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DESIGN OF SEWAGE TREATMENT PLANT FOR TRIMBAKESHWAR

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ABSTRACT

A study on domestic waste water characterization has been performed followed by the design of sewage treatment plant. A sewage treatment plant is quite necessary to receive the domestic and commercial waste and removes the materials which pose harm for general public. Its objective is to produce an environmentally-safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer). The sewage treatment plant in Trimbakeshwar uses primary, secondary and tertiary treatment units for treating predominantly domestic sewage. The treated effluent is used in irrigating agricultural farms for growing animal fodder and in landscape irrigation in the village. The plant is designed, operated and maintained so as to ensure safety and reliability in the treated effluent quality. Any overloading of the treatment processes is handled effectively. The quality meets the required basic standards and guidelines for landscape irrigation and farming.

I.INTRODUCTION

The population of India as per 2011 census is about 121 corers out of this 70% population is in rural area and 30% is in urban areas. Due to lack of job opportunities divided land, the rural population is migrating in urban areas. Therefore rate of urbanization is increasing decade to decade.Henceforth due to inadequate sewage collection network and improper handling of sewage we see the pollution of Godavari River reaching its peak from its source and therefore we need a proper sewage treatment plant for control and recycling purposes and to provide effective and efficient source of water.Sewage or waste water is a dilute mixture of various wastes from residential and other public places. Before deciding the line of its treatment and disposal, it is necessary to know its composition, quality, and characteristic. Though the characteristics of sewage or wastewater depends upto the source of its discharge, sewage in general contains organic matter, inorganic matter, and living organisms. The organic and inorganic matter may be in dissolved, suspended and colloidal state. The inorganic or mineral matter consists of ash, cinder, sand, grit, mud and other mineral salts. The organic matter may be either nitrogenous or nitrogen free. The chief sources of nitrogenous matter are urea and protein, while the nitrogen free compounds include carbohydrates fats and soaps. Trimabak or Trimbakeshwar, one of the taluka headquarters from Nashik, has a religious importance in India as one of the twelve “Jyotirlingas” which is a place of holy pilgrims and worship for Lord Shiva. The Peshva’s ruled the city and build the holy temple about 400 years ago, adding to this importance, it was the adobe of Lord Rama with Sita and Laxman. During the part

of his exile forest .It is also said that, Chatrapati Shivaji Maharaj has visited this town and lived in the city.The historical importance of Trimbakeshwar had made a profound effect on the religion.There are many religious places of temples of Gods, Goddess (viz Gayatri temple,Sant Nivrutinath Maharaj Mandir.) Other than the Trimbakeshwar, math, Samadhi, Bhramhagiri hill range, Gangadwar, place for Narayan Nagbali etc. Years the round devotees perform religious functions in Trimbakeshwar. Adding to this, once in twelve years, as sacred Hindu pilgrimage, Kumbh Mela is celebrated in Nashik and Trimbak on the banks of river Godavari. Billions of people visit the town and take a holy bath at Kushavarta Tirth.Trimbakeshwar has its own environmental value other than its importance. This place is known for its natural scenic beauty, a clean and fresh air, water and peaceful atmosphere. Attempts are made to develop this region as a place of religious tourism. The quality of natural resources, diversity in the biological components and related environmental assets of Trimbak are well recognized and appreciated. Ecologically, Trimbakeshwar is a part of the Western Ghats, one of the globally recognized hotspots in India. Ecologically, this region falls in the northern region of western ghats and this area is rich in floral and faunal diversity.Trimbak is also a place of origin for the river Godavari, which has a significant basin in the state of Maharashtra. The holy river Godavari originates from the top of Bhramhagiri hills. It emerges again at Kushavarta Tirth and further flows down and becomes the main river course. There is another small river Ahilya that flows through small track and joins the river Godavari within the town itself. Also most Mhatar Nala is connected to river Ahilya. Nearly 2.5km long stretch of river falls within the limit of trimbakeshwar Municipal limit.All the pilgrimage activities, exponential increase in the form of visitors as floating population, is responsible for creating pressure on the environmental assets of the town. Sanitation facilities, sewage treatment and soil waste management are some of the important challenges before the administrative authority of the town i.e Trimbak Nagar Parishad (TNP). Regular monitoring of some of this environmental parameters is carried out by the Maharashtra Pollution Control Board (MPCB) as per the guidelines laid down by the Central Pollution Control Board (CPCB). Nevertheless, it becomes the responsibility of the TNP to maintain the environmental parameters through managing the waste adopting best possible methods and technologies despite the financial, infrastructure, human resource constraints.

II.LITERATURE SURVEY

Scope of work

Under the project work studies will be conducted with reference to following:

- Materials and Methodology (Population Forecasting)
- Estimation of Sewage Generation
- Techno-economical Selection Of Process
- Process Design
- Cost Detailing
- Process Flow Diagram
- General Layout

Population Forecasting

The various methods which are generally adopted for estimating future population by engineers are described below. However, as pointed out earlier, none of these methods is exact, and they are all based on laws of probability, and thus, only approximate estimates for the possible future populations can be made.

- Arithmetic increase method.
- Geometric increase method.
- Incremental increase method.
- Decreasing rate of growth method.
- Demographic method of population projection.
- Logistic method.
- Method of density.
- Graphical method
- Graphical method based on single city.
- Graphical method based on cities with similar growth pattern.

Population change can occur in three ways: by birth (population gain), by death (population loss), or by migration (population loss or gain depending on whether movement-out or movement-in occurs in excess). Annexation of area may be considered a special form of migration. Population forecasts are frequently made by preparing and summing up separate but related projections of natural increases and of net migration, and are expressed below. The net effect of births and deaths on population is called natural increase (natural decrease, if deaths exceed births). Migration also affects the number of births and deaths in an area, and so, projections of net migration are prepared before projections for natural increase. This method thus takes into account the prevailing and anticipated birth rates and death rates of the region or city for the period under consideration. An estimate is also made of the emigration from and immigration to the community, its growth area-wise and the net increase of population is calculated accordingly considering all these factors by arithmetical balancing.

The population of Trimbak can be classified into residential and floating. The residential population has limited scope of growth in the town whereas the growth pattern of floating population is exponential. There is significant increase in the devotees visiting Trimbak during festival, Pooja Vidhi and KumbhMela etc.

Analysis of the growth in residential population is imperative to understand the current scenario and forcast the future. Accordingly, the available census records were listed and population for next four decades is calculated using arithmetic method.

Data regarding the population (current and estimate)

Year	Population	Source
1951	4135	FROM CENSUS DATA
1961	4814	FROM CENSUS DATA
1971	5495	FROM CENSUS DATA
1981	6759	FROM CENSUS DATA
1991	7883	FROM CENSUS DATA
2001	9804	FROM CENSUS DATA

2011	12056	FROM CENSUS DATA
2015	12672	FORECASTED
2021	13691	FORECASTED
2031	15641	FORECASTED
2041	17905	FORECASTED
2051	21064	FORECASTED

Formula: In this method, a progressively decreasing or increasing rather than a constant rate is adopted. This is a modification over the Arithmetical Progression method.

Calculation of Population Forecast

Year	Population	Increase(X)	Incremental Increase(Y)
1951	4135		
1961	4814	679	
1971	5495	681	2
1981	6759	1264	583
1991	7883	1124	-140
2001	9804	1921	797
2011	12056	2252	331
Total		7921	1573
Average		7921/6= 1320.17	1573/5= 314.6

CALCULATIONS:

Population can be projected using the formula:

$P_n = P_1 + nX + n(n+1)\,Y/2$

$P_{2015} = 12056 + 0.4 \times 1320.17 + 0.4(0.4+1)314.6/2$

$= 12672$

$P_{2021} = 12056 + 1 \times 1320.17 + 1(1+1)314.6/2$

$= 13690.77 = 13691$

$P_{2031} = 12056 + 2 \times 1320.17 + 2(2+1)314.6/2$

$= 15640.14 = 15641$

$P_{2041} = 12056 + 3 \times 1320.17 + 3(3+1)314.6/2$

$= 17904.11 = 17905$

$P_{2051} = 12056 + 4 \times 1320.17 + 4(4+1)314.6/2$

$= 21064$

III. ESTIMATION OF SEWAGE GENERATION

The composition of sewage or wastewater largely depends upon the source from which it is found in domestic wastewater which may be classified as strong, medium and weak, depending upon the concentration of these constituents. It should be noted that sewage contains only a very small percentage of solids in relation to huge amount of water. Liquid content of sewage is 99.9% while total amount of solids is only 0.1%.

Characteristics of Wastewater. The most important physical characteristics of water is its total solids content, consisting of floating matter, matter in suspension, colloidal matter and matter in solution. Other physical characteristics are: smell or odour, color, temperature.

Sewage contains complex organic matters derived from urine, faeces etc. and inorganic chemicals. Fresh domestic sewage is lightly alkaline but tends towards acidic as it becomes stale.

Important chemical characteristics of sewage are:-

- pH value
- Biochemical oxygen demand
- Chemical oxygen demand
- Fat, grease and oil content
- Nitrogen content
- Sulphides, Sulphates and H_2S gas
- Dissolved oxygen

Biological characteristics

Biological characteristics relate to various micro-organisms found in wastewater, some of which might be pathogenic. However, all bacteria present in wastewater are not harmful. Some of these help to treat the wastewater and reduce the cost of treatment plants.

Following table shows a summary of physical, chemical and biological characteristics of wastewater and their sources.

Layouts

The water supply rate for the Layouts has been considered as 135 lpcd as per the CPHEEO manual. The 85% of the water supplied is considered for sewage generation.

Calculation:

Water Supply Rate = [135*0.85*Population + 10% Infiltraton]/ 10^6

= [135*0.85*21064 + 10% Infiltration)] / 10^6

= 2.65 MLD

= 3.00 MLD (approx)

Capacity of Proposed STP

The sewage flow by the year 2031 would be 2.10 MLD and by the year 2051 would be 3 MLD. In this context, it is proposed to build STP of 3 MLD capacity depending upon the development and subsequent sewage flow generation, which would ultimately cater flows of year 2051. This will facilitates optimum utilisation of plant capacity.

Raw Sewage Characteristics:

As per CPHEEO manual the per capita BOD and SS contribution for Indian condition are 45-54 gm/day and 90-100 gm/day respectively. Based on water supply to consumers the corresponding BOD and SS would be 210 - 260 mg/l and 300 – 350 mg/l respectively. This shows that the BOD and SS values expected are relatively higher. In view of this and considering overall scenario of Trimbakeshwar town and in future entire sewerage will be conveyed through gravity sewers with 100% house connection ratios, the design raw sewage

Effluent Standards

It is proposed to discharge the treated sewage into the river stream Godavari within the norms prescribed by Maharashtra Pollution Control Board standards (MPCB). It is proposed to provide disinfection for reduction of fecal coliforms to treated sewage before discharge into river stream Godavari. Biological nutrient removal is not proposed for reduction of Ammonical nitrogen. Higher chlorine residual and/or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed.Chlorine residual of 0.3-0.5 mg/l or greater in the distribution system is recommended to reduce odours, slime, and bacterial re-growth.

Techno-economical Selection of Process

The broad objective is to determine a technically and economically viable Sewage Treatment technology for Trimbakeshwar Municipal Council.The sewage generated will be collected by gravity sewers leading to the inlet chamber of of terminals sewage pumping station and further pumped to inlet chamber of STP. The STP will be the state of the art technology with automatic operation and control with PLC system. Necessary other facilities such as water supply, drains etc. will be considered.The municipal council will have population of around 21064 (including residential and floating) in as per census data & further escalated. As per CPHEEO Water Supply Manual, per capita water requirement for residential demand is 135 lpcd..Considering sewage generation would be 85% of water supply and 100% of treated sewage will be recycled for irrigation and other purposes. The ultimate capacity of sewage treatment plant is 3 MLD. The objective of waste water treatment is to stabilize decomposable organic matter present in sewage so as to produce an effluent and sludge which can be disposed of in the environment without causing pollution, health hazard and nuisance.

The following treatment processes are evaluated for treatment of sewage with tertiary treatment for reuse to gardening and flushing.

- Extended Aeration (EA)
- Moving Bed Bioreactor (MBBR)
- Sequence Batch Reactor (SBR)
- Membrane Bio-Rector (MBR) without tertiary treatment.

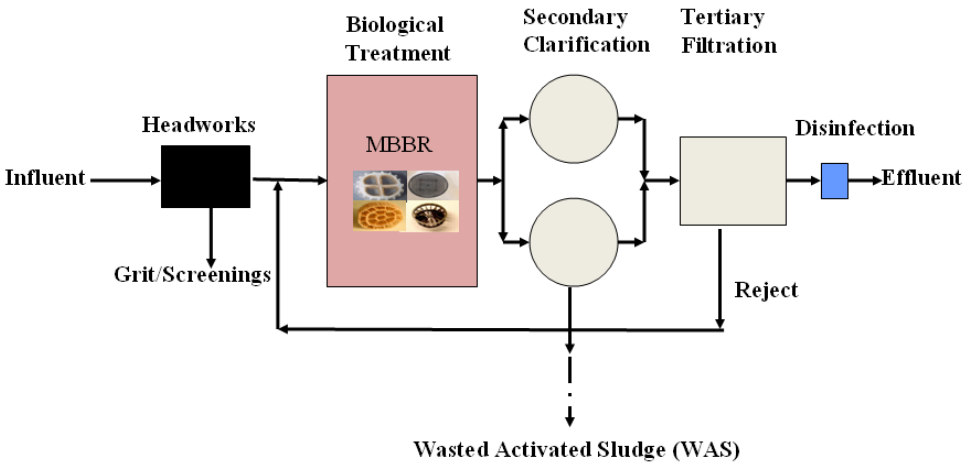
Parameters	Impact	EA	SBR	MBBR	MBR
Capital cost	Initial Investment	Medium cost	High cost - no separate clarifiers required but high cost of decanters, mixers	Medium cost - Need for secondary clarifier	Potential highest cost - membranes
Periodic equipment replacement cost	Proportional to impact on lifecycle cost	Replacement after 15 year	Replacement after 15 year	Replacement after 5-7 year	Membrane replacement once in 5-7 years
Power cost	Proportional to impact on lifecycle cost	Medium power cost	Higher power cost	Medium power cost	Highest power cost
Skilled personnel cost	Proportional to impact on lifecycle cost	Simplest to operate	Cycle time control needs higher skill	Simple to operate	MBRs need higher skill
Maintenance cost	Proportional to impact on lifecycle cost	Medium	More automation maintenance	Medium	More automation maintenance
Chemical cost	Proportional to impact on lifecycle cost	Sodium hypochlorite for disinfection	Sodium hypochlorite for disinfection	Sodium hypochlorite for disinfection	Sodium hypochlorite for disinfection & Membrane cleaning chemicals
Complexity	Simpler is better, but not a critical factor	Relatively simple process	Cycle time control adds some operational complexity	Relatively simple process	MBR TMP/permeability monitoring, scour, backpulse, and maintenance cleaning adds some complexity
Performance reliability	Relates to regulatory compliance and reuse applications	Proven reliable with proper operation and control - need additional units for reuse applications	Proven reliable with proper operation and control - need additional units for reuse applications	Proven reliable with proper operation and control - need additional units for reuse applications	Highly reliable effluent quality. Additional units for reuse applications not required excellent disinfection
Space requirements	Space available on ground within campus in open area	Greater than MBBR, SBR and MBR.	20 – 30 % less as compare to EA	15 – 20% less as compare to EA	30 – 40% less as compare to EA
Tertiary Treatment		Required	Required	Required	Not Required

Comparison for 3 MLD between EA, SBR, MBBR & MBR Process

Sr. No.	Description	EA	SBR	MBBR	MBR
A	Land Requirement (Sqm)	2250	1800	1680	1320
B	Land Cost (in Lacs) (Land cost considered 20lacs per acre)	11.25	9	8.4	6.6
C	Total Capital Cost (Rs. Crores)	3.21	3.39	3.3	4.2
	i) Electromechanical cost	1.446	2.034	1.488	2.856
	ii) Civil cost	1.764	1.356	1.818	1.344
D	Power Requirement in (KW hrs/day)	756	684	678	1029
E	Total O&M Cost (Rs. Lacs per Annum)	28.56	27	26.46	31.92
F	Total Capitalized cost (in lacs)	706.8	699	684	870

Moving Bed Bioreactor (MBBR)

The MBBR is an aerobic attached growth process which uses cylindrical shaped polyethylene carrier elements for biological growth. The moving media increases the contact time between the microorganisms and the organics. Since the media has high porosity it provides large surface area for microorganisms to attach and grow. It has excellent characteristics for BOD/COD removal and nitrification/ gentrification for all types of sewage. It is compact and requires comparatively lesser space than the conventional system



IV .CONCLUSION & RECOMMENDATIONS

- Capital Costs for STP with SBR and MBBR is almost same whereas for STP with MBR is relatively more.
- Power requirement of Extended Aeration is more compared to MBBR while for SBR it is comparatively less and for MBR it is highest.
- Operation & Maintenance is marginally higher for MBR as compared to three alternatives.
- Area requirement for MBR is less as compared to that required for other alternatives. Further Tertiary Treatment is not required for MBR.
- The MBR system is more robust and can handle shock loads with respect to BOD load and can give effluent quality with Suspended Solids less than 10 ppm which can be directly used for Flushing and gardening.
- Considering area requirement, operating flexibility, cost comparison, better quality of Effluent and reuse of treated wastewater; it is proposed to provide MBBR based STP for the project.
- Considering above aspects, it is recommended that STP shall be MBBR based.

V. PROPOSED TREATMENT PROCESS

This section gives the scope of Work for Sewage treatment plant (STP). The scope includes process requirements to achieve final discharge quality standards. The plant capacity and modules are as indicated below:

SR No	Description		STP
1	Inlet Sewage Pumping Station (Average/Peak)	:	3 / 7.5 MLD
2	Plant Capacity (Treated Water)	:	3 MLD
3	Plant operating Time	:	24 Hours per day
4	Peak Factor	:	2.5

5	Peak Flow	:	7.5 MLD
6	Treatment Process	:	MBBR Treatment Technology

The secondary treatment is consists of MBBR basin and lamella clarifier. Raw sewage after Preliminary treatment will be conveyed by gravity into the MBBR Basins for biological treatment of organic matter. BODwill take place in MBBR basin. The MBBR basin will be oxygenated using fine air bubble diffused aeration andwill effectively bio-degrade the organic matter to the required BOD level of purity.

The bacterial population is present on the media, which forms an integral part of the reactor system. The media is made of small plastic elements. Millions of such pieces are present in the reactor. A very large surface area is available for the bacterial population to grow. The bacteria grow on the plastic media, by using the organic content in the raw sewage, and the dissolved oxygen available. Due to constant aeration, the media is set in whirling motion, so that continuous mixing takes place. The bacterial layer growth on the media surface increases to a certain extent, and then gets sloughed off after a specific period. This creates new surface for further bacterial growth. Sloughing takes place only after complete growth and subsequent dyeing off of the bacterial layer and hence the sloughed off material is completely digested. The bacterial reaction is carried out in two stages, for maximizing the BOD removal efficiency. Hence, two such reactors are provided in series. Within the reactors, arrangements are made to retain the plastic media in place. Air supply is done through perforated stainless steel pipes. Use of stainless steel pipes ensures that no maintenance is required.

To maintain MLSS concentration in MBBR basin, RAS pumps will pump the settled sludge from clarifier to inlet of anoxic basin. The wasted sludge will be taken to sludge holding tank.

Description		**STP1**	**Units**
Design capacity/unit (Average flow)	:	3000+Return Sludge	Cum/day
Aerobic detention time	:	5.5 - 6.5	H
Biofilm Area	:	200-500	m^2/m^3
BOD Loading	:	0.8-1.2	Kg BOD/m^3.d
Packing may fill	:	25 to 50	% of tank volume
MLSS Concentration	:	2500-4500	mg/L
F/M Ratio (BOD)	:	0.1 to 0.3	/day
Oxygen Requirement for BOD removal	:	1.2	KgO_2/KgBOD
Solids Retention Time	:	8 – 15	Days
DO in the Aeration tank	:	2.0	mg/l
BOD Oxidation (Oxygen Requirement)	:	1.2 x Inlet BOD Load	
Air Blower for MBBR Basin	:		
Operation Mode	:	2 x 100 % design capacity (1 W+ 1 S)	

Description		STP1	Units
Type of Blowers	:	Roots Type Twin Lobe Blower	
Air Diffusers for Aeration Tank			
Type	:	Fine bubble tube type diffusers	
Total no. of diffusers	:	No. of diffusers shall be as per the capacity of blowers and air handled by each diffuser.	

Disposal of Treated Sewage

Treated sewage after chlorination will be discharged into River Stream. The bypass arrangement will be made for diversion of preliminary treated sewage from common distribution chamber after the grit chambers for discharge into river in case of emergency and shutdown of the plant.

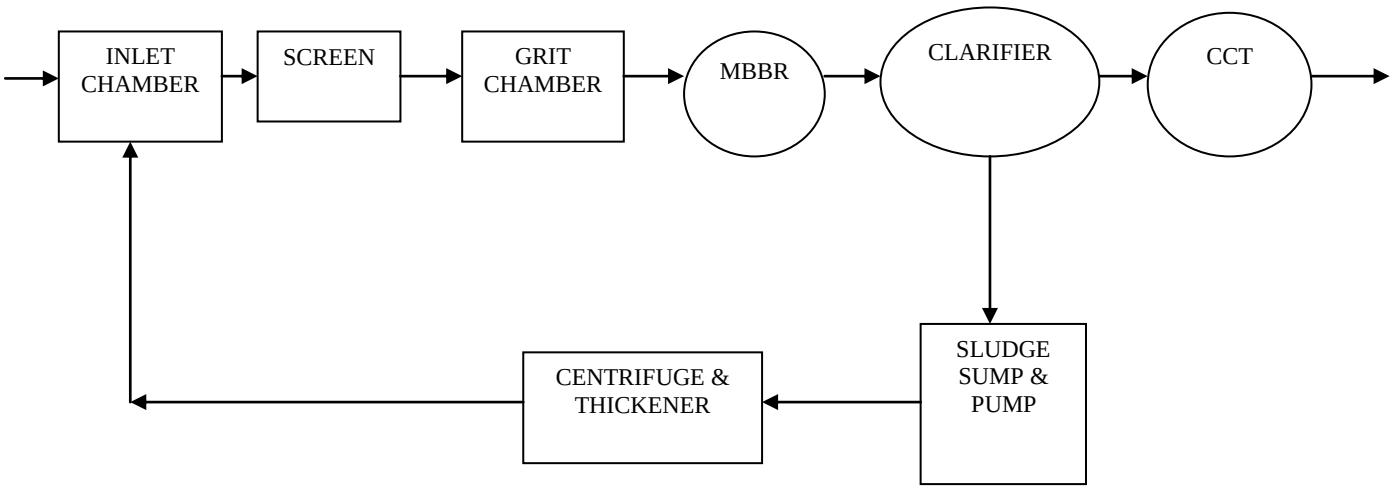
Sludge Dewatering System

The waste sludge of 1% consistency will be stored in sludge holding tank. The mixers will be provided in the sludge holding tank to maintain the aerobic condition of the sludge. The sludge will be pumped to drum thickener for further thickening of sludge up to 3 to 4%. The sludge will be conveyed to sludge dewatering equipment (centrifuge) where sludge will be dewatered to required sludge concentration (20% dry solids). Polyelectrolyte dosing system comprising of solution preparation tanks with agitators and dosing pumps, will be provided to enhance the dewatering efficiency of centrifuge. The cent rate will be recycled back to the inlet of TSPS. The dewatered sludge can either be transported in trucks for disposal to sanitary landfills or for use as manure on agricultural land.

Design Flow	:	71.3 m^3/day
Hydraulic Retention Time	:	8 hrs
Pressure (Operating/Design) in Bar Gauge	:	Atmospheric / Full of Liquid
Type of Pumps	:	Rotary Screw Pumps
Solids concentration in sludge wasting		0.8 – 1.0 %

VI. PROCESS DESIGN

The Process Design Calculations are given in the next page :



VI. CONCLUSIONS AND DISCUSSIONS

As per the modern day facilities and system, we see the various problems in the Trimabkeshwar Village regarding sewage treatment and its disposal. As per our project, we propose a 3.0 MLD Sewage Treatment Plant. The present day population of the village and the future forecasted population are both taken into account for the design of the plant. There are 4 major processes for the treatment among which MBBR is the most suitable and hence it is selected as per the design. There will be plenty of benefits and advantages with the implementation of the STP in the village. Right from Pollution levels to Pollution Loads there will be tremendous changes in the area. The River Godavari will also go through alterations. The Flow of River Godavari will become Perennial. The river Godavari will not be seasonal i.e. depend upon the precipitation only. Also the pollution levels of the river will simultaneously decrease by time due to proper disposal of wastes. Sewers will also be clean and will remain maintained due to decrease in the pollution loads. Efficient Treatment will also ensure that there is no blocking of the sewers. Due to the setting up of a new STP there will be increase in Employment and Job Opportunities in the Municipal Council of the town Trimbakeshwar. This will also lead to profits and benefits that will directly result in the increase in Revenue Generation for the Trimbakeshwar Municipal Council. The amount of water obtained from the STP will not be wasted or sent into gutters. Instead the water will be collected and will be recycled and reused. This will ensure optimization in the use of water. The water will be used for irrigation, gardening and flushing purposes. Sometimes the water might be used for constructional purposes and sold out to the industries. Due to the setting up of an **Effective** and **Efficient** standard STP in a small town like Trimbakeshwar, it will also lead to increase in awareness in other small villages to bring up the same kind of projects. Safety measures will be taken in various treatment processes. The work of an operator in a sewage treatment plant presents many hazards that must be valid against common type of accidents like injuries from falls, deaths from drowning and asphyxiation. All open tanks should be provided with guard rails to prevent accident falls. The staff should be trained and compelled to use helmets, gumboots, hand gloves etc. Wherever necessary danger boards/sign boards should be displayed in the plant, drawing attention to potential spots. All operating records of the various treatment units in a plant should be properly compiled in the day-to-day basis and daily, monthly and yearly reports are maintained and

periodically reviewed. Hence these were the required conclusions and discussions necessary for the design of 3.0 MLD sewage treatment plant using MBBR process and population-21,000.

REFERENCES

[1]. "Water And Wastewater Engineering" Vol I -"Water Supply And Wastewater Removal", Vol II - "Water Purification And Wastewater Treatment And Disposal", Fair, G.M, Geyer.J.C And Okun, D.A, 1981, Wiley & Toppan.

[2]. "Wastewater Engineering: Treatment, Disposal and Use "Second Edition 1979, Metcalf and Eddy, Inc. Revised By G.Tchobanoglous, Tata Mc.Graw- Hill, New Delhi.

[3]. "Environmental Engineering" 1986, Peavy H.S.Rowe.D.R and Tchobanoglous G. Mc.Graw- Hill Book Company.

[4]. "Wastewater Treatment Plants- Planning, Design And Operation", 1985, Qasim S.R Holt. Rinehart and Winston.

[5]. "Wastewater Treatment for Pollution Control", 1986, Arceivala S.J. Tata Mcgraw Hill Publishing Company.

[6]. "Water Treatment Handbook" 5th Edition, 1979, Degremont, John Wiley & Sons.

[7]. "Sewerage and Sewage Treatment" First Indian Edition 1960, Babbitt. H.E and Baumann.

[8]. "Public Health Engineering Practice" Fourth Edition 1972, Vol II-Sewerage and Sewage Disposal, Escritt.L.B.

[9]. "Public Health Engineering -Design in Metric" 1970, Sewerage, Barlett R.E

[10]. "Design and Construction of Sanitary and Storm Sewers", Revised Edition 1970, Manual of practice no.9, Water Pollution Control Federation, Washington, D.C.U.S.A.

[11]. "Sewage Treatment Plant Design" 1959, Manual of Practice No.8, Water Pollution Control Federation, Washington, D.C.U.S.A.

[12]. "Disposal of Sewage and Other Water-Borne Wastes", Second Edition 1971, Imhoff K.M.Muller W.J. And Thistlewayte D.K.B

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