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A Study on Performance Evaluation of 100 KLD Sewage Treatment Plant in the Circuit Breaker Assembly Process

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Abstract **– The Proposed Study focuses on performance evaluation of 100 KLD sewage treatment plant. It is essential to monitor the performance characteristics of STP plant as treated water from STP is used for watering the garden. It came to the notice of the management that treated water supplied for watering garden from STP have an unbearable odour and it is sometimes very strong that it is causing discomfort to the plant employees who are passing by the passageways near to garden. In this study an attempt has been made in providing a solution that aims at reducing bad odour coming out from STP and thereby avoiding the discomfort to the employees who are passing by the passageways near to garden. The current study also aims at evaluating performance characteristics of the STP which helps in understanding the operating difficulties and design of STP. Sewage samples were collected from outlet of sewage treatment plant and is used to assess the water quality parameters such as chemical oxygen demand (COD), Bio-chemical oxygen demand (BOD), Total dissolved solids (TDS), Total suspended solids (TSS), Mixed liquid suspended solids(MLSS). The proposed sewage samples of 100 KLD sewage treatment plant were taken for a period of 20 days. The conclusions were drawn after precise evaluation of water quality parameters and possible recommendations were made with intent to tackle bad odour coming out from sewage treatment plant.**

Keywords **– STP, Treated water, COD, BOD, TDS, TSS, MLSS, Performance Characteristics.**

I. INTRODUCTION

The main function of sewage treatment plant is to protect the human health and supply the quality water which is free from pollutants and wastes for watering garden. In this plant Canteen, Pantry (delivers refreshment services to employees working in Administrative department of the plant), Restrooms, Kitchens, Water Fountains, drained water collected in drums from compressors contributes a bulk of waste water generated in the plant . The waste water generated also contains black water comprising of Flush water from toilets, excreta, urine etc.
The unbearable or bad odour coming out from treated water in watering the garden may be indication of implementation of inadequate sewage treatment technologies that result in low performance of water treatment, operational difficulties, Complexities involved in maintenance of STP or lack of competency of skilled personnel involved in the operation and maintenance of STP. The Existing condition of STP may pave the way for the plant being decommissioned.

Trained operators working in sewage treatment plant are questioned with a view to determine the root cause for the treated water being smelly. Moving/fluidized bed bio reactor (MBBR) is the treatment technology adopted for sewage treatment.[9]
The identified problem is due to increase in the organic load in the aeration tank and less aeration time corresponding to organic load as a result it creates shortage of oxygen in the aeration tank. The shortage of oxygen in the aeration tank is also governed by discharge of organic load into the aeration tank, pumping rate of oxygen supplied to the aeration tank by air blowers, Number of air blowers employed in the process in supplying oxygen to aeration tank. [6]

The treatment facility is designed to treat 100KLD sewage. There isn't any assessment carried out to assess the impact of treated water on garden and plant employees passing nearby prior to release of treated water to garden. State authorities such as state pollution board of Tamil Nadu have established standards of purity to ensure waste water isn't directly released into water bodies. The efficiency of performance of sewage treatment plant in stabilizing the sewage has not been assessed since its inception i.e.,, from the day the plant became operational or from the day the plant was commissioned.

II. MBBR OPERATING PRINCIPLES

The moving bed biofilm reactor process is similar to the integrated fixed film activated sludge process with mixed, suspended media contained within the reactor by sieves, with a condition that there isn't activated sludge. The volume fraction of fill contained in the media is generally higher, the suspended solid concentration in the flow to the secondary clarifier may be in the range of 100 to 250 mg/L versus 2500 to 3500 mg/L.[4] Process designs for MBBR also include the suspended media in anoxic zones for fixed film biological denitrification. With moving bed biofilm reactor effluent, filtration processes, including granular media and membrane filtration, and dissolved air floatation can be used in the lieu of gravity settling.[2] Much of the information presented on the integrated fixed film activated sludge process includes the characteristics of biofilm media, media retention, aeration and mixing and substrate flux into the biofilm.

III. SEWAGE TREATMENT PLANT IN CIRCUIT BREAKER ASSEMBLY PLANT

1. Operation of Units and Equipments:
Primary Treatment:

2. Bar Screen:
The bar screen is used to screen off/serve of all serial particles of above 20mm in size. When water passes through the mesh all the solid particles get collected in the inlet side of the mesh. This has to be cleaned periodically (Depends on collection of particles) using a brush.

3. Collection Tank:
Waste water free from all serial particles is ensured by passing it through bar screen prior to collection tank, raw sewage is collected in collection tank, the purpose of collection tank is to act as an equalization tank during peak load of sewage water.

4. Pump at Raw Sewage Receiving Tank:
There are 2 pumps installed in the raw collection tank. One will be operating and another will be standby. Non-Return valves N1 and N2 are installed at the deliver line to ensure there is no water return to the non-working pumps. These pumps are used to pump raw sewage to the aeration tank.

5. Aeration Tank:
In the Aeration tank sewage is pumped from the bottom to top. The aeration tank consists of 2 parts.

6. Diffused Aeration:
The first part in the aeration tank is the diffused aeration system. This air is distributed all through the aeration tank through neatly laid diffusion membranes.[3] These membranes are non-clog type and break up the air into fine bubbles to ensure the bacteria get enough air constantly. This has to be operated continuously (24hrs/day).

7. Blower at Aeration Tank:
There are 2 blowers installed for Aeration tank. One will be operating and another will be standby. Non-return valves N3 and N4 are installed at the deliver line to ensure there is no water return to the non-working Blower. This blower is used to supply the Air to aeration tank for maintaining the dissolved oxygen level in aeration tank and biological decomposition of organic matters.

8. Clarifier Tank:
In this tank the aerated water is sent from bottom to top. The solid particles to settle in the clarifier tank bottom. The bottom of the settling tank is tapered and scrubber mechanism is provided to ensure proper settling of particles. The sludge collected at the bottom is pumped back into the aeration tank through return sludge pump for maintaining bacterial growth. Maintain the MLSS in aeration tank between 300 to 500 mg/ltr. If the MLSS exceed 500 mg/ltr then the sludge is sent to the sludge drying bed through return sludge pump and if reduced below 300 mg/ltr and fertilizer(Urea and Di ammonium phosphate in 3:1 ratio) or cow dung in the aeration tank to raise the MLSS.

9. Chlorine Dosing Systems:
The dosing systems is provided to add chlorine in the water through electro- magnetic metering pump provided at the top of the chlorine dosing tank, Chlorine is dosed at 2 ppm.
It includes mixing of 120 litres of treated water with 10 litres of chlorine solution chemical. This is done for a 24 hour operation.

10. Sludge Drying Bed:
The sludge drying bed is a Gravity sand filter. This contains graded pebbles and Sand. When excess sludge is formed in the aeration tank then the water from the settling tank is passed into the sludge drying bed. In this the sludge is filtered when the water passes through the sand layer to the aeration tank. The sludge is let dry in the sunlight and dried sludge is scrapped out. This dried sludge is good manure for trees and provide only to gardeners.

11. Filter Feed Tank:
The overflow of the settling tank goes to the filter feed tank. The water is then sent through the sand filter and activated carbon filter and chlorinated then connected to the overhead tank.

12. Standard Values of Water Quality Parameters:
Standard values prescribed by industrial effluents discharged on land for irrigation are as follows

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WATER QUALITY PARAMETER	RANGE
PH	5.5 – 9
TOTAL CHLORIDES AS CL, mg/L	MAX 600
TOTAL SUSPENDED SOLIDS, mg/L	MAX 30
BIO CHEMICAL OXYGEN DEMAND, mg/L (at 20°C for 5 days)	MAX 20
Oil and grease, mg/L	MAX 10
TOTAL SULPHATES, as SO_4, mg/L	MAX 1000
TOTAL DISSOLVED SOLVENTS(TDS)	MAX 2100

Tank Capacity and Level:

TYPE OF TANK	CAPACITY OF TANK
SEWAGE COLLECTION TANK	75 KL
FILTER FEED TANK	35 KL
TREATED WATER TANK	40 KL
ANAEROBIC TANK	50 KL
AERATION TANK	25 KL

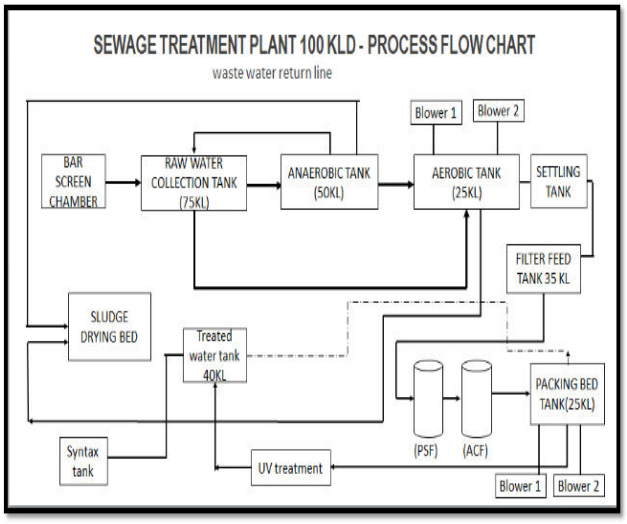

Fig .1. Process flow chart.

IV. OBJECTIVE

Reduction of foul odour in treated water in STP.

1. Problem Description:

Waste water generated in the plant is treated STP as per requirements of Tamilnadu pollution control Board. At first solid particles are removed in the bar screen chamber and stored in collection tank. BOD is reduced in waste water in the aeration tank where blowers are deployed to increase the dissolved oxygen content for the micro-organisms present in the liquid. After the aeration process if the required oxygen demand is not achieved, the liquid is further treated in packing bed tank of 25 KL where two blowers are used to increase the dissolved oxygen content in the waste water. Due to the excess flow of water in the aeration tank, the time required for the aeration process is not sufficient in sewage treatment plant leading to undesirable foul odours in the treated water.[8] However dissolved oxygen content, TDS, TSS are maintained as per the standards in the process.

2. Data Observation:

S.NO	Date	SHIFT	Raw water PH	Treated water PH	TDS	Sludge volume (ml)	Quantity treated in (KL)
1.	21/06/2019	A	7.2	7.8	1120	100	46
		B	7.3	7.4	1120	100	
		C	7.4	7.1	1120	100	
2.	22/06/2019	A	7.1	7.1	1070	100	51
		B	7.1	7.1	1070	100	
		C	7.1	7.1	1060	90	
3.	23/06/2019	A	7.2	7.1	1020	100	72
		B	7.2	7.1	1020	100	
		C	7.2	7.0	1020	100	
4.	24/06/2019	A	7.1	7.5	1311	90	50
		B	7.2	7.3	1310	90	
		C	7.3	7.2	1310	80	
5.	25/06/2019	A	7.5	7.8	1122	90	51
		B	7.3	7.4	1120	90	
		C	7.2	7.1	1140	80	
6.	26/06/2019	A	7.1	7.1	1095	50	57
		B	7.1	7.1	1090	50	
		C	7.1	7.2	1110	50	
7.	27/06/2019	A	7.1	7.1	1095	50	57
		B	7.1	7.1	1095	40	
		C	7.3	7.3	1116	40	
8.	28/06/2019	A	7.1	7.1	1190	50	50
		B	7.1	7.1	1190	50	
		C	7.1	7.1	1190	50	
9.	29/06/2019	A	7.1	7.2	1100	100	52
		B	7.1	7.1	1120	50	
		C	7.1	7.1	1110	50	
10.	30/06/2019	A	7.1	7	1180	60	24
		B	-	-	-	-	
		C	-	-	-	-	
12.	01/07/2019	A	-	-	-	-	47
		B	7.4	-	-	-	
		C	-	-	-	-	
13.	02/07/2019	A	7.2	7.1	1110	100	37
		B	7.4	7.2	1110	80	
		C	7.4	7.2	1110	80	
14.	03/07/2019	A	7.5	7.2	1160	100	47
		B	7.5	7.2	1160	100	
		C	7.5	7.2	1160	100	
15.	04/07/2019	A	7.2	7.1	1079	50	52
		B	7.4	7.1	1120	-	

25.	14/07/2019	A	-	-	-	-	56
		B	7.2	6.9	1090	100	
		C	7.3	6.9	1090	100	
26.	15/07/2019	A	7.0	7.1	1110	100	65
		B	7.0	7.1	1110	100	
		C	7.3	7.1	1120	100	
27.	16/07/2019	A	7.4	7.1	1120	100	54
		B	7.1	7.1	1110	100	
		C	7.1	7.1	1120	100	
28.	17/07/2019	A	7.3	7.0	1070	100	50
		B	7.3	7.0	1070	100	
		C	7.3	7.0	1080	100	

V. RECOMMENDATIONS

The following recommendation is proposed based on the observations done on sewage treatment plant. It is recommended to implement vapour phase biological process to reduce the odour coming out from treated water.

Vapour phase biological treatment process:

The biological processes used in the treatment of odour gases in the vapour phases present in the vapor phase are

1. Bio filters
2. Bio-trickling filters

- **Bio filters:**

Biofilters comes under packed bed type filters. In biofilters the gases to be treated move upward through

filter bed. In closed bio-filters the gases to be treated are either blown or drawn through packing material.[7] As the odorous gases move through the packing in the biofilter the two processes occur simultaneously namely absorption/adsorption and bioconversion.[1] Odorous gases are absorbed into the moist surface biofilm layer and the surfaces of the biofilm packing material. Temperature and moisture content are important environmental parameters that must be maintained to optimize microorganism activity. The only drawback of biofilters is they occupy large surface area.

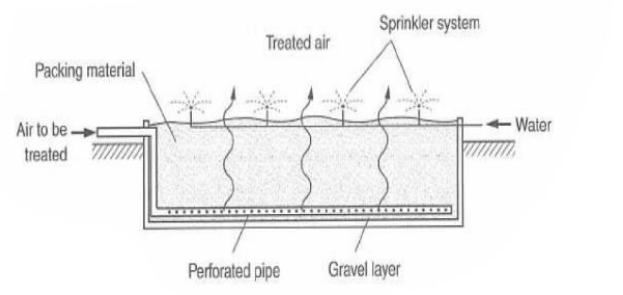

Fig .2. Open bed type.

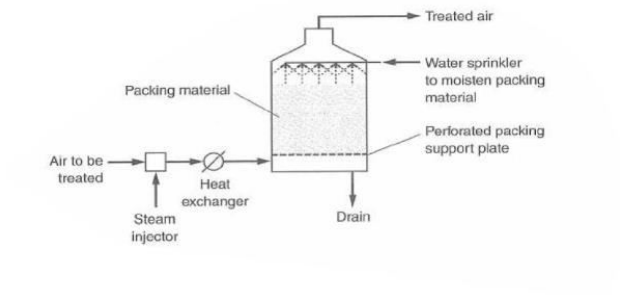

Fig .3. Enclosed reactor type.

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