severe burns. Hydrofluoric acid is particularly dangerous. At low concentrations, hydrofluoric acid does not immediately show any signs or symptoms upon contact with skin. It may take several hours for the hydrofluoric acid to penetrate the skin before you would notice a burning sensation. However, by this time permanent damage, such as second and third-degree burns with scarring, can result.

Acute Health Effects:

Inhalation	irritation of mucus membranes, difficulty in breathing, fits of coughing, pulmonary edema
Ingestion	irritation and burning sensation of lips, mouth, and throat; pain in swallowing; swelling of the throat; painful abdominal cramps; vomiting; shock; risk of perforation of the stomach
Skin Contact	burning, redness and swelling, painful blisters, profound damage to tissues, and with alkalis; a slippery, soapy feeling
Eye Contact	stinging, watering of eyes, swelling of eyelids, intense pain, ulceration of eyes, loss of eyes or eyesight.

Chronic Health Effects

Symptoms associated with a chronic exposure vary greatly depending on the chemical. For example, the chronic effect of hydrochloric acid is damage to the teeth; the chronic effects of hydrofluoric acid are decreased bone density, fluorosis, and anaemia; the chronic effects of sodium hydroxide are unknown.

First Aid:

Inhalation	Remove person from source of contamination if safe to do so. Get medical attention. Keep person warm and quiet and do not leave unattended
Ingestion	Remove person from source of contamination if safe to do so. Get medical attention. Keep person warm and quiet and do not leave unattended.
Skin Contact	Remove person from source of contamination and take immediately to an emergency shower or source of water. Remove clothing, shoes, socks, and jewellery from affected areas as quickly as possible, cutting them off if necessary. Be careful not to get any chemical on your skin or to inhale the vapours. Flush the affected area with water for a minimum of 15 minutes. Get medical attention.
Eye Contact	Areas as quickly as possible, cutting them off if necessary Be careful not to get any chemical on your skin or to inhale the vapours. Flush the affected area with water for a minimum of 15 minutes. Get medical attention.

Personal Protective Equipment

Always wear the proper gloves when working with acids. Neoprene and rubber gloves are effective against most acids and bases. Polyvinyl chloride (PVC) is also effective for most acids. A rubber coated apron and goggles should also be worn. If splashing is likely to occur, wear a face shield over the goggles. Always use corrosives in a chemical fume hood.

The following parameters are an essential part of analysis at the on-site laboratory. The location of sampling and the parameters that are required to be tested for are also given in the table below.

1. Ph
2. Total Solids (TS)
3. Suspended Solids (SS)
4. Total Dissolved Solids (TDS)
5. Biochemical Oxygen Demand (BOD)
6. Chemical Oxygen Demand (COD)
7. Dissolved Oxygen (DO)
8. Temperature
9. Chlorine Demand
10. Residual Chlorine
11. Mixed Liquor Suspended Solids (MLSS)
12. Mixed Liquor Volatile Suspended Solids (MLVSS) and Sludge Volume Index

Guidelines For Record Keeping

Running Records are required to be kept for various operating machines such as Me-chanical Screens, Mechanical Grit Removers, Pumps, Motors, Scrapers, Aerators, Chemical consumption, Chlorine consumption etc. as maintained by the operators and kept at Control Room or duty room of the operators that is closer to the location of the machines.

The records of effluent quality and other laboratory tests are kept in the laboratory as per daily sample collection and testing schedules.

The record with respect to flow need to be maintained by operators as per Table below. The daily log sheet is passed to the Plant Manager on the subsequent day duly signed by the operator in the first shift. All operators shall be responsible to fill up their part of observations and calculations. The Plant Manager shall verify the daily record as well as the calculations and shall be responsible to generate further data using these.

CONSTRUCTION OF CETP AT EDAYAR							
Operation and Maintenance Estimate							
Sl. No.	Description						Expenditure per Month (INR)
I	**Power Charges**						
	kWh	Working hours/d	No. of days in a month	*KESB Rate/kWh (INR)	Total Amount (INR)		
	265.46	10	30	5	398190		398190
***** The rate may fluctuate according to the actual usage of plant and variation in KSEB rates							
II	**Staff for Operation**						
	Designation			No. of Persons	Salary/Head	Total Salary	
1	Plant Manager			1	40,000	40000	
2	Operators			3	25,000	75000	
a	Chemist/microbiologist			3	20,000	60000	
b	Lab Assistants			3	10000	30000	
c	Unskilled workers			6	15000	90,000	
d	Sweeper cum cleaner			1	8000	8000	
	Sub Total					*303000*	303000
III	**Consummables**						
a	Assuming that DG set is working at half load for 10 hours/month fuel consumption is 29 liters/hour including chemicals, lubrication oil, spare parts etc.						
							8700
b	Chlorine Gas		Consumption (kg/month)	Rate (INR/kg)	No. of days in a month		
			300	20			6000
c	Poly Electrolyte		8.5	106	30		27030
d	Caustic soda		250	38	30		285000
e	Lime		4410	22	30		2910600

f	Alum	5000	26	30		3900000
g	Ferric Chloride	25	20	30		15000
h	Spares, Lubricants & Replacements					10000
IV	Cost for transportation of effluents through lorry					
	Capacity (Liters)	No. of lorries	Rate /day			
a	12 kl tanker 2 Nos. @6000/- per day					360000
b	6 kl tanker 2 Nos. @5000/- per day					300000
e	2 kl tanker 1 No. @4000/- per day					120000
V	Solid Waste Management					
a	One time registration charge for waste disposal to KEIL including GS					59000
b	One time analysis charge including GST to KEIL					7080
c	Hire charges for lorry conveyance for disposing twice a month (2x15					30000
d	Charges levied by KEIL for the taking the waste material @ Rs.2500/MT @4MT / Day					300000
	Grand Total Per Month					***9039600***
	Annual Operation & Maintenance Charge					107682240
	Treatment Cost per day					295020
	Unit Cost of Treatment per kilo Liter					147.51
	5 Years Annual O&M Cost considering 10% annual increase each year					
	First Year					107682240
	Second year					118450464
	Third year					129218688
	Fourth Year					139986912
	Fifth year					150755136
	Grand Total for 5years O&M					**646093440**

CHAPTER-10

CONCLUSION

ayar Industrial Area in the Ernakulam district is the major industrial area locating on either sides of river Periyar in its lower stretches. There are 336 industries in Edayar Industrial Estate, of which about 68industries are trade effluents generating. These industrial units depend the river Periyar for intake of process water and disposal of effluents. Many number of court cases regarding the pollution of rivers especially river Periyar are still outstanding. The plan for rejuvenation of polluted river stretches is proposed to be executed through a concept of regulation and enforcement of standards allocation of discharges with stipulated norms. The implementation of the Common Effluent Treatment Plant at Edayar Industrial Estate was brought to the notice of the Government and discussions are being held. Common Effluent Treatment Plant (CETP) not only help the industries in easier control of pollution, but also act as a step towards cleaner environment and service to the society at large. Preliminary treatability analysis of the industries in Edayar indicates that the effluents are highly heterogeneous in nature and proposed to treat in different streams. The proposed CETP having capacity 2 mld is planned to implement at IDA Eadayar. CETP is designed for treating the effluents generating from industries of Edayar industrial area and discharging with the stipulated standards to the river Periyar. The total cost of the project comes to **INR 375000000/-.**

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