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DESIGN OF RELIABLE SEWAGE TREATMENT PLANT FOR NARAYANA ENGINEERING COLLEGE GUDUR BY USING SBR TECHNOLOGY

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ABSTRACT: -

Wastewater generated in schools and colleges has to take care of as it may pollute the groundwater if not treated properly. This project focuses on the design of an STP unit in Narayana engineering college Gudur (NECG) for the treatment of college hostel wastewater.

Physical and chemical characteristics of the wastewater samples showed a low strength in pollutant concentrations. Treatment units were planned and designed based on the existing condition. The equalization tank was designed for flow balancing.

Sewage is treated by a variety of methods to make it suitable for its intended use, be it for spraying ontoirrigation fields (for watering crops) or be it for human consumption.

INTRODUCTION TO SEWAGE TREATMENT: -

- ❖ Water plays an imperative part in the development of any action within the world. Due to the development of the populace, utilization of water assets is more and accessibility is less. So the water demand is expanding. Sewage treatment is the method of evacuating contaminants from wastewater, essentially from family sewage.
- ❖ Physical, chemical, and biological forms are utilized to expel contaminants and deliver treated wastewater that's more secure for the environment. A by-product of sewage treatment is ordinarily semi-solid squander or slurry called sewage sludge.
- ❖ The sludge needs to experience advanced treatment recently being reasonable for transfer or application to arrive. Sewage can be treated near where the sewage is made, which may be called a decentralized framework. The treatment preparation contains an arrangement of treating units which are categorized as essential treatment, auxiliary treatment, and tertiary treatment.

NECESSITY OF SEWAGE TREATMENT:-

- Sewage treatment plant plays an important role in mankind.
- The main function of these plants is to make the water of the sewage clean that comes from the home, commercial and industrial sectors.
- The treatment of sewage water has become a need of our as it stops spreading the diseases and illnesses caused by the sewage water.
- It helps society in making the water as well as the environment clean.
- Globally, over 80 percent of all wastewater is discharged without treatment. In the countries that do have water treatment facilities, they use various methods to treat water with one common goal: purify water as much as possible and send it back intothe environment to keep humans and the Earth safe and thriving.The main objective of wastewater treatment facilities is to secure people and
the environment from harmful and poisonous components found in wastewater.
- Water treatment facilities were designed to speed up the natural process of purifying water because the natural process is overloaded. These facilities are used to treat the wastewater in various ways and then send the purified water back into the environment.

SCOPE:-

- The scope for wastewater recycling in India is tremendous especially when we have stressed underground sources of water and polluted ground sources, namely rivers and lakes. The treated wastewater often referred to as reclaimed water can be used to irrigate parks, golf courses, and other landscaping. With the entry of private sectors, players more and more advanced technologies can be offered to end-users that work best keeping in mind Indian conditions. As per the latest survey release of wastewater into nearby resources (lakes,rivers,canals) tremendously increased. It leads to a lot of difficulties in water treatment.
- In the earth we have only 3% of fresh water is available. In the future, it reduced to1%.it leads to so much water scarcity on earth. So, we have to treat the wastewater by various treatment methods and reuse the water for gardening and sanitary purposes.

LITERATURE REVIEW:-

- International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 07 | July 2019 www.irjet.net p-ISSN: 2395-0072 © 2019, IRJET | Impact Factor value: 7.211 | ISO 9001:2008 Certified Journal | A Design of Sewage Treatment Plant for Parbhani City.
- International Journal of Engineering Research & Technology (IJERT) IJERT ISSN: 2278-0181. Vol. 3 Issue 4, April - 2014 Design of Sewage Treatment Plant for a Gated Community Bharathi Bhattu1, Prof. Murthy Polasa (P.E.) Department of Civil Engineering, SreeDattha Institute of Engineering & Science, Hyderabad, Andhra Pradesh, India.
- International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 08 Issue: 01 | Jan 2021 www.irjet.net p-ISSN: 2395-0072 © 2021, IRJET | Impact Factor value: 7.529 | ISO 9001:2008 Certified Journal | Page 1343 DESIGN OF SEWAGE TREATMENT PLANT(STP) FOR DAYANANDA SAGAR INSTITUTE , BENGALURU

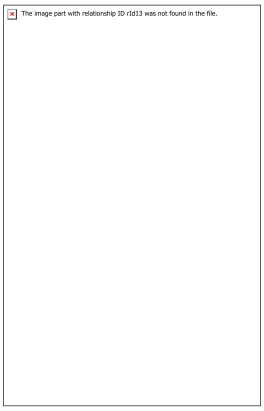
EXPERIMENTALANALYSISOF SEWAGE SAMPLE:-

- DETERMINATION OF PH USING PH METER.
- DETERMINATION OF TURBIDITY.
- DETERMINATION OF TOTAL DISSOLVED SOLIDS [TDS].
- DETERMINATION OF DISSOLVED OXYGEN [DO].
- DETERMINATION OF BIO-CHEMICAL OXYGEN DEMAND [BOD].
- DETERMINATION OF CHEMICAL OXYGEN DEMAND [COD].
- DETERMINATION OF OPTIMUM DOSAGE OF COAGULANT.
- DETERMINATION OF NITROGEN.

PERFORMING TESTS IN THE LABORATORY:-

PH &TDS

TURBIDITY METER



BOD INCUBATOR

EXPERIMENTAL VALUES:-

PARAMETERS	**RAW SEWAGE**
Total Dissolved Solids	300 mg /lit
B.O.D for 5-days at 20°C	420 mg/lit.
C O D	450mg/lit
PH	7.8
Ammoniacal - Nitrogen	45 mg/lit
Total nitrogen	50 mg/lit
Turbidity	103NTU

SELECTION OF SBR:-

The sewage can be treated either by conventional or Mechanical methods keepingthe Following parameters like availability of land, Budgetary constraints, Sustainability, and O&M. Hence as per CPHEEO guidelines the sewage can be treated with the following methods intensive Waste Stabilization Pond (WSP) System, Activated Sludge Process (ASP), Biological Filters (Trickling Filters) and technically advanced systems like Up-Flow Anaerobic Sludge Blanket (UASB) Process, Sequential Batch Reactor (SBR), Moving Bed Bio Reactor (MBBR), Fluidized Aerobic Bioreactor (FAB) and MembraneBio-Reactor (MBR), etc.

Technology	Average concentrations at the outlet [mg/dm³]			Work stability	Handling difficulty	Costs	Space required	Com-ments
	COD	NH_4-N	NO_3-N					
Activated sludge	120	30	10	low	very high	very high	low	for >15 M
Sprayed (biofilter) filters	100	20	10	average	high	high	low	-
Circular filters	75	20	25	average	high	high	low	-
Submerged aerated filters	110	55	20	low	high	high	low	-
Vertical reed filters	70	10	40	high	low	average	average	-
Horizontal reed filters	90	30	5	average	low	average	average	-
Sand filters in the trenches by DIN 4261	160	40	10	low	low	low	average	-
Sand filters in the trenches, Renner system	46*	1*	56*	high	low	low	average	little data
Wastewater ponds	80	25	5	high	very low	low	high	-
Drainage system	-	-	-	insecure	very low	low	high	-

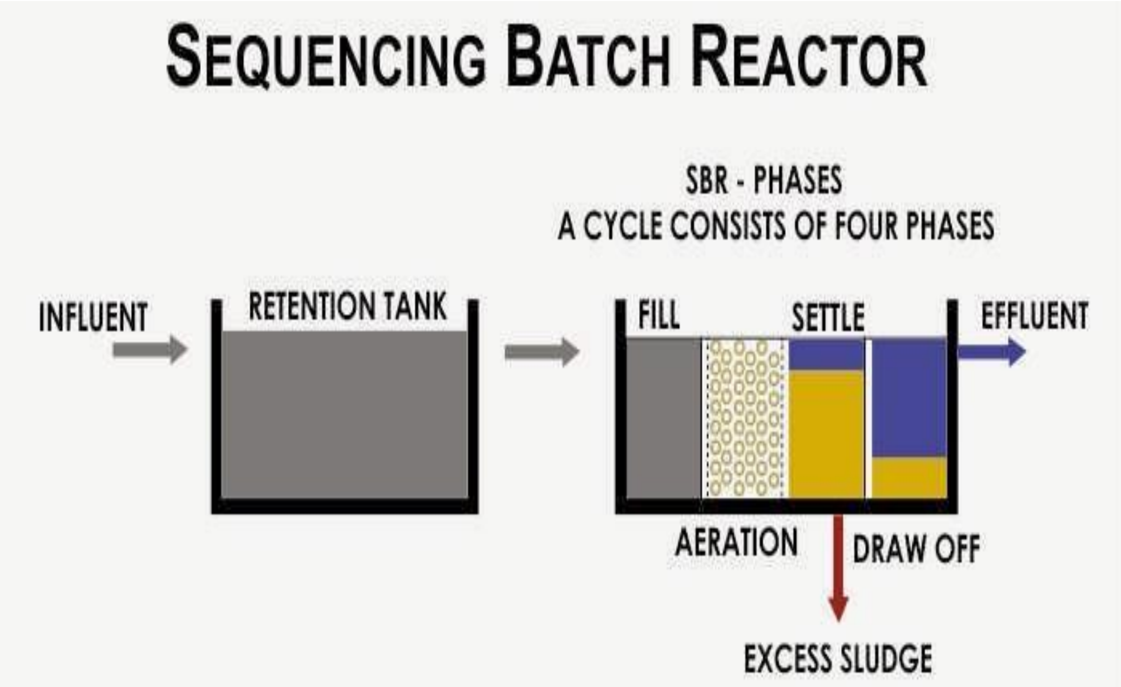
Source: Mazurkiewicz, 2007.

- Among the above methods available, so as to achieve the quality of final effluent as per CPHEEO standards, the cost-effective and proven S.B.R technology is to be adopted in Narayana engineering college gudur. Accordingly, the land requirement is also estimated and a decentralized Sewage Treatment System is proposed.

SEQUENTIAL BATCH REACTOR (SBR) :

SBRtechnology processes all these units into a single tank for their specific duration and intervals and provides the best treatment very quickly. The SBR technology incorporates a fill-and-draw type biological wastewater treatment process, functionally resembling an activated sludge process. It uses a five stages process for the treatment of wastewater. These stages include:

1. Fill
2. React
3. Settle
4. decant
5. Idle



INNER VIEW OF SBR CHAMBER

ADVANTAGES OF SBR:-

- Equalization, primary clarification, biological treatment and secondary clarification can be achieved in a single reactor vessel.
- SBR requires small space.
- SBR has controllable react time and quiescent settling.
- Minimal footprint.

- High nutrient removal capabilities.
- The BOD removal efficiency is generally 85 to 90%
- The COD removal efficiency is generally up to 90%

DISADVANTAGES OFSBR:-

- Low pathogen removal.
- Requires skilled personnel.
- Dependence on uninterruptedpower supply.
- More automation required than for CAS/EA.
- Biogas is explosive (Risk in case of improper operation).
- High maintenance requirements.
- Dependence on some foreignspare partsis inevitable.
- High CAPEX and OPEX, but slightly cheaper than CAS/EA.

TREATMENT PROCESS: -

The system is operated in a batch modesequence which eliminates all the inefficiencies of the continuous processes. A batch reactor is a perfect reactor, which ensures 100% treatment. Two basins are provided to ensure continuous treatment and the flow is distributed by providing a weir in the splitter chamber. To maintain the cycle Gate at the inlet of the anoxic the zone of basin is provided controlled on PLC. The complete process takes place in a single reactor, within which all biological treatment steps take place sequentially.

The SBR basins are equipped with air blowers, diffusers, Excess /Waste Activated Sludge (WAS) pumps, Decanters, Auto valves, PLC, etc. All cycles will be automatically controlled using PLC. Excess sludge at a consistency level of approx. 0.8% - 1.0% will be pumped intermittently from WAS pump to the sludge sump. The sludge from thesludge sump is taken for dewatering to centrifuge units and finally for its ultimate disposal. The treated effluent from the SBR Basins beconveyed to the Chlorine contact tank for disinfection NO additional settling unit / secondary clarifiers are required.

The complete biological operation is divided into cycles. Each cycle is 3-4 hrs.

During the period of the fill/aeration cycle, the liquid is filled in the SBR Basin up to a set operating water level. Air Blowers are started for aeration of the influent. After the fill/aeration cycle, the biomass settles under perfect settling conditions. After settling cycle Settled the supernatant is removed from the top using a DECANTER. Solids are wasted from the tanks during the decanting phase.

The SBR Technology is the configuration of the activated sludge process which operates on extended aeration of activated sludge. This works on the principle for BOD reduction, Nitrification, DE nitrification as well as biological phosphorous removal. This is equipped with energy-efficient fine bubble membrane diffused aeration system, with automatic control of oxygen uptake rate, resulting in 20 – 30% power savings.

Explanation of cyclic operation:

A basic cycle comprises:

- Fill-Aeration (F/A) – 1.5 Hrs.
- Settling (S) –0.75 .Hrs.
- Decanting (D) -0.75 .Hrs.

Typically, the total Duration of Each Cycle is 3.0 hrs

ESTIMATION OF SEWAGE GENERATED:-

COLLECTED DATA

s.no	Year	Total students except for hostlers	Staff	Total population	Increase in population	Wastewater generated
1	2011	1300	175	1475	------	66375
2	2021	1550	200	1700	225	76500

From the above data :

- **Increase in population for every decade = 225 no's**
- **Total population in college in 2021 =1700 no's**
- **Considering 45 lpcd for college as per CPHEEO**

Calculation of waste water generated in college for the next 3 decades :

For population forecasting we are using arithmetical increase method

Formula = p + nc

:where n= number of decades

c =increase in population

For the year 2051:

Total population =population in 2041+nc

total population = 2150+1 X 225

=2375 no's

Waste water generated in college in 2051 = total population X 45 lpcd

= 2375 X 45

= 106875 lit/day

Calculation of waste water generated in hostel for the next 3 decades :

Considerations:

- The max number of students fit for both boys and girls hostel = 300no's
- Considering 80% of 135 lpcd is considered for sewage generation for hostel

Total sewage water generated in hostel:-

=300 X 108

=32400 lit/day

Total sewage generated in (2051)=sewage generated from college +sewagegenerated from hostel

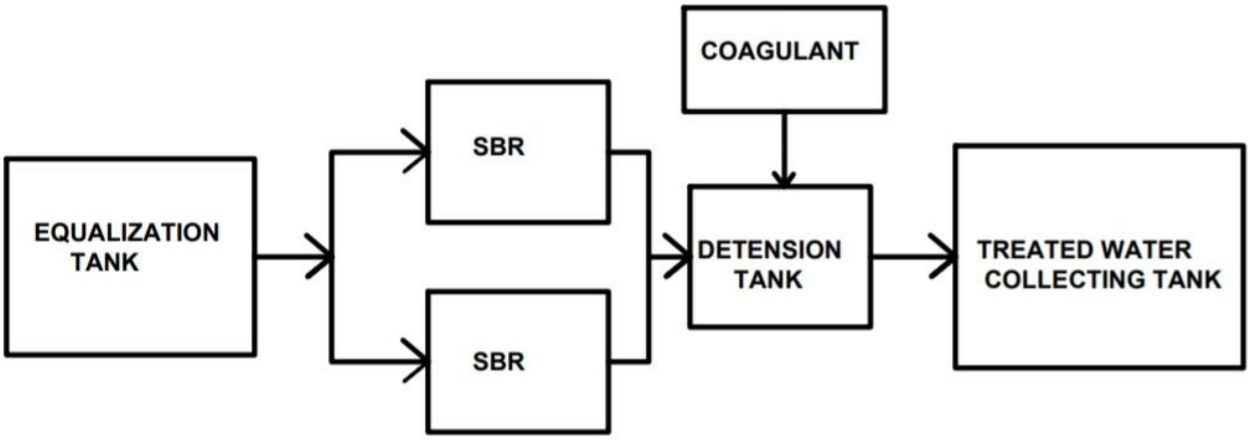
=106875+32400

=139275 lit/day

Say =150000 lit /day

Sewage inflow = **150000 lit /day**

= 0.0017 m^3/s



LAYOUT PLAN OF STP UNIT AT NARAYANA ENGINEERING COLLEGE GUDUR

BASIN DESIGN :-

Design considerations:

1. Sewage to be treated in day = 150 m^3/day
2. Time for "Fill & Aerate" phase provided = 1.50hrs
3. Time for settle phase provided = 0.75 hrs
4. Time for decant phase provided = 0.75 hrs

Total cycle time provided:

= Time for "Fill & Aerate" phase provided **+** Time for settle Phase provided + Time for decant phase provided

=1.50+.75+.75=3.0 hours

Number of cycles provided per basin per day = 3 numbers(as per college timings)

Aeration time provided per basin per day= Time for "Fill & Aerate" phase provided x Number of cycles provided per basin per day

= 1.5 X 3 => 4.5hrs

Number of basin under fill = 1 numbers

Number of basins under aerate simultaneously = 1 numbers

Number basins under decant simultaneously = 1 numbers

Flow rate = Sewage to be treated in day / 24= 6.25 m^3/hr

Volume of Sewage to be treated in day = 150 m^3/day

Inlet BOD = 420 mg/lt

MLSS considered = 4,400 mg/lt

MLVSS = MLSS x 0.7== 3,080 mg/lt

F/M considered = 0.123

Total Volume of Aeration Basins required =(150 X 420)/(3080 X 0.123)=160 m^3

No. of Basins provided = 1 no's

- **Volume required per Basin** = (Total Volume of Aeration Basins required)/ No. of Basins provided X N o .of cycles in a day)

=160/(2 X 3) = 26.66m^3

Say=27m^3

Side Water Depth (SWD) provided = 3 m

Width provided = 3 m

Length required = 3 m

Length provided = 3 m

Volume provided = Side Water Depth (SWD) provided x Width provided x Length provided

= 27 m^3

- **Total volume provided** = 54 m^3
- **Free board provided** = 0.5 m
- **Total depth provided** = Side Water Depth (SWD) provided + Free board provided

=3 + 0.5.

=3.5 m

Capacity of Return Activated Sludge (RAS) Pump provided = 1 m^3/hr

ACTUAL OXYGEN REQUIREMENT (AOR) :

- **CALCULATION OF BOD REMOVED PER DAY :**

Volume of Sewage to be treated in day =150 m^3/day or 150 KL /day

Inlet BOD = 420 mg/lt

Outlet BOD = 8 mg/lt

- **BODremoved**= Inlet BOD - Outlet BOD=420-8=412 mg/lt
- **BODremoved inaday** = (Volume of Sewage to be treated in dayxBODremoved) / 1000)

=(150 X 412)/1000=62 Kg/day

- **O2requiredforoxidationofBOD** = 1.20 Kg/KgBOD (A s per CPHEEO manual)
- **O2requiredforoxidationofBOD in a day** = BODremoved inaday xO2requiredforoxidationofBOD=62 X 1.2 =74.5Kg/day

Inlet TKN = 45.0 mg/l

OutletNH3-N = 0.4mg/l

- **Nitrogenassimilatedduringoxidationof BOD** = (BODremoved x 5%)

=412 X 0.05=21mg/lt

- **NH3-Nnitrified** = Inlet TKN - outletNH3-N - Nitrogenassimilatedduringoxidation of BOD =45 – 0.4 – 21= 23.6 mg/lt
- **NH3-Nnitrifiedina day** = (Volume of Sewage to be treated in day x NH3-Nnitrifiedina day) / 1000) =(150 X 23.6)/1000 =3. 54 Kg/day
- **O2requiredfornitrificationofNH3** = 4.56 Kg/NH3-N

- **O_2requiredfornitrificationofNH3-N**= (NH3-Nnitrifiedina day x O_2requiredfornitrificationofNH3-N)
  =3.54 X 4.56= 16 Kg/day
  - KgNO3-Ngenerated = 3.54 Kg/day (NH3-Nnitrifiedina day)
  - OutletNO3-N = 3 mg/lt
  - KgofNO3-Nintreatedsewage = 0.45 Kg/day
- **NO3-Nthatisdenitrified** = KgNO3-Ngenerated - KgofNO3-Nintreatedsewage =3.09 Kg/day
- **AmountofNO3-Nthatisdenitrified** = (NO3-Nthatisdenitrified x Assuming Denitrification as 75% ofavailableNitrate Nitrogen) = 3.09 X 0 .75= 2.31 Kg/day
- **O_2creditduringde-nitrificationofNO3-N** = 2.86 Kg/KgNO3-N
- **O_2credit availableduringde-nitrification** = (AmountofNO3-Nthatisdenitrified x O_2creditduringde-nitrificationofNO3-N) =2.31 X 2.86=6.60 Kg/day

- **Total O_2requiredincludingO_2creditduringde-nitrification**= (O_2requiredforoxidationof BOD + O_2requiredfornitrificationofNH3-N - O_2credit availableduringde-nitrification).

  =74.5 +16+ 6.60

  =97.1 Kg/day

Sl. No.	STPProcess	Energy Requirement	CapitalCost,Rs.Million/MLD	O&MCost,million/year/MLD
1	WasteStabilizationPondSystem(WSPS)	Negligible.	Rs.2.5-5.0	Rs. 0.09-0.15 million/year/MLD Rs.0.25-0.41/m^3
2	DuckweedPondSystem(DPS)	Negligible.	Rs.2.5-5.0	Rs.0.25million/MLD/year Rs.0.68/m^3.
3	FacultativeAeratedLagoon(FAL)	18KWh/ML	Rs.2.2 to3.0	0.15to0.2million/MLD/yr. Rs.0.41 to0.55/m^3
4	TricklingFilter(TF)	180KWh/ML	Rs.4 to5	Rs.0.5million/MLD/year. Rs.1.40/m^3
5	ActivatedSludgeProcess(ASP)	180-225 KWh/ML	Rs.5 to6	Rs.0.5 to0.7 million/MLD/YearRs.1.40to1.92 /m^3
6	BIOFORTechnology(Biological FiltrationandOxygenatedReactor)	220 -335	Rs.10to 12	RS1.2million/mld/Year Rs.3.30/m^3
7	HighRateActivatedSludgeBiofor-F Technology	180kWh/ML	Rs.7.5	Rs.0.80million/MLD/Year Rs.2.20/m^3
8	FluidizedAeratedBed(FAB)	99to170 kWh/ML	Rs6 to8	Rs.0.9to 1.0 million/MLD/ year Rs.2.47 to2.74/m^3

9	SubmergedAerationFixedFilm(SAFF) Technology	390kWh/ML	Rs.9	Rs.1.4million/MLD/year Rs.3.84/m^3
10	CyclicActivatedSludgeProcess(CASP)	150-200 kWh/ML	Rs.11	Rs.1.4million/MLD/year
11	Up flowAnaerobicSludgeBlanket(UASB)Process	10 -15 KWh/ML	Rs.3.0to4.0	Rs.0.12to0.17 million/MLD/Year Rs.0.33 to0.47 m^3

COST COMPARISION B/W VARIOUS TECHNOLOGIES IN SEWAGE TREATMENT PLANT:-

CONCLUSION:-

- Sequencingbatch reactors are useful forareas where the availablelandislimited. Equalization, primarilyclarification,biologicaltreatment,andsecondaryclarificationcanbeachievedina singlevessel.
- Thepollutantremovalefficiencyof the SBRsystemishigher for nitrogenand phosphate.The SBR system can remove heavy metals such as Zn, Cu, and Pb with organicpollutantsandnitrogen
- Experimental results of STPs based on SBR Technology indicate that BOD, COD&TotalSuspended Solids (TSS),Phosphate,andTotalKjeldahlNitrogen(TN)removalefficiencieswerecalculated to be97.88%,996.62%,97.40%,98.87%, 84.50%respectively.

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