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Construction of Sewage Treatment Plant of Capacity 30 MLD at Coimbatore

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A B S T R A C T

One of the newest possibilities for the treatment of municipal sewage is the sequential batch reactor (SBR). As opposed to working in space, SBR operates in a single tank and utilises time. It is easier to use, requires less space to run, and is cost-effective even on small volumes. The goal of this study is to develop a sequential batch reactor sewage treatment system for an industrial building in Coimbatore. According to estimates, 30 MLD of sewage were produced in one day. Bar screen chambers, equalisation tanks, SBR tanks, and treated wastewater collecting tanks are among the sewage treatment plants numerous parts. It is suggested that the different parts of wastewater treatment facilities be designed taking into account the varied permissibility limitations and standards of treated sewage water. The sludge product created by the treatment process can be suggested for use as fertilisers TO boost the fertility of the soil, which decreases the usage of ground water. The treated wastewater will be used for gardening proposals.

Keywords: Sequential Batch Reactor, Industrial sewage, Sewage treatment plant,30 MLD, permissibility limits.

INTRODUCTION

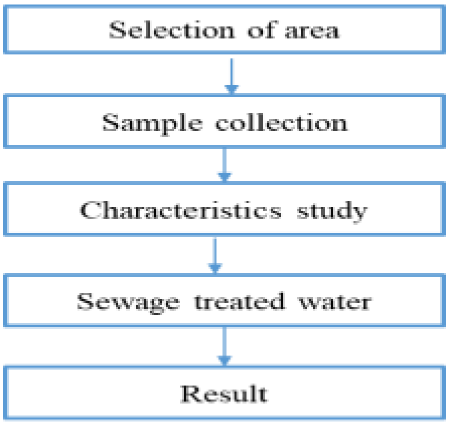
A vital role for humanity is played by sewage treatment plants (STPs). The main function of these facilities cleans the sewage water that comes from homes and industrial sewages Sequential batch reactors (SBRs) have drawn attention from all around world because they can handle a variety of effluents, including household, municipal, saline, tannery, brewery, and dairy wastewater as well as landfill leachates ni a variety of settings. It simple to run, needs little space, and cost-effective even on small scales. Five steps-Fill, React, Settle, Decent, and Ideal-make up the comprehensive operation of SBR. Because the SBR is versatile, the modification process is fairly straightforward. As a result, it offers a wide range of treatment options for a single reactor, which is the most important feature together with the other treatment facilities SBR can be used successfully. Dislodge retention time SRI, hydraulic retention time HRT, and cycles can be changed. Due to the fact that the basins are already present, older wastewater treatment plants can be converted to an SBR. As sewage disposal permits become more and more stringent, SBR offers a workable solution for lowering effluent limitations. After the SBR treatment stage, discharge limits that need higher levels of care may necessitate the expansion of a tertiary unit. This idea should play a key role in the planning process. In order to limit the use of groundwater and develop a sewage treatment plant (STP) with sequencing batch reactor, the treated water will be used for gardening and flushing.

SCOPE OF WORK:

1. Reusing of water
2. Reducing the usage of fresh water
3. Cost effective.

METHODLOGY

Methodology is the methodical, theoretical evaluation of the approaches used in a particular field of study. In order to do research or address issues in a given field, it is a collection of guidelines, methods, and process. Methodology includes the choice and use of acceptable research methodologies, procedures for gathering and analyzing data, and the interpretation of findings.



RAW SEWAGE

Raw sewage means untreated water which is directly from the household or commercial area. This sewage consists of Human waste, soaps, detergents and sometime food waste. Sewage can be classified into three different types they are Domestic sewage, Industrial Sewage and Strom Sewage. Domestic Sewage carries the used water from the houses and apartments, whereas industrial sewage is the used water from the manufacturing, chemical process. Strom waters are also called as runoff water these waters are collected from the open channels and opens during rainy season. This water consists of bacteria and their other microorganism which are mostly from the Human intestinal track. Industrial Sewage consists of lot of chemicals depending on the manufacturing process. So, it is necessary to treat industry water according to the nature of the water. Before reusing the water, the odour, Colour, TDS and Pollutants should be removed properly.

Table 1: Characteristics of raw sewage

S.NO	PARAMETERS	UNIT	DESIGN VALUE
1	pH	mg/L	7.34
2	Total suspended solids	mg/L	346
3	Total dissolved solids	mg/L	1034
4	BOD_5	mg/L	270
5	COD	mg/L	400
6	Total nitrogen	mg/L	45
7	Total phosphorus	mg/L	7

DESIGN PROCEDURE

Design of Receiving Bar Screen Chamber:

Design flow = 0.005787 m3/sec

Detention time = 6min

Volume of receiving chamber V = 0.005787(6x60)

=2.08332 m3

Chamber size = 1.793 X 1.16 X 1.2m

Design of coarse screen:

velocity at maximum flow across the screen = 0.58m/s

Bar spacing = 2.5cm

Average discharge of wastewater = 0.0057m/s

Peak discharge of sewage = Q average x peak factor

= 0.00578 X 3

Q = 0.0174m/s

The Velocity at average flow not allowed to exceed 0.58m/s

Vertical projected area of screen, A = Q/V = 0.0174/0.58

= 0.0298m3

Gross area of screen

Manual Hand cleaned coarse screen.

Thickness = 25mm,

Width = 11mm,

Clear spacing = 25mm

Therefore, A = 0.0298|(25+ 10)/25]

= 0.0213m2

The screen is inclined 40

= Area / sin (40)

= 0.0245

Width of screen = 0.6

Width of Screen = (no.of bars X thickness) + (no.of openings X spacing)

0.6 = (n X 0.01) + ((n+1) X 0.025)

no.of bars =17

no. of opening = 18

Assume d = 0.9m

Coarse Screen is designed for the size 0.6 m X 0.9m

Equalization tank design:

Providing Equalization tank of 7 hrs of hydraulic retention time

Q maximum = 250m3/day

Flow rate per hr = 10.41 m3/hr

Chamber volume = 10.41 X 7

= 72.87m3

= 73m3

Equalization tank size = 5.8m X2.84m X 4.5m

Take Equalization tank size as 73m3.

Equalization Chamber air required = 1.6m3 of air / m3 of chamber volume when more than 2 hrs of retention time is to be provided.

= 1.6 X 73 = 116. 8cum/hr

Take diffuser diameter as 100mm, height = 1000mm.

No of Diffuser = 116.8/10

= 12 Nos

Design of SBR Reactor

Organic Load = 100 cu.m X (300 - 10) X 10-3

= 29 kg/day

F/M Ratio = 0.1 - 0.18

Adopt = 0.125

Assuming the total oxygen requirement as 29.0kg of 02/kg of BOD

BOD extracted: 29 X 2 = 58 kg/day

MLSS in the reactor = 4000mg/l

Hydraulic R.T = BOD/ (MLSS X F/M)

= 58 / (0.2 X 4000)

= 1.74hr (2hr)

So, the cycle time = 1.74 (Aeration) + 0.5 (Decantation) + 0.5 (settling)

= 2.74 hrs (say 3hrs)

Hence designed for 4 batches a day

Design of Tank:

Design Flow = 200m3/day

BOD = 300mg/lit

Volume of SBR Tank = Q X BOD/ MLSSXF/M

= (200 X 300)/ (0.2X4000)

= 75M3

Sludge accumulation provided is 30%

= 97.5m°

SWD assumed is 3m.

Plan area = 98/3

= 32.6m2

Size of tank m 6.6m X 3.29m X 4.5m+0.5m F.B

Oxygen Requirement for SBR

Oxygen Requirement = 1.5 X BOD Load

= 1.5 X 29/4

= 10.875 kg/Batch

= 11/3

= 3.660 kg/hr

Assuming oxygen transfer efficiency at 3.5% per meter depth of water column.

Total SWD of the reactor = 3.0m

Overall Efficiency = 3.0 X 3.5

= 10.50%

Oxygen to be supplied = 3.66/0.105

= 34.85 kg/hr

Air to be supplied =oxygen required /(Density of air xw/ of oxygen ni air) = 34.85/ (0.23X1.4)

= 108.22 cu.m/hr

Total Air required =Air of eqt +Air for SBR

= 100 + 108.22

=208cu.m.hr

Assuming 80% efficiency for blower

= 208/0.8

= 260 cu.m.hr

Assuming compression factor of 14. required volume si 260/1.4

= 185. 7c.m/hr

Provide blower with a capacity of 260cum/hr. Considering air ot be provided in sludge tank.

Considering the requirement for sludge digestion &efficiency factor of provide 300 cu.m/hr Capacity blower.

Decant Tank Design:

Average flow = 10.4m3/hr

Sludge holding capacity of 4hrs.

lank required volume =42m3

Decant tank = 5.7mX3mX2.5m

SWD Provided is 2.5m

Final collection size of tank 5.7mX3mX2.5m +0.5mFB

Tertiary Treatment:

Adopt 4mg/l of Chlorine. Required Dosage =4X250

= 1000gm/day

Sodium hypo chlorine to be used as asource of chlorine @6.5%

= 1000/0.065 = 15.38 kg of sodium hypo chloride solution

per day

3.845 lit of sodium hypo chlorite per batch.

Pressure Sand Filter:

20hrs of operation in a day average flow rate

Flow rate = 250/24

= 12.5m3/hr

Filter type = vertical type sand filter Rate of filtration = 170lit/m2.min

= 0.170 X 60m3/m2.hr

= 10.2 m3/m2.hr

Cross section area of filter = 12.5/10.2

= 1.23 m2

Dia = 900mm X 1500mm - 1nos

Activated Sand filter

Considering one ACF with the period of filtration of 20 hrs / day

Flow Rate =250/20 = 12.5m3/hr

Filter type =Vertical type

Rate of filtration = 170lit/m2.min

=0.170 X60m3/m2.hr

= 10.2 m3/m2.hr

Cross section area of filter = 12.5/10.2

= 1.23 m2

Dia = 900mm X 1500mm – Inos

Sludge Calculation for design of filter press

Reduction of BOD ni aeration tank = 300 - 10

= 290mg/l

Net yield considering average age of sludge of 20 days 25%

Therefore, Sludge production =0.280kg/cum X1000cu.m/Day X0.25

=7Kg/day of secondary sludge

Contribution of sludge by TS =0.5 X350 g/cum X100c.m/day

= 17.5Kg/day on dry basis

Total Produced sludge = 7 + 17.5 = 24.5Kg, say 25Kg

Sludge is drawn from the SBR reactor at the end of settling at 1% concentration.

So the volume of produced sludge =25/0.01 =2500Lit

= 2.5 cum./Day

The excess sludge generated si dried from the above treatment, filter press is used for Sludge de-watering.

The filtrate wil be connected with the screen chamber.

Assuming the type of sludge =organic

Designed sludge flow = 2500|trs/day 21

Solids concentration = 1%

Dyr solids minimum ot be alowed ni = 52 - 30% the cake of sludge.

Sludge solids generated on daily basis

Generation rate: 2500 x 12. x 0.01 =30 kgs/ day

Quantity of Sludge load on filter : 30 x3 (three days of

operation per week) = 90 kgs/day

Assuming sludge holding capacity as 40 kgs/m2

The size of the filter press required = 90/40 =2.25 m2

Szie of each plate taken wil l eb (0.6 x 0.6 m) = 0.36 sq.m.

No. of chambers required = 2.25/0.36 = 6.25 nos

However, provide 8chambers with 30mm of spacing and

filter press of 0.6m x0.6m.

Consider 125 kg sludge production per day, and at 30% solids

in sludge cake the volume of sludge cake = 125/0.3 = 416.67 Lit

Henceforth the filter press given is satisfactory.

Final collection Tank:

Average flow = 10.42m3/hr

Provide 6hrs of capacity of holding Tank vol. required =50m3

Providing SWD 2.5m

Size of final collection tank is 5m X 5m X2.5m

Pumps:

A. Providing 3Nos. sewage transfer pumps (Two working and one standby)

Capacity: 12 KLH @10 mhead

Type: Centrifugal pumps

Solid handling capacity: Up to 10 m

Purpose: To pump the sewage from the Equalization tank ot SBR tank.

B. Provide 1No. Sludge Transfer pump. Capacity: 12 KLH @10 mhead

Type: Centrifugal pumps

Solid handling capacity: Up ot 25 m

Purpose: To pump the sludge from the SBR tank to the

Sludge holding tank.

C. Provide 2 Nos Filter feed pumps. Capacity:30KLH @30m head

Type: Centrifugal pumps,

Solid handling capacity: Up ot 5m

Purpose: To pump the treated effluent from the Pre filtration tank through both the tertiary treatment filters.

RESULTS

SI.NO	Item Description	Capacity of Tank	units
1	Inlet chamber	2.8m (L) x 5.0m (W) x 2.2m (LD) + 0.5m (FB)	1
2	Fine screen chamber	6.5m (L) × 1.0m (W) × 0.7m (LD) + 0.5m (FB)	1
3	Sequential batch reactor	29.4m (L) × 29.4m (W) × 5.5m (LD) + 0.5m (FB)	4
4	Chlorine contact tank	22.0m (L) × 9.9m (W) × 3.0m (LD) + 0.5m (FB)	1
5	Thickened sludge sump	3.5m (L) × 3.0m (W) × 3.0m (LD) + 0.5m (FB)	1

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