EVALUATION OF COST EFFECTIVE SEWAGE TREATMENT PLANT FOR AUGMENTATION OF IRRIGATION WATER SUPPLY IN SULUR SMALL TANK, SULUR

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SYNOPSIS

In domestic wastewater, the main aim is that anything generated in a house, especially of excremental nature, should be immediately removed to suitable place, usually situated at some distance from the town, for treatment. In sulur, domestic wastewater is distributed directly into the sulur small tank. This pollutes the ground and surface water. So there is a need to treat the domestic wastewater and reuse of wastewater to irrigate agricultural land. Treatment plant is established near to small tank at the back of market.

In this process, Bioclean powder is added in the collection tank. The active ingredients present in Boolean powder are enzymes and bacteria. This speeds up the removal digestion of the organic material. From the collection tank, it is fed to aeration tank and tertiary units. It is simple process, which does not require sludge disposal. The Bioclean increases the biodegradation activity.

The effectiveness of the treatment is taken as study project. The sample are collected once in 20 days from the various treatment units. The physical and chemical characteristics for the collected samples are determined. From the parameters the treatment efficiency of the unit and seasonal variation changes are analyzed. These units are designed based upon the quantity of the incoming flow.

INTRODUCTION

GENERAL

Agriculture is the heart and soul of Indian economy. Many agricultural products are exported and a lot of profit is earned by our country. The primary requisite for agriculture is the necessity of water. The whole world is facing the problem of water scarcity, and Southern Indian is also not an exception. So providing water free from contamination to our farmers is a major concern.

The main aim of this thesis work is to purify the contaminated water, fit for the purpose of agriculture. These purification processes is applied to domestic who for sulur discharging a small tank at Sulur in Coimbatore district.

Sulur is a Section Grade Town Panchayt in Coimbatore. It is situated on the Coimbatore - Trichy National Highway Road, 20 Km away from Coimbatore. As it is situated very close to Coimbatore City, it almost resembles to City nature. More over it is a trade center also. Sulur Air Force Station is a military center with runway facility makes the town an important from all sectors usage.

BACK GROUND

The Sulur small tank is situated with a latitude of 11^{o}01'53" and longitude 77^{o}07'53" in the Sulur village of Palladam Taluk in Coimbatore district. The population of the town is 31,000 as per 2001.

PRESENT METHODS OF DISPOSAL

The Sulur small tank receives the surplus water from the Sulur large tank and excess water discharges into the Noyyal River. The Sulur town has 11 lakhs liters per day of Siruvani water supply and 20 lakhs liters per day of Well water supply.

The approximate sewage generation in this town is around 28 lakhs liter per day, which is continuously discharging the sewage into the tank without any proper treatments. Due to this, the Ground water, land and cultivation have extremely affected and there is no fish production in the tank. The tank water is not utilized for irrigation purposes for the pas 15 years, even though a good volume of water is available in the tank.

DETAILS THE TANK

NAME	AREA	CAPACITY	BENEFITED
Sulur Big tank	17.62 acre	17.85 mcft	No direct irrigation
Sulur Small tank	77.35 acre	14.36 mcft	522 acres
Sulur canal of length 3 Km			183 acres

Due to the discharge of the sewage, the quality of water in the tank has gone far below the permissible limits. There is no fish production, which is a indicator of water quality of tank. Even the livestock are unable to quench their thirst. The waste water from the dyeing industries on the upstream side of the river Noyyal and the sewage from Coimbatore has also contributing its Bacteriological load over the tank resulting into environmental degradation to tank. Failure of monsoon was also one of the reasons for the causes of the degradation to the tank in terms of dilution factors.

There is no under ground drainage system for Sulur. The Sullage and Sewage water are taking through the natural gradient and reaches to Sulur tank at the North East part of the town at Sandaipet area. The PWD, WRO Wing of Environmental Cell division, Coimbatore had initiated a new Sewage Treatment Plant in collaboration with Green Solution, an environmental enterpriser, with a new technology. After the treatment, the treated effluent is let into the Sulur tank.

SEWAGE

Municipal wastewater consists of a mixture of domestic wastewater, effluents from commercial, industrial establishments and urban runoff. Domestic wastewater composition depends on the specific water consumption that can vary from 40 to 300 liters/day. Composition is on physical observation influenced by seepage (or) ground water infiltration into the sewer system.

Not all the waste water of sulur is reaching treatment plant only a part of it is reaching.

Domestic wastewater produced in an area that has in house tap connections and that are connected to sewer infrastructure. In areas where hand pumps (or) public stand posts are used for water supply, there is relatively less water consumption and sewer infrastructure is mostly unavailable.

TYPES OF SEWAGE DISPOSAL SYSTEMS

Domestic sewage produced in urban residences, institutions and markets is usually collected by pipes (or) conduits called sanitary sewers. Which lead to a central point. In several residencies domestic sewage is often collected in a septic tank.

Sewage is eventually discharged into underground (or) surface watercourses that naturally drain an area. In past centuries, the dilution produced by discharging sewage into large bodies of water was considered sufficient to render harmless even though any toxic substances contained in it. However the volume of sewage is now very high, so that the dilution method of is no longer considered adequate to safeguard, water courses.

SEWAGE TREATMENT

The Bio-Chemical processes that take place in water bodies have also been relied on to neutralize sewage. Aerobic or oxygen requiring bacteria feed in to sewage, which contains organic materials and decomposing it. However this process uses the oxygen that is dissolved in water. If the concentration of organic wastes present in the sewage is so great that the biochemical oxygen demand (BOD) depletes the Dissolved oxygen, and killing fish & aqua plants. In order to avoid these problems, it is now recognized that all sewage except unmixed storm sewage must be treated before it is going to be discharged.

Sewage treatment is classified as primary, secondary and tertiary, depending on the degree to which the effluent is purified. Primary treatment is used to remove floating and suspended solids. Secondary treatment uses biological methods such as oxidation, decomposition and digestion. Complete (or) tertiary treatment removes all but a negligible portion of bacterial and organic matter.

Domestic sewage must be treated to produce, that is free of odors, suspended solids and objectionable bacteria (Coliform Bacteria) which inhabit the lower intestines of mammals, while not pathogenic of themselves are taken as an index of contamination of water sources. In rural areas, sewage can be stored in a holding tank e.g., a septic tank; naturally occurring anaerobic bacteria can decompose the solids, which then settle into the bottom. While suitable for small systems, this methods has several disadvantages. First, anaerobic decomposition produces noxious gases and it is fairly slow. Second, the harmful bacteria may still be present in the discharged liquid effluent.

SEWAGE TREATMENT-METHODS AND MERITS

Uncontrolled disposal of sewage cause several economic disadvantages to a region, state and the country as a whole. However this disadvantage are never perceived, Because of societal negligence. A recent study substantiate the following facts.

The above enumeration is not exhaustive. It illustrates that we face a globally deteriorating situation. The growing urban populations on the coastal zones will multiply the incidence of pathogen contamination, oxygen stress and emergence of red tides and growth of toxic microorganisms.

SOME CHARACTERISTICS OF A CONVENTIONAL WASTEWATER COLLECTION AND DISPOSAL SYSTEMS ARE

- Aims to control transmission of waterborne diseases and to prevent degradation of the environment.
- Comprises of large volumes of diluted wastewater collected vi an extensive sewer system and treated in modern centralized treatment works.
- Requires large-scale investment, highly skilled labors as well as socio-economic conditions.
- Not available in most developing countries, when it exits, maintenance and operations are poor (or) a problem.
- If collection of wastewater is not combined with effective end-of-pipe treatment, risks for waterborne disease might be increase.

The national plans of all developing nations address the importance of increasing the coverage of safe water supply to the populations. Donor agencies & development banks stimulate this objective and provide support to the low-income countries, it is not likely that sufficient additional financial resources will remain for the proper collection and treatment of the generated sewage before discharge into nearby water bodies. As a result, the sanitary waste was previously contained & treated via on-site technology, will now probably appear as sewage pollution in nearby of those water resources. The can seriously threaten the environment and the health of the users and downstream communities.

AN OVERVIEW OF VARIOUS TREATMENT OPTIONS ARE PRESENTED BELOW

PRIMARY TREATMENT	SECONDARY TREATMENT	TERTIARY TREATMENT	ADVANCED TREATMENT
Bar/Bow screen	Activated Sludge	Nitrification	Chemical Treatment
Grit Removal	Extended Aeration	Denitrification	Reverse osmosis
Primary Sedimentation	Aerated Lagoon	Chemical Precipitation	Electro-Dialysis
Comminution	Trickling Filter	Disinfection	Carbon Adsorption
Flotation	Rotating Bio-Discs	Filtration	Selective lon exchange
Flow Equalization	Anaerobic Treatment	Biological Removal	Hyper Filtration
PH Neutralization	Stabilization Ponds	Constructed Wetlands	Oxidation
Detoxification	Constructed Wetlands Aquaculture Anaerobic + Aerobic	Aquaculture	Aquaculture

The cost conventional wastewater treatment infrastructure is prohibitive in the majority, if not all of the developing countries. According to the World Bank, up to 3% of the countries Gross National Product (GNP) can be realistically spent on environmental protection (Including Wastewater Treatment). Assuming that 1.5% of the GNP could be invested in Sewers & Treatment facilities will far exceed the economic lifetime of the treatment plant and in many cases, even that of sewers. The implementation of conventional wastewater collection & Treatment in developing countries to reach European effluents standards is therefore unrealistic.

NEED FOR THE SEWAGE TREATMENT

Depending on the nature of the community and the industry, the projected uses of the waters of the receiving water sources (i.e.; Streams, Rivers and Sea), various waste constituents may have to be removed before discharge. These may be summarized as follows,

- **Soluble organics** causing depletion of dissolved oxygen since most of receiving water require maintaining of minimum dissolved oxygen for the sustaining the existing desirable biodiversity. The quantity of soluble organics is correspondingly restricted to the capacity of the receiving waters for assimilation (or) by specified effluent limitations.
- **Suspended solids** - Depositions of solids in quiescent stretches of a watercourse will impair the normal aquatic life of the watercourse. Sludge blankets containing organic solids will undergo progressive decomposition resulting in oxygen depletion and the production of noxious gases.
- **Trace organics** - When receiving water is to be used as a portable water supply where phenol and other organics discharged from industrial activity will cause tastes and odors in the receiving water. If these contaminants are not removed before discharge, the additional water treatment will be required.

- **Heavy metals, cyanide and toxic organics**
  The ETP govern the toxic organic and inorganic chemicals contained in the final effluent discharged into watercourses.
- **Color and turbidity -** These present aesthetic problems even though they may not be particularly deleterious for most water uses. In some industries, such as pulp and paper, the economic methods are not presently available for color removal.
- **Nitrogen and phosphorous** - When effluents are discharged in to lakes, ponds and other recreational areas, the presence of nitrogen and phosphorus is particularly undesirable. Because it will enhance the eutrophication and stimulates undesirable algae growth.
- **Refractory substances** resistant to biodegrading. These may be undesirable for certain water quality requirements. ABS (Alkyl Benzene Sulfonate) from detergents is substantially non degradable and frequently leads to a persistence of form in a watercourse. Some refractory organics are toxic to aquatic life.
- **Oil and Floating material** - These produce unsightly conditions and in most cases are restricted by regulations.
- **Volatile materials -** Hydrogen sulfide and other volatile organics and are usually restricted by regulation.

HEALTH IMPACTS

A major challenge for the 21st century is not only creation of wealth, but also the management of health. Concern over the rapid depletion and degradation of the worlds biological resources and implications of this loss on the global biosphere and human welfare have been mounting in recent years.

ENVIRONMENTAL HEALTH-CAUSES & EFFECTS

The causes of diseases associated with environment are as follows.

- Difficulties with biological adaptation.
- Excessive stress working through the nervous system on the Psycho-Physical condition.
- Growth of unfavorable Physical & Chemical stimuli, including carcinogenic & allergic particularly notable in collection with prolonged life span.

An examination of trends in human health at the end of the 20th century reveals some changes in cultural lifestyles with global cultural confluence but with a heavy environment based health risks from mosquito borne diseases to chemical contaminants.

TREATED WASTEWATER FOR IRRIGATION

In rural and per urban areas of most developing countries, the use of treated sewage and wastewater for irrigation is a fact of life, not a matter of choice. In semi arid areas, the use of local sewage is the only water source that supports the livelihood of millions of poor people who irrigate high value crops.

POSSITIVE EFFECTS OF TREATED WASTEWATER FOR IRRIGATION

- Conserves water
- Low cost method for sanitary disposal of municipal wastewater
- Reduces pollution of rivers, canals and other surface water resources
- Increase crop yields
- Provides a reliable water supply to farmer.

POTENTIAL NEGATIVE EFFECTS OF TREATED WATEWATER FOR IRRIGATION

- Health risks for irrigators and communities with prolonged contact with untreated wastewater and consumers of vegetables irrigated with wastewater
- Contamination of ground water interacts
- Buildup of chemical pollutants in the soil ex heavy metals
- Creation of habitats for disease vectors
- Eutrophication of canals carrying wastewater

REUSE FOR AGRICULTURAL PURPOSE

For general agricultural uses of reclaimed water, the quantity guidelines may be useful though it is advisable to associate an experienced agronomist in deciding on actual water quality requirement, especially in case of large farms. If the water quality after secondary treatment does not meet agricultural use additional treatment would have to be provided.

Tertiary treatment is mainly needed for meeting standards of coliform and helminthes which are not met by conventional treatment processes. While coliforms are readily removable by chlorination, helminthes are not. The land required of such ponds can generally be found within the relatively large irrigation command area.

For small orchards and forms and for lawns and gardens, helminth removal can be achieved by small land space by using pressure filters or open sand filters rather than oxidation pond. Chlorination is done for coliform removal. Filtration is also useful where drip irrigation systems are proposed to be used.

ROOT ZONE TECHNOLOGY

The root zone technology also referred to as artificial or constructed wetland systems is basically a man made wetland. Where wastewater is kept at or above the soil surface for enough time during the year to maintain saturated conditions and appropriate vegetation. The three essential components of the system include the soil, the appropriate vegetation such as reeds, cattails, bulrushes and sedges and the microbial organisms. The system has been used in Europe and U.S.A for treatment of industrial waste waters including effluents from textile plant containing over 250 organic chemicals, ammonia liquor from a steel industry and acid mine drainage. COD reductions of 84% have been reported from textile plant effluent with COD around 1500 mg/I at hydraulic residence time of 28 days.

OBJECTIVES OF THE PROJECT

The object of the project study has been narrated as

- ❖ To Study the effectiveness of the Cost Effective Sewage Treatment Plant by using Bio-clean Technology and Root Zone Technology.
- ❖ To analyze the samples collected from each unit for Physico-chemial parameters.
- ❖ To study the suitability of treated water for irrigation purposes.
- ❖ To redesign the plant units to achieve the standard value if necessary.
- ❖ To study the variation of the various parameters using graphs.

CONSTRUCTED WET LAND SYSTEM

After the application of microbes in the aeration, the sewage will be degraded and passes through filter media. The filter media is filled with course and fine filter along with the planting of Typha latifola in Reed bed system.

When the typha plants are planted in the filter media and the treated sewage is retained for 4 to 6 hrs, BOD, COD will be totally reduced. This treated water could be let out into the tan are used for cultivation.

Macrophytes grown in the system play an important role as oxygen donors to the heterotrophic microorganisms in the rhino sphere and to increase the hydraulic conductivity of the root-zone bed. Soil, sand and gravel provide support to the plants grown in wetlands besides renovating the wastewater through various physic-chemical processes.

Then the pollutants in the combined system are removed through physic-chemical and biological process like sedimentation, precipitation, filtration, adsorption, lon exchange and aerobic and anaerobic microbial degradation. This system acts as an efficient nutrient link.

BIO CLEAN

It is a blend of bacteria and enzymes. The bacteria are not genetically engineered. The enzyme concentration is the most power market.

Bioclean is non-poisonous. It creates no heat, no fumes and no boiling. It is neither tissue nor inorganic materials only organic wastes like grease, hair, food part cotton & sewage. This makes BIOCLEAN safe for people, plumbing and the BIOCLEAN change the waste particles in to water, CO_2 and mineral ash. These elements are then available for plant life.

ACTION

Within an hour after introducing bacteria (Bioclean) into the drain, the bacteria begin to eat their wastes that have accumulated on the sides and top of the drainpipe. This is their natural way of digestion and spread throughout the system, cleaning it completely.

APPLICATIONS

- ❖ Residential and Commercial establishments
- ❖ All drain and sewer pipes
- ❖ Septic tank and Drain fields
- ❖ Garbage disposal odors
- ❖ Grease traps
- ❖ Sewage ejector sumps
- ❖ Outdoor out houses and responds
- ❖ R.V. & boat holding tanks
- ❖ Lift stations
- ❖ Cat lifter boxes

ECONOMICAL

- ❖ 2l bottle container treats 1000-gallon septic tank waste
- ❖ Eliminates the need of grease traps and cable drains
- ❖ Eliminates the need to buy dangerous chemicals
- ❖ Eliminates the need to buy deodorant blocks
- ❖ Eliminates the costly compensation to employees who have been injured by handling dangerous chemicals

Bio degradation is the earth's natural process of converting organic matter into environmentally safe by products including water, CO_2 and methane gas. This process is accomplished through naturally occurring microorganisms such as bacteria and fungi.

Although these microorganisms are naturally occurring, certain extraneous factor may not be conductive to proper growth of these microbes or for the reduction of organic compounds.

Bioclean cultures are specifically formulated to resolve problems in wastewater systems receiving high-strength effluents. They have been selectively adapted through a scientific process that develops the bacteria and allows them to degrade, tough and toxic compounds that would normally overwhelm naturally occurring bacteria. The bioclean series is designed to make good systems, operate better and significantly improve conditions in problematic effluent treatment plants. These microbes increase the efficiency of the plants without the need for increasing plant capacity and save cost of electricity.

BENEFITS OF BIOCLEAN

- It digests the difficult compounds that are toxic to naturally occurring bacteria or existing genetic bacteria.
- Provides rapid breakdown of difficult to degrade substances viz surfactants, fats, oil, sulphides, mercaptans, phenols, cresylates, hydrocarbons, aromatic compounds etc.
- Cultures grow in either the presence or the absence of oxygen
- Bioclean is the only bio-product that can perform efficiently in effluents having high TDS
- No need to modify the existing process
- This bioclean gives low treatment cost, increases the efficiency of the treatment plant and saves the cost of energy.
- It controls the odor because of complete biodegradation of organic compounds.
- Sludge generation is minimum compared to the other process because most of the wastes are converted into carbon dioxide and water
- Non-corrosive, non-pathogenic and low quantities of use, making it safe and easy to handle and store.

THE ROLE OF BIOCLEAN IN ENVIRONMENTAL PROTECTION NORMS

With the government bodies imposing stringent pollution control measures and adopting an uncompromising stand on polluting industries, it augurs well for all such industries to comply with the specified norms. Violation thereof, can invite heavy penalty, and consequently, dispute to the organization.

DISPOSAL INTO WATER BODIES

The effluent from sewage treatment plants may be discharged in receiving waters such as lakes, streams, rivers, estuaries, and oceans and on the land. The nature and degree of treatment given to the sewage is dependent upon the requirements imposed by the regulatory authorities. It is the large water pollution along with small residual organics after treatment that has to be disposed of while the major portion of the organics is removed within the treatment plant itself. The treated sewage effluent has rich in nutrients which increase the fertility value and it is used for the irrigation and pisciculture. The effluent can also be used for low grade industrial purposes and artificial recharging of aquifers in areas. Competing land uses, public health impact, energy requirement, aesthetics and biological effects decide the mode of disposal whether on land or in the water. The problems encountered in the selection process are complex and demand a multidisciplinary approach.

Treated effluents conforming to prescribed standards may be disposed into a stream course or into which the effluent is discharged decide the degree of treatment required for the sewage. Since the treated wastewater may be considered for reducing the coliform density before disposal of treated effluent into the water bodies.

MATERIALS OF METHODS

NEED OF THE COST EFFECTIVE SEWAGE TECHNOLOGY

The conventional method of sewage treatment either need more land on more mechanical and electrical apparatus. In land application though the process of the treatment is very simple, the main obstacle is acquiring lands near the urban center some 10 to 20years back this technology had proved more efficient than any other techniques, because of no mixing of industrial effluent but today the scenario is different. Any urban center develops along with small and medium scale industries. These industries are discharging their effluents into the drains which ultimately finds its way with sewage. The chemical usage in domestic sector are also increased to three to four times than in 1980. So the oxidation ponds (or) aerated lagoons could not able treat the chemical contamination.

Where the trickling filter (or) activated sludge process can tackle any quantity of sewage. These technologies proved well and there is no second thought. But the underground pipeline arrangements made to collect sewage from all part of city need more money and pathway. This seems to be very success in metropolitan bodies could generate more fund from various sector for implementation and operation. Now there is a change in the concept of centralized system. Almost all the corporations and major cities have divided the cities as north, south, east and west zones. Based on their zone the water supply bus stand, hospitals, transportation facilities are being arranged on this basis the sewage treatment can also decentralized.

The second and third grade towns are needed an alternative technology with minimum lands and mechanical equipments for easy maintenance. This demand, forced to develop a cost effective treatment technology blending the old wetland systems and the new biological methods with modern aerators with less power.

TYPICAL COMPOSITION OF UNTREATED DOMESTIC WASTEWATER

ITEM	CONCENTRATION
PH	6-9

ELECTRICAL CONDUCTIVITY	2.25 (mg / l) -
CHLORIDES	100 (mg / l) - 120(mg / l)
TOTAL SOLIDS	1200 (mg / l) - 1210 (mg / l)
TOTAL DISSOLVED SOLIDS	850 (mg / l) - 870 (mg / l)
TOTAL SUSPENDED SOLIDS	330 (mg / l) - 350 (mg / l)
DISSOLVED OXYGEN	1.8 (mg / l) - 2.0 (mg / l)
CHEMICAL OXYGEN DEMAND	1000 (mg / l) - 1020 (mg / l)
BIOCHEMICAL OXYGEN DEMAND	350(mg / l) - 400 (mg / l)
CHLORIDES	100 (mg / l) - 120 (mg / l)

ISI TOLERANCE LIMITS FOR THE INLAND SURFACE WATER (IS 2490)

ITEM	TOLERANCE LIMITS
PH	5.5-9
ELECTRICAL CONDUCTIVITY	
CHLORIDES	600(mg / l)
TOTAL SUSPENDED SOLIDS	100 (mg / l)
DISSOLVED OXYGEN	3 (mg / l)
CHEMICAL OXYGEN DEMAND	250 (mg / l)
BIOCHEMICAL OXYGEN DEMAND	30 (mg / l)

STANDARDS FOR IRRIGATION WATER (IS 2490)

ITEM	STANDARD VALUES
pH	6-8.5
ELECTRICAL CONDUCTIVITY	2.25 (mg / l)
CHLORIDES	355 (mg / l)
TOTAL SOLIDS	2000 (mg / l)
TOTAL DISSOLVED SOLIDS	500-2000 (mg / l)
TOTAL SUSPENDED SOLIDS	200 (mg / l)
BIOCHEMICAL OXYGEN DEMAND	100 (mg / l)

PRESENT METHOD OF DISPOSAL AT SULUR

The conventional type of sewage treatment methods either needs larger area or huge machinery involvement like heavy aerators, pipe lines etc., Because of these constraints many townships, municipalities do not have sewage treatment plants even if they are having a STP, running STP is great task to them, because of heavy machineries involvements.

Hence to achieve a cost effective treatment plant the following technologies have been evolved and are to be implemented in this study.

UNITS INVOLVED IN THE TREATMENT PLANTS

1. Bar screen arrangements
2. Collection tank with screening arrangements (below ground level)
3. Aeration tank (above ground level) with settling tank
4. Pump room and mechanical and electrical arrangements
5. Filter arrangements (Collection tank, coarse filter tank, medium coarse Filter tank, and fine sand filter tank)

CIVIL WORKS AND CONSTRUCTION OF TANKS

CIVIL WORKS

The civil works include the following items:

1. **Collection Zone**
   (a) Diversion Drain
   (b) Bar Screens / Mesh Screens
2. **Treatment Zone**
   (a) Application of microbes and aerator below ground level
   (b) Application through constructed wetland system above ground Level
   (c) Pump room and Mechanical Equipments
3. **Filtration Zone**
   (a) Multigrade Filter
   (b) Natural Filter

CONSTRUCTION OF TANKS

(1) COLLECTION ZONE

DIVERSION DRAIN

The Sulur Town sewage is draining to Sulur small tank through market area. The treatment plant is so arranged near to the drain so that conveyance problem was avoided. The diversion was constructed using R.R. masonry with Cement mortar 1:5. A small inspection tank was also constructed just before the collection tank.

SCREENS

A screen is a device with opening generally of uniform size for removing bigger suspended or floating matter in sewage. The screening elements may consists of parallel bars, rods greating (or) wire meshes (or) perforated plate and the opening may be of any shape although generally they are circular (or) rectangular.

For the drain two rectangular types of bar screens were vertically fixed. The bar screen is fixed to remove bigger size solid wastes. The weld mesh screen was fixed to retain the next size of floating solids like polythene bags, bottles etc.,

In the collection tank near sewage pumping area a wire mesh screen was fixed to filter are solid wastes.

COLLECTION TANK

A Collection tank of size 10 m x 8 m x 2.50 m depth was constructed to collect the town sewage. In the collection drain three types of screens were provided to screen the solid wastes like Polythene bags and any other domestic waste. The inlet level was fixed based on the site condition of the existing drain. This tank has constructed below ground level and hence the walls, base slab are designed as RCC tank. The inlet level of sewer is 1:2m below ground level sewage could be stored up to 1.40 m height only.

PUMP ROOM

A small pump room of size 1.50 m x 2.40 m was constructed in between collection tank and aeration tank. The waste water from collection tank will be pumped to aeration tank for which 3HP motor is needed. For each aerations 1.5HP motor is required, so the power requirement is restricted to 10.5 HP. A panel board was also erected in the power room.

(2) TREATMENT ZONE
AERATION TANK

Aeration tank is one where microbes will be added and powerful inject type diffuser aeration is fixed. This tank was designed with three parts where the effluent pass through this three pars as Zig-Zag. Five numbers of aerators have been analyzed. The walls were constructed with BW in C:M 1:5 and side portion was constructed with RCC lining of 10 cm thick. The total height of the tank is 1.80 m height. The size of each tank is 13.5m x 2.90m x 2.20m necessary holes with 6”dia PVC pipe is made in the third part of the tank so that waste water will go to next tank by siphon action.

The main purpose of aeration tank is after pumping the sewage water from collection tank to aeration tank, necessary microbes in the form of powder will be added. The powerful diffuser type aerator will multiple the Bacteria’s population. The Bacteria will do the digestion and water will go to next tank in gravity.

SLUDGE SETTLING TANK

The sludge-settling tank does the purpose of settling the sludge. Arrangements have been made to Recirculation the sludge if is accumulated. Then the water will pass to filtration tanks. The sludge settling tank is also with three parts of size 5m x 2.90m 1.90m. The wastewater pass through these three parts and then to filtration tanks.

(3) FILTRATION ZONE
COURSE FILTER TANK

Serial of filter tanks have been constructed. The First filter tank of size 10m x 7m x 1.8m depth. This is filled with 40mm size HBGS jelly as filter media. Arrangements made so that water flow through Zig - Zag path for better retention period.

MEDIUM FILTER TANK

The Second filter Tank is of size 10m x 7m x 1.50m. Half of the tank is fillted with medium filter media of 20mm HBGS jelly. Arrangements were made so that water will flow through Zig - Zag way.

FINE FILTER TANK

The third and final tank of size 10m x 7m with two baffle walls so that the water flow in three compartments. Half of the was filled with fine and media filter media of sand and pebbles.

AERATION PIPES

In all three filter tanks vertical perforated PVC pipe of 3” Dia are fixed for better aeration below and Root zone area.

PLANTS

Conventional Type plants will be planted in the filter tank over the filter media. The roots of Typha can able to sustain in the filter media. The Typha Oxygen will be emits through roots, which also increase the DO level in the water.

The combined new biological and conventional filter and plants the sewage treatment will be done.

SAMPLE COLLECTION

The samples are collected once in 20 days from the outlet point of Collection tank , Aeration tank, Settling tank, Filtration unit and final discharge point.

These samples are tested for the following Physic-chemical parameterslike PH, electrical Conductivity, Chlorides, Total Solids, Total Dissolved Solids, Total Suspended Solids, Dissolved Oxygen, Chemical Oxygen Demand, Bio chemical Oxygen Demand.

Then these values are compared with the IRRIGATION STANDARDS value.

For the quantity of sewage uptake in Sulur small tank the dimensions of each unit is designed based on the conventional method. Then both the designs are compared and the cost effectiveness of the present unit is evaluated.

RESULTS AND DISCUSSIONS

TABLE-1

PARMETER	COLLECTOIN TANK	AERATION TANK	SETTLING TANK	FILTER UNIT	FINAL DISCH ARGE
Ph	7.2	7.3	7.2	7.1	7.1
EC	2.57	2.54	2.52	2.44	2.44
CL_2	1350	1340	1320	1300	1285
TS	2350	2115	2025	1965	1885
TDS	1950	1930	1905	1885	1885
TSS	400	185	120	8	30
DO	0.3	1.8	1.7	1.5	1.3
COD	495	185	120	80	30
BOD	305	170	105	70	55

TABLE-2

PARMETERS	COLLECTION TANK	AERATION TANK	SETTLING TANK	FILTER UNIT	FINAL DISCHARGE
Ph	7.0	6.8	6.8	6.8	6.7
EC (mg / l)	2.42	2.39	2.37	2.36	2.33
CL_2 (mg / l)	1280	1260	1255	1245	1220
TS (mg / l)	2340	2090	1955	1890	1800
TDS (mg / l)	1840	1810	1800	1790	1760
TSS (mg / l)	500	230	155	100	40
DO (mg / l)	0.3	2.0	2.0	1.8	1.5
COD (mg / l)	690	300	180	120	65
BOD (mg / l)	430	200	135	85	50

TABLE-3

PARMETERS	COLLECTION TANK	AERATION TANK	SETTLING TANK	FILTER UNIT	FINAL DISCHARGE
pH	6.4	6.4	6.4	6.5	6.5
EC (mg / l)	2.29	2.26	2.26	2.25	2.23
CL_2 (mg / l)	995	980	980	970	955
TS (mg / l)	2065	1870	1825	1785	1715
TDS (mg / l)	1745	1720	1720	1710	1085
TSS (mg / l)	320	150	105	75	30
DO (mg / l)	0.6	2.0	1.9	1.7	1.5
COD (mg / l)	450	200	125	90	55
BOD (mg / l)	280	135	90	65	35

TABLE-4

PARMETERS	COLLECTION TANK	AERATION TANK	SETTLING TANK	FILTER UNIT	FINAL DISCHARGE
pH	7.0	6.9	6.8	6.8	6.9
EC (mg / l)	2.31	2.30	2.30	2.29	2.27
CL_2 (mg / l)	980	970	970	965	950
TS (mg / l)	2140	1915	1895	1830	1769
TDS (mg / l)	1760	1745	1745	1735	1720
TSS (mg / l)	380	170	150	95	49
DO (mg / l)	0.2	1.8	1.6	1.4	1.4
COD (mg / l)	560	315	185	120	80
BOD (mg / l)	350	195	115	75	55

TABLE-5

PARMETERS	COLLECTION TANK	AERATION TANK	SETTLING TANK	FILTER UNIT	FINAL DISCHARGE
pH	6.9	6.8	6.9	6.9	6.9
EC (mg / l)	2.39	2.36	2.35	2.34	2.31

CL_2 (mg / l)	1050	1040	1035	1025	1005
TS (mg / l)	2280	2020	1945	1870	1775
TDS (mg / l)	1816	1800	1780	1760	1730
TSS (mg / l)	460	221	165	110	45
DO (mg / l)	0.3	1.7	1.6	1.4	1.3
COD (mg / l)	625	290	185	130	85
BOD (mg / l)	390	190	125	90	64

TABLE-6

PARMETERS	COLLECTION TANK	AERATION TANK	SETTLING TANK	FILTER UNIT	FINAL DISCHARGE
pH	6.8	6.7	6.9	7.0	7.0
EC (mg / l)	2.44	2.41	2.40	2.35	2.31
CL_2 (mg / l)	1220	1210	1210	1200	1180
TS (mg / l)	2220	2000	1965	18700	1790
TDS (mg / l)	1865	1830	1820	1776	1740
TSS (mg / l)	355	163	145	96	50
DO (mg / l)	0.2	1.8	1.6	1.3	1.1
COD (mg / l)	530	295	175	115	75
BOD (mg / l)	330	185	110	75	45

pH VARIATIONS

SAMPLE COLLECTION	RAW WATER	pH
1	7.2	7.1
2	7.0	6.7
3	6.4	6.5
4	7.0	6.9
5	6.9	6.9
6	6.8	7.0

CHLORIDES VARIATIONS

SAMPLE COLLECTION	RAW WATER CHLORIDES VALUE	CHLORIDES VALUE	% REDUCTION
1	1350	1340	0.7
2	1280	1260	1.5
3	995	980	1.5
4	980	970	1.0
5	1050	1040	0.95
6	1220	1210	0.81

TOTAL SOLIDS VARIATIONS

SAMPLE COLLECTION	INITIAL TOTAL SOLIDS mg/l	FINAL TOTAL SOLIDS mg/l	% REDUCTION
1	2350	1885	19.78
2	2340	1800	23.07
3	2065	1715	16.94
4	2140	1769	17.33
5	2280	1775	21.49
6	2220	1790	19.36

TOTAL DISSOLVED SOLIDS VARIATIONS

SAMPLE COLLECTION	TOTAL DISSOLVED SOLIDS mg/l	TOTAL DISSOLVED SOLIDS mg/l	% REDUCTION
1	1950	1855	4.87
2	1840	1760	4.34
3	1745	1080	38.10
4	1760	1720	2.27
5	1816	1730	4.73
6	1865	1740	6.70

DO VARIATIONS

SAMPLE COLLECTION	INITIAL DO mg/l	FINAL DO mg/l
1	0.3	1.3
2	0.3	1.5
3	0.6	1.5
4	0.2	1.4
5	0.3	1.3
6	0.5	1.6

TOTAL SUSPENDED SOLIDS VARIATIONS

SAMPLE COLLECTION	INITIAL TOTAL SUSPENDED SOLIDS mg/l	FINAL TOTAL SUSPENDED SOLIDS mg/l	% REDUCTION
1	400	30	92.5
2	500	40	92
3	320	30	90.63
4	380	49	87.10
5	460	45	90.27
6	355	50	85.91

COD VARIATIONS

SAMPLE COLLECTION	INITIAL COD mg/l	FINAL COD Mg/l	% REDUCTION
1	490	30	93.87
2	690	65	90.57
3	450	55	87.77
4	560	80	85.71
5	625	85	86.40
6	530	75	85.84

BOD VARIATIONS

NO OF TIMES COLLECTED	INITIAL BOD mg/l	FINAL BOD Mg/l	% REDUCTION
1	305	55	81.96
2	430	50	88.37
3	280	35	87.5
4	350	55	84.28
5	390	64	83.58

pH

The investigation of data reveals that pH is 6 to 7.3. These values are compared with irrigation standard and its value come within the limit.

ELECTRICAL CONDUCTIVITY

By having the analytical data, these ranges from 2.23 to 2.57 (mg/l). This values also within the standards pressured for as use agriculture.

CHLORIDES

From the investigation data, these values range are 950 to 1350 (mg/l). Due to this chlorides can often serve as a chemical - pollution indicator of domestic sewage contamination when considered together with other parameters.

TOTAL SOLIDS

Total salt is one of the important parameter. Its concentrations of the water as it affects crop yield through osmotic effects. The presence of soluble salts in excessive quantities than recommended value is very harmful to the soil and plants. On the analysis of sample showed the range between 1735 to 2350 (mg/l) for TS.

TOTAL DISSOLVED SOLIDS

The term refers to the matter either filterable or non-filterable that remains as a residue in water.

Its contains mainly of inorganic salts such as carbonates, bicarbonates, chlorides, sulphates etc., in small amount of inorganic matter and dissolved gases.

Its ranged from 1080-1950 (mg/l)

TOTAL SUSPENDED SOLIDS

The Suspended solid materials are often natural contaminants resulting from erosive action of water flowing over land surface.

From analytical data the value is 30 to 50 (mg/l), its within the standard limit presented for agriculture use.

DISSOLVED OXYGEN

It is one of the important parameters to assessing the quality of water bodies and also plays key role in water pollution control activities. All living organisms are dependent upon oxygen in one form or the other to maintain metabolic process that produces energy for growth and reproduction. Aerobic process is the subject of great interest for their need for oxygen.

By having the analytical data value is up to 2 mg/l.

Most of the samples showed upto 2 mg/l.

CHEMICAL OXYGEN DEMAND

This test indicates the total oxidizable and doesn't diffractive between biological oxidizable and biologically inert organic matter.

The Degree of oxidation depends upon the type of substance, pH value, temperature, reaction time and concentration of oxidizing agent as the type of added accelerators. The COD values ranges from 30 to 690 mg/l for the samples tested.

BIOCHEMICAL OXYGEN DEMAND

The BOD is an Empirical biological test in which the water condition (or) type of bacteria plays a decisive role. This test has a special importance in the assessment of pollution of surface waters. The samples showed BOD values ranging from 35 to 430 mg/l which is less than 500 mg/l required for irrigation.

DESIGN CONSIDERATIONS:

CHOICE-1

Design of sewage treatment plant for Sulur
Population of Sulur (as per 2001 census) - 31,000
Per capita contribution - 90.3 lit/day
Total quantity of sewage generation - 31000cum

The treatment plant may be designed from the economical point of view 50% sewage generation for under ground drainage system due to the following reasons:

- Less water distribution
- Evaporation at various points
- Percolation
- Low level area and unserved areas
- Absorption by plants etc.
- Other losses

The components of the treatment plant are

- Collection Well
- Anaerobic lagoon
- Aerated lagoon
- Secondary settling tank

COLLECTION TANK:

Design

Quantity of sewage collection - 300 m^3 / day
Detention Time - 1 hr
Volume of tank required - 12.5 m^3
Area required - 4.7 m^2

Hence, provide a RCC / masonry tank of size 2m x 2m x 3.5m with a free bard of 20 cm and 0.15m-scour depth.

ANAEROBIC LAGOON

Design

Quantity of sewage to be treated - 300m^3 / day
Detention time5 days
Quantity lagoon required - 300 x 5 = 1500 m^3
Provide an effective depth of 3.50m
Surface area required 1500/3.5 = 428m^2
Provide 4 nos of lagoon with each area of
428/2 = 214m^2
Provide each lagoon of size 20 x 10 x 3.95m over all depth with 0.30m free board and 0.15m depth, top width of 1.5m, overall base which will be 8m
Overall area required- 2 x 36 x 26 = 1872m^2

AERATED LAGOON

Oxygen Requirement:
Quantity of Sewage - 300m3/day
BOD contribution - 50mg/l
Oxygen required - 1.4 x 300 x 50
= 210
Power required - 210/0.8 x 2 = 131.25KW

Aerated lagoon
Flow - 300m^3/day
Detention Time - 24 hrs
Volume of the Tank - 300m^3
Provide a depth of 1.5m
Surface area required - 300/1.5 = 200m2
Provide 2 Nos of tank with surface area of 100m2 overall depth of 1.50m and free board and 0.15m scour depth, size of tank will be 10m x 10m with 2:1 slope and 1.0m top with, base width for 1.95m will be of size 5m.
Overall required = 2 x 20 x 20 = 800m^2

SECONDARY SETTLING TANK
Flow - 300m^3/day
Detention Time - 12 Hrs
Volume of the Tank - 300 x12/24 = 150m^3
Provide a depth of 1.5m
Surface area required = 150 / 1.5 = 100m^2

Provide 2 Nos of tank with surface area of 50 sqm overall depth of 1.50m and free board and 0.15m scour depth, size of tank will be 10m x 10m

With 2:1 slope and 1.0m top with, base width for 1.95m will be of size 5m
Overall area required - 2 x 20 x 20 = 800m^2
Total land requirement = 1872 + 800 + 800 = 3472m^2

CHOISE 2

PRIMARY SETTLING TANK
Assume detention time - 2 hrs
Removal efficiency of suspended solids (%) -60%
The Sulur waste water contains suspended solids - 400mg/lit
Mass of dry solids removed - 0.6 x 400 = 240mg/lit

$$\text{Volume of the tank} = \frac{\text{Dry solids}}{\text{Specific gravity x \% of solid contents}}$$

= 240 / 1.03 x 0.6
V = 388m^3

ACTIVATED SLUDGE PROCESS

Population - 31000
Per capita / sewage flow - 90lit/day
Influent BOD - 350mg/lit
Effluent BOD - 50mg/lit
Average of Flow - 31000 x 90 / 1000
= 27.9 x 10^{3}m^3/day

- Required efficiency = (350-50/350) x 100
= 86%
- Compute the Volume of the tank
  Adopting F/M ratio = 0.2
  MLSSconcentration = 3000mg/lit
  F/M = Ql$_a$/VX$_r$
  V = 7.9 x 10^3 x 350 / 0.2 x 3000
  V = 1627 m^3 / day

Check the Hydraulic retention time
HRT = (V/Q x 1000) x 24
=16275 x 24 / 27.9 x 10^3
=14 hrs

- **Determine the volumetric loadin**
  =QL$_a$ / V
  =27.9 x 10^3 x 350 / 16275 x 1000
  =0.6 kg/day
- **Return of sludge (for SVI = 100)**
  $Q_r / Q = \frac{X_t}{(10^6 / SVI) - 3000}$

  $X_t = \frac{3000}{(10^6 / 100) - 3000}$
  = 43%
- **Tank dimensions**

Adopting the depth of 5m and width 6.5m, Length of aeration channel.
= 16275 / (5 x 6.5) = 500m

Providing a continuous channel with 6 baffles, each length being 70m to give a total length of 500m. Total width of each unit (including 6 baffles of 0.25m thickness).
=500 / 80 = 6.25 = 7m
=7 x (6.5 + 1.5) = 56m
Free board of size = 0.5 m
Overall dimensions of the tank = 70m x 56m x 5.5m

SECONDARY SETTLING TANK
Flow = 300m^3/day
MLSS = 3000mg/lit
Peak factor = 2.25
Average flow = 300/2.25 = 133.3m3 / day
Adopting a surface load of 20m^3 / day/m^2 at average flow.
Surface area = 133.3 / 20 = 6.67 m^2
Check surface loading for peak flow
= 300 / 6.67 = 45.5 m^2 / sec
For a solids loading of 125kg/day/m^2 at average flow, area required
= (133.3 x 3000) / (1000 x 125 x 1000)
= 3m^2
But area required at solid loading of 250 kg/day/m^2
= 300 x 3000 / 250 x 1000 = 3.6 m^2
Adopt a higher surface area of 6.6 m^2
Diameter = $\sqrt{6.6}$ x 4/3.14 = 2.89 m

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