SEWAGE TREATMENT PLANTS OF HOSPITALS:HI-TECH HOSPITAL-A CASE STUDY

A DISSERTATION SUBMITTED FOR THE PARTIAL FULFILMENT OF THE

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IN

BIOTECHNOLOGY

BY

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UNDER THE SUPERVISION OF

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CERTIFICATE

This is to certify the dissertation entitled "***case study of stp of Hitech hospital***" Submitted by *'**Agnidev Chakravarty**'* in partial fulfilment of the requirement for the degree of Master of Science in Biotechnology/Applied Microbiology, KIIT School of Biotechnology, KIIT University, Bhubaneswar bearing Roll No. *1661001.'* & Registration No. *16675558343.'* is a *bona fide* research work carried out by his/her under my guidance and supervision from ***2nd feb 2018 to 2nd may 2018***'.

(*Research Supervisor full Signature*)

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DECLARATION

I,Agnidev Chakravarty,M.sc. in Biotecnology,kalinga institute of industrial technology, Bhubaneswar, declare that all my dissertation works are original and no part of this work has been submitted for any other degree or diploma in any other university .all the given information and works are true to my knowledge and belief.

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Date:

Place: *Signature & Name*

Abstract

The dirty water that comes from homes and businesses as a result of laundry, using the-bathroom, and all the soapy water that comes from washing dishes and the likes in the kitchen is what we call sewage or wastewater. Rainwater entering drains and industrial wastes also appear to fit under this category.

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

Sewage treatment mainly takes place in two main stages: Primary and Secondary treatment

In arid areas, where there is not enough water, sewage also undergoes a tertiary treatment to meet the demands of the drinking water supply.

During primary treatment, the suspended solids are separated from the water and the BOD(Biochemical Oxygen Demand) of the water is reduced, preparing it for the next stage inwastewater treatment.

Secondary treatment can be accomplished by a wide variety of means. However, in our project and poster, we will only be concentrating on two of the most commonly used methods: the trickling filter and activated sludge.

The activated sludge method uses air and a biological floc that is comprised of bacteria (mainly Zoogloea) and protozoans.

This “aeration” continues for 4-6 hours, after which it is stopped and the contents moved to a settling tank. In the settling tank, the floc settles out and removes much of the organic material with it.

This process removes 75-95% of the BOD.

In the trickling filter, sewage is passed (as a fine spray) over a bed of rocks or molded plastic,over which a biofilm of aerobic micro Organisms grow. This method removes 80 to 85% 0f BOD.

The water is then disinfected, mostly by chlorination, and released into flowing streams or oceans.If needed (or desired), the sewage water can be treated in such a way as to make it safe for consumption. This is where tertiary treatment appears.

The sole purpose of any tertiary treatment is to make sewage water (after it has passed through secondary treatment) suitablefor human consumption.In other words, it gives us potable water.

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Abbreviations/Acronyms

STP : Sewage treatment plant.

MBBR : Moving Bed Biofilm Reactors.

IFSA : Integrated Fixed-Film Activated Sludge.

BNR : Biological nutrient removal.

BOD : Biochemical Oxygen Demand.

COD : Chemical Oxygen Demand.

AWWA : American Water Works Association.

TSS : Total suspended solid.

KLD : Kiloliter per day.

WWT : Waste Water treatment.

FAB : Fluidised Aerobic Bio Reactor

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INTRODUCTION

1.1 Sewage Treatment Plant :

It is the process of removing contaminants from wastewater, primarily from household sewage. It includes physical, chemical, and biological processes to remove these contaminants and produce environmentally safe treated wastewater (or treated effluent). A by-product of sewage treatment is usually a semi-solid waste or slurry, called sewage sludge, that has to undergo further treatment before being suitable for disposal or land application.

For most cities, the sewer system will also carry a proportion of industrial effluent to the sewage treatment plant which has usually received pre treatment at the factories themselves to reduce the pollutant load. If the sewer system is a combined sewer then it will also carry urban runoff (storm water) to the sewage treatment plant. Sewage water can travel towards treatment plants via piping and in a flow aided by gravity and pumps. The first part of filtration of sewage typically includes a bar screen to filter solids and large objects which are then collected in dumpsters and disposed of in landfills. Fat and grease will also be removed before the primary treatment of sewage.

1.1.1 Primary treatment:

In the primary sedimentation stage, sewage flows through large tanks, commonly called "pre-settling basins", "primary sedimentation tanks" or "primary clarifiers”. The tanks are used to settle sludge while grease and oils rise to the surface and are skimmed off. Primary settling tanks are usually equipped with mechanically driven scrapers that continually drive the collected sludge towards a hopper in the base of the tank where it is pumped to sludge treatment facilities. Grease and oil from the floating material can sometimes be recovered for saponification (soap making).

1.1.2 Secondary treatment:

Secondary treatment is designed to substantially degrade the biological content of the sewage which are derived from human waste, food waste, soaps and detergent. The majority of municipal plants treat the settled sewage liquor using aerobic biological processes. To be effective, the biota require both oxygen and food to live. The bacteria and protozoa consume biodegradable soluble organic contaminants (e.g. sugars, fats, organic short-chain carbon molecules, etc.) and

bind much of the less soluble fractions into floc. Secondary treatment systems are classified as fixed-film or suspended-growth systems.

- **Fixed-film** or **attached growth** systems include trickling filters, bio-towers, and rotating biological contactors, where the biomass grows on media and the sewage passes over its surface. The fixed-film principle has further developed into Moving Bed Biofilm Reactors (MBBR) and Integrated Fixed-Film Activated Sludge (IFAS) processes. An MBBR system typically requires a smaller footprint than suspended-growth systems.
- **Suspended-growth** systems include activated sludge, where the biomass is mixed with the sewage and can be operated in a smaller space than trickling filters that treat the same amount of water. However, fixed-film systems are more able to cope with drastic changes in the amount of biological material and can provide higher removal rates for organic material and suspended solids than suspended growth systems.

Secondary sedimentation:

Some secondary treatment methods include a secondary clarifier to settle out and separate biological floc or filter material grown in the secondary treatment bioreactor.

List of process types

- Activated sludge
- Aerated lagoon
- Aerobic granulation
- Constructed wetland
- Membrane bioreactor
- Rotating biological contactor
- Sequencing batch reactor
- Trickling filter

To use less space, treat difficult waste, and intermittent flows, a number of designs of hybrid treatment plants have been produced. Such plants often combine at least two stages of the three main treatment stages into one combined stage. In the UK, where a large number of wastewater treatment plants serve small populations, package plants are a viable alternative to building a large structure for each process stage. In the US, package plants are typically used in rural areas, highway rest stops and trailer parks.

1.3 Tertiary treatment

The purpose of tertiary treatment is to provide a final treatment stage to further improve the effluent quality before it is discharged to the receiving environment (sea, river, lake, wet lands, ground, etc.). More than one tertiary treatment process may be used at any treatment plant. If disinfection is practised, it is always the final process. It is also called "effluent polishing."

1.3.1 Filtration

Sand filtration removes much of the residual suspended matter. Filtration over activated carbon, also called carbon adsorption, removes residual toxins.

1.3.2 Lagoons or ponds:

Lagoons or ponds provide settlement and further biological improvement through storage in large man-made ponds or lagoons. These lagoons are highly aerobic and colonization by native macrophytes, especially reeds, is often encouraged. Small filter-feeding invertebrates such as Daphnia and species of Rotifera greatly assist in treatment by removing fine particulates.

1.3.3 Biological nutrient removal:

Biological nutrient removal (BNR) is regarded by some as a type of secondary treatment process, and by others as a tertiary (or "advanced") treatment process.

Nitrogen is removed through the biological oxidation of nitrogen from ammonia to nitrate (nitrification), followed by denitrification, the reduction of nitrate to nitrogen gas. Nitrogen gas is released to the atmosphere and thus removed from the water.

AIM AND OBJECTIVES

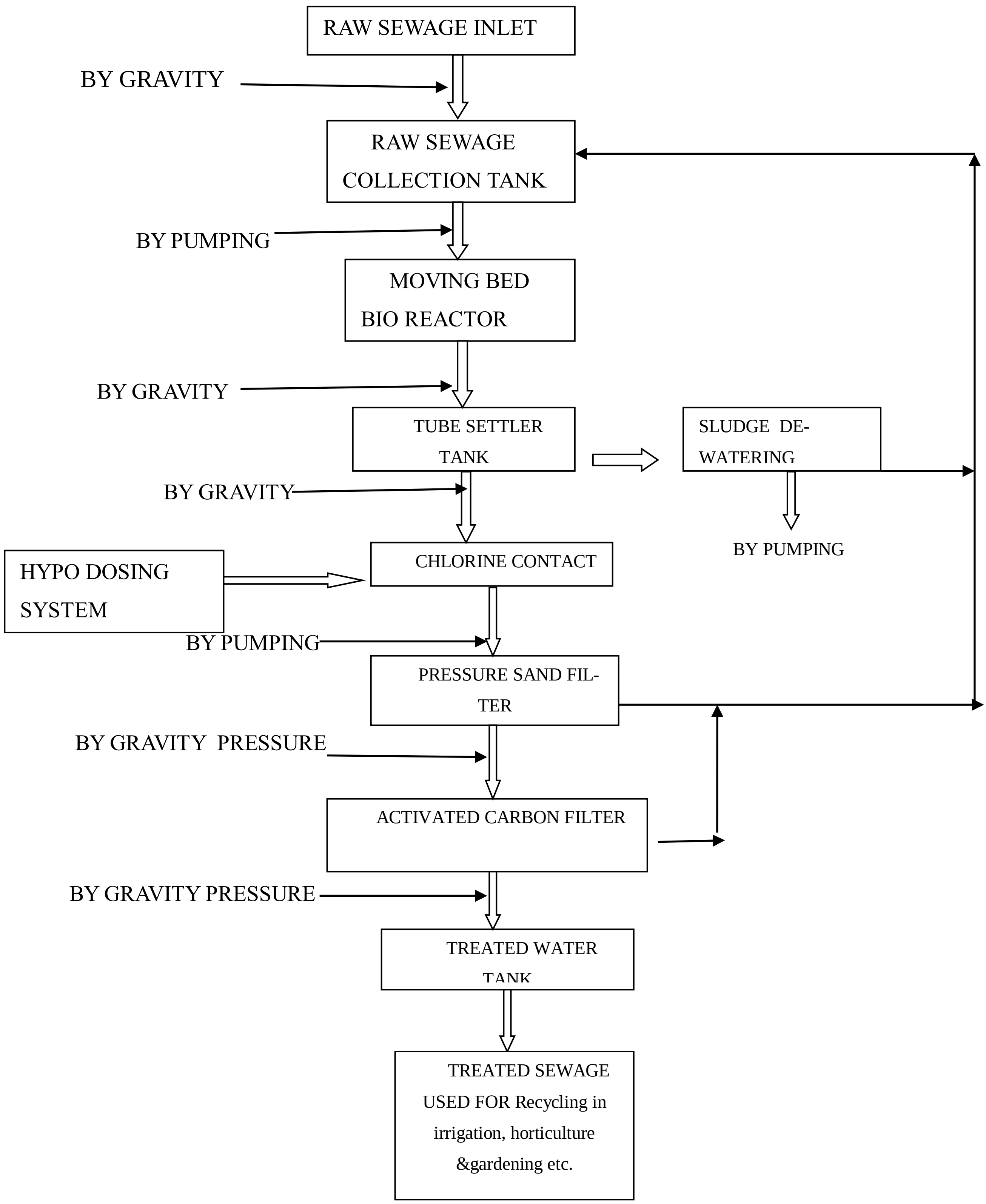
Aim and Objectives:

My desertation deals with the case study of the Sewage Treatment Plant that is present in the HI-Tech Hospital. This is to proof how effectively the plant can recycle the waste water of the hospital. Main objective is to make a comparitive studies between the parameters (pH,TSS,BOD,COD,Ammoniacal nitrogen , Oil&Greese) of waste water and recycled water in different period of time (keeping 15 days gap) so as to proof the effectivity. Reading also taken in betweeen the steps of the process so as to assure the proper recycling process of the plant.

Sample is collected from the waste water tank (inlet) and sample is recycled water tank (out-let) . Then the parameters of the waste water as well as recycled water is measured. This process is repeated thrice keeping 15 days gap. Then those recorded values are obseved and understood at different time period how effectively this recycling process is being carried away. The recycled values at three times are seen nearly same so we conclude that the plant is working effectively.

My project mainly deals with establishing the effectiveness of the recycling plant of HI-Tech hospital. So as to find any flaws in the plant and modification or rectification could be done if needed.

Fig-1 Schematic diagram of a typical Sewage Treatment Plant



Achievements

We did the case study , we compared the values of inlet and outlet of the STP three times and we concluded that the STP is working effectively .

Review of Literature

Waste from water treatment plants

This literature review on wastes from water treatment plants discusses previous literature reviews on the subject, sources and types of waste, characteristics of each type of waste, and waste management. The discussion of management of sludge (waste) covers minimizing sludge production, methods of sludge treatment, and ultimate sludge disposal.

Previous Reports

- During the period 1969 to 1981 the American Water Works Association (AWWA) Research Foundation and the AWWA Sludge Disposal Committee prepared a series of reports with a comprehensive literature review on the nature and solutions of water treatment plant waste disposal problems. The first report, prepared by the AWWA Research Foundation, was divided into four parts (AWWA Research Foundation, 1969a, 1969b, 1969c, 1970) and was entitled "Disposal of Wastes from Water Treatment Plants." The first part of this report (AWWA, 1969a) covered the status of research and engineering practices for treating various wastes from water treatment plants. The second part (AWWA, 1969b) reviewed plant operations for the disposal of various types of wastes, and the regulatory aspects of disposal. The third part (AWWA, 1969c) described various treatment processes employed and their efficiency and degree of success, and presented cost analyses. The last part (AWWA, 1970) sum
- Concurrently with the initial preparation of the report by the AWWA Research Foundation, the Water Resources Quality Control Committee of the Illinois Section of the AWWA conducted a survey of the handling of wastes from water treatment plants in Illinois (Evans et al., 1970). This effort was made to determine the type and quantities of waste produced, the characteristics of the wastes, and the existing methods of waste disposal in Illinois.
- In 1972, the AWWA Disposal of Water Treatment Plant Waste Committee published an updated report (AWWA, 1972). It dealt with processing and re-processing in sludge production, i.e., selection and modification of treatment processes, reclamation

of lime and alum, recovery of filter backwash water, processing of wastes to recover useful by-products, processing of wastes for disposal, ultimate disposal, and future research needs. marized research needs, engineering needs, plant operation needs, and regulatory needs.

- In 1978, the AWWA Sludge Disposal Committee prepared a 2-part article (AWWA Sludge Disposal Committee, 1978a, 1978b) entitled "Water Treatment Plant Sludge . An Update of the State of the Art." Part 1 dealt with regulatory requirements, sludge production and characteristics, minimizing of waste production, and European and Japanese practices. Part 2 detailed non-mechanical and mechanical methods of dewatering water plant sludges, ultimate solids disposal, and research and development needs. These reports focused mainly on coagulant sludges.

- In 1981, the AWWA Sludge Disposal Committee provided an overview of the production, processing, and disposal of lime-softening sludges; recent technological advances in handling, treatment, and disposal of softening sludges; and research needs (AWWA, 1981).

Sample collection:

Samples may be required when sewage enters a treatment plant, after various stages of treatment and the treated effluent. Crude sewages samples are taken after preliminary treatment process (grit removal and screening) to exclude large particles. In case of sewers and narrow effluent channels. samples should be drawn from a point which is at one-third water depths from the top without skimminq the top or scrapping the bottom. In any event velocity of flow at the sampling point should be sufficient to prevent deposition of solids. Sample should bedrawn" gently without causing aeration or liberation of dissolved gases. In most cases. sewage flows are intermittent and collection of sample every hour may be necessary.

STP of a Hospital Unit

Hospital wastewater (HWW) were normally discharged directly, without pre-treatment, to the sewers. However, HWW has gained increasing scientific and public attention in the last decade.Depending upon the concentration of the constituents, such as BOD, TSS, domestic waste water is classified as strong, medium or weak. Various study and research work reveals that pH, BOD, COD, TSS and oil and grease the hospital wastewater is similar to medium values of the domestic wastewater.In hospitals, also, the water consumed in different units such as inpatient wards, operating rooms, laboratories, laundries, kitchens, health services and administrative units decreases its physical, chemical and biological quality and is converted to wastewater.

Hospital wastewater may contain various potential hazardous materials including, microbiological pathogens, radioactive isotopes, disinfectants, drugs, chemical compounds and pharmaceuticals. Indeed the hospital wastewater may have an adverse impact on environment and human health. Therefore, the selection of suitable treatment technology and proper treatment of hospital wastewater is essential. The discharge standards for hospital wastewater should conforms to those laid down under Environment (Protection) Act, 1986. Bio- medical Waste Management Rules, 2016 notified under this Rule has prescribed the discharge limits for the effluent generated or treated from the premises of occupier or operator of a common biomedical waste treatment and disposal facility, before discharge into the sewer as follows.

PARAMETERS	PERMISSIBLE LIMITS
pH	6.5 – 9.0
TotalSuspended solids	100 mg/l
Oil and grease	10 mg/l
BOD, 3 days at 27^0C	30 mg/l
COD	250 mg/l
Bio-assay test	90% survival of fish after 96 hours in 100% effluent

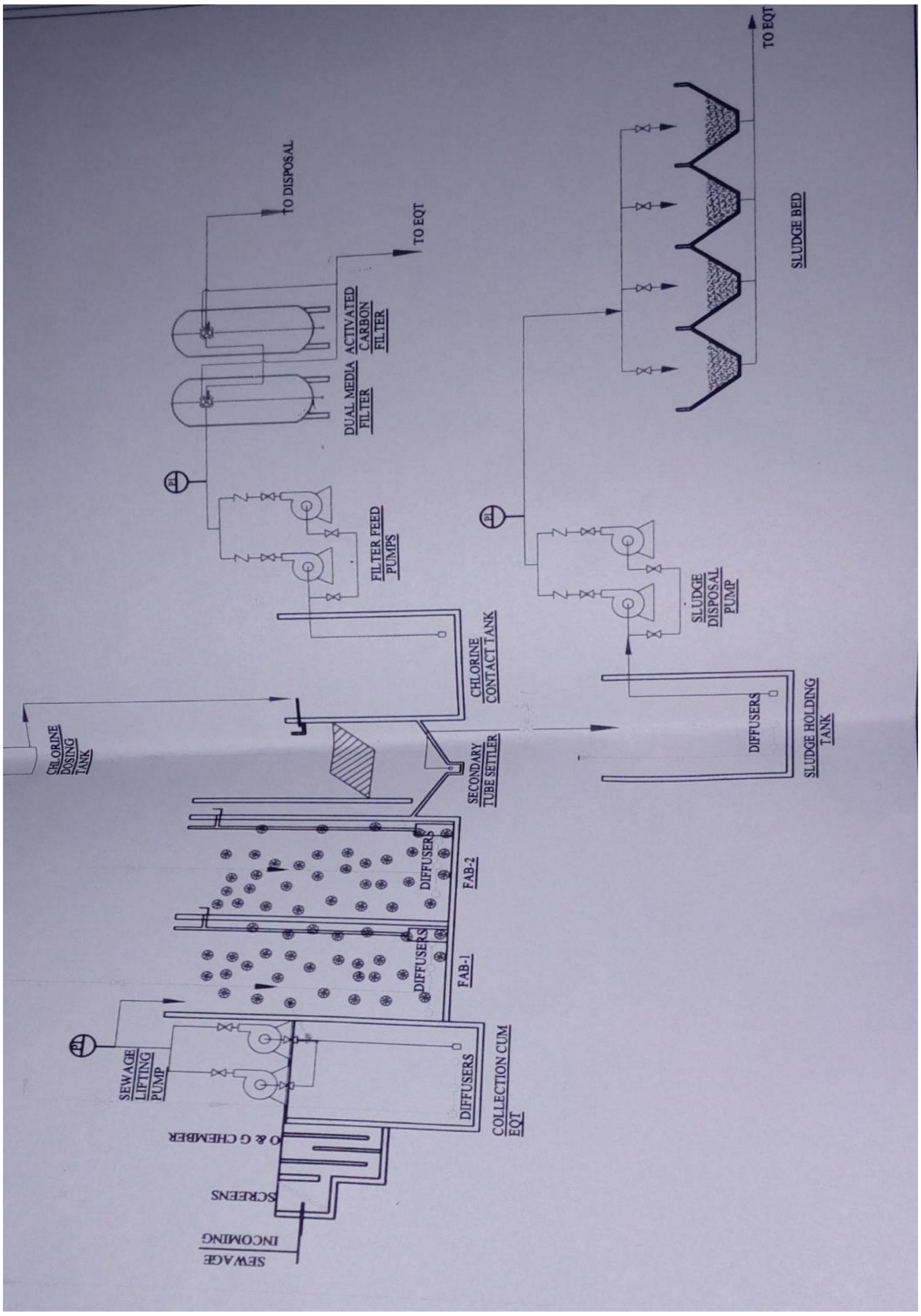
In the present dissertation work, STP of Hi-Tech Hospital is taken under investigation.

The Hi-Tech college and hospitals` is situated in Bhubaneswar, Odisha. This institute provides hospital facilities. It is a 1500-bedded multi specialist hospital.

The unit has established a sewage treatment plant to treat 400 KLD (Kiloliter per Day)of waste water generated within its premises from various activities. The components of the STP are as follows.

- Bar Screen : Two Bar screens of 10 mm spacing followed by 8 mm spacing made up of MS material are kept in series for removal of suspended solids.
- Oil and Grease Trap : It is in place next to Bar screen to arrest oil and grease.
- Equalization Tank : Equalization tank-cum-collection Tank with air distribution piping with adequate number of coarse bubble diffusers.
- Biological Treatment of wastewater using FAB media : Two reactor tanks are provided in parallel with floating media of PVC material. The sewage water flows down keeping in contact with the FAB media. The air in form of fine bubbles coming from the bottom of tank comes in contact with the water and FAB media. The tank is provided with fine bubble, non-clog diffusers for the biological oxidation of sewage.
- Air shall be used in FAB tank and in collection-cum-equalization tank to avoid the anaerobic condition, smell problem and sedimentation of solids to the tank.
- Tube Deck Media Clarifier : The overflow of FAB tank is taken to secondary clarifier having baffle wall containing tube deck media made up of PVC material (1.2 meter length) and is arranged in 60^0 angle to facilitate solid-liquid separation.
- Clarified/ Clear Water Tank : The clear water from Tube Deck Media Clarifier flows into this tank. Sodium hypochlorite solution ois doses in this tank using a meterinhg pump for disinfection purpose.
- Media Filtration and Carbon FiltartionSystem : The clarified and Chlorinated water is pumped to media filter followed by Carbon filter to further polish the treated effluent. The Carbon filter removes the colour and odour of the treated effluent.
- Sludge Collection Tank : The treated water is being stored in Kuchha holding pond of size (100 ft x 80 ft x 16 ft) for re-use in building construction work and gardening purpose.

The Flow schematic diagram of the STP established in the unit is shown in **Fig. 2**.


SEWAGE INCOMING
SCREENS
O & G CHEMBER
SEWAGE LIFTING PUMP
COLLECTION CUM EQT
DIFFUSERS
FAB-1
FAB-2
SECONDARY TUBE SETTLER
CHLORINE DOSING TANK
CHLORINE CONTACT TANK
FILTER FEED PUMPS
DUAL MEDIA FILTER
ACTIVATED CARBON FILTER
TO DISPOSAL
TO EQT
SLUDGE HOLDING TANK
SLUDGE DISPOSAL PUMP
SLUDGE BED

MATERIALS

AND METHODOLOGY

SEWAGE SAMPLING AND ANALYSIS

The purpose of sewage sampling and analysis is to ensure adequacy of sewage treatment or to identify problem areas in its operation.

Sampling. Sampling was conducted on the influent to each component of the treatment system and the final effluent after treatment. Grab Sampling was conducted at each location. This is a sample of sewage taken at a designated time. It involves nothing more than collecting a designated amount of sewage in a container at a specific point in the system.

Analysis: The samples were analysed for the parameters like pH, TSS, BOD, COD, Ammonical Nitrogen and oil&grease. Principles of measurement of these parameters are described in following pages.

<u>For pH :</u>

<u>Materials / Equipment:</u>

1. pH Meter
2. Wash Bottle
3. Distilled water / De-ionized water
4. Absorbent cloth / paper (Tissue Paper)
5. Discard Tray / Beaker
6. Glass pipette
7. Glass Vial (20ml)
8. Lubricants / Reagents
9. Reference Solution / Tap Water

Procedure:

- Determination of the activity of hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.
- Take 15-18 ml of selected samples in to a 20 ml glass vial and dip the electrode. Wait some time to stable the pH reading,then Record the pH value.
- pH meter is used to coduct the test.

For Total Suspended Solids (TSS) :

Materials / Equipment:

1 .Gooch crucible with adapter

2 .Hot Air Oven

3 . Measuring Cylinder

4 . Dessicator

Procedure:

Preparation of filter disk: Assemble filtering apparatus, filter & begin suction. Apply vaccum and wash with three successive 20ml volume of distilled water continue suction to remove all traces of water, turn vacuum off and discard washing. Remove crucible and filter combination, dry in an oven at 103 to 105°C for 1 Hour. Repeat cycle of drying, cooling, desiccating and weighing until a constant weight is obtained or until weight change is less than 4% of previous weight.

Sample Analysis: Assemble filtering apparatus, stir sample with a magnetic stirrer at uniform speed.Pour 100ml of sample (sample volume increases up to 1 liter) apply vacuum and begin suction. Upon filtration of sample, wash with three successive 20ml volume of distilled water continue suction to remove all traces of water, continue suction for about 3mins afte filtration is complete, turn off vacuum. Remove crucible and filter combination, dry in an oven at 103 to 105°C for 1h. Repeat cycle of drying, cooling, desiccating and weighing until a constant weight obtained or until weight change is less than 4% of previous weighing.

For Biological oxygen demand:

Materials / Equipment:

1. Manganous sulphate ($MnSO_4 .H_2O$)
2. Potassium Hydroxide (KOH)
3. Potassium Iodide (KI)
4. Sodium azide (NaN_3)
5. Sodium ThioSulphate ($Na_2S_2O_3 .5H_2O$)
6. Starch
7. Distilled Water
8. Potassium bi-iodate [$KH(IO_3)_2$]
9. Conc. H_2SO_4

Procedure:

Take BOD bottles and fill it with diluted sample, avoid any kind of bubbling and trapping of air bubbles. Prepare two bottles for each sample, determine DO-I on the first bottle & stopper second bottle tightly, water seal, place a paper or plastic foil over a flared mouth of bottle & incubate it for 5 days at 20°C.Remove stopper and add 1 ml of $MnSO_4$ Sol^n followed by 1 ml. of alkali Iodide azide Soln. then put the stopper carefully not to leave any air bubble inside. Shake the bottle upside down manner (mix by inverting) for few times. Allow it to stand for some time for precipitation.When precipitate has settled sufficiently, add 1 ml of conc. H_2So_4 in to the BOD bottle and re stopper it. Mix it by inverting several times till precipitate dissolves. Titrate 20ml of the sample against 0.025N $Na_2S_2O_3$ till pale straw color develops. Then add few drops of Starch indicator and titrate with $Na_2S_2O_3$ till blue color disappears. Note the burette reading.

For Chemical oxygen demand :

Take 0.4gm $HgSO_4$ in COD vials and add 20 ml or an aliquot of sample diluted to 20 ml with distilled water. For blank, similarly take 0.4gm $HgSO_4$ in an another COD vial and 20 ml of distilled water. Then add 10ml of potassium dichromate reagent ($k_2Cr_2O_7$) (as digestion solution) and 30ml of sulphuric acid reagent (H_2SO_4) (as catalyst solution both in to the above COD vials.If the color turns green, take fresh sample with smaller aliquot. Connect the tubes (condenser) tightly and keep the COD vials in the respective blocks of COD digester and reflux for 2 hrs. at temperature 150 ± 2 °C. The digester automatically switch off then remove the vials and allow to cool at the room temperature. Then wash down the condensers with 60ml distilled water. Transfer the contents of the vial in to a conical flask and add few drops of ferroin indicator & titrate against 0.1N FAS solution (End Point is reddish brown).Titrate the blank as same as sample & note the reading.

For Ammonical nitrogen:

Take 0.4gm $HgSO_4$ in COD vials and add 20 ml or an aliquot of sample diluted to 20 ml with distilled water. For blank, similarly take 0.4gm $HgSO_4$ in an another COD vial and 20 ml of

distilled water. Then add 10ml of potassium dichromate reagent ($k_2Cr_2O_7$) (as digestion

solution) and 30ml of sulphuric acid reagent (H_2SO_4) (as catalyst solution) slowly both in to the above COD vials. If the color turns green, take fresh sample with smaller aliquot. Connect the tubes (condenser) tightly and keep the COD vials in the respective blocks of COD digester and reflux for 2 hrs. at temperature 150 ± 2 °C. The digester automatically switch off then remove the vials and allow to cool at the room temperature. Then wash down the condensers with 60ml distilled water. Transfer the contents of the vial in to a conical flask and add few drops of ferroin indicator & titrate against 0.1N FAS solution (End Point is reddish brown). Titrate the blank as same as sample & note the reading.

For Oil & grease:

Materials / Equipment:

1 Hydrochloric acid / Sulphuric acid

2 n-Hexane

3 Sodium Sulphate anhydrous Crystal

4 Distilled Water

5 Separatory Funnel

6 Distilling Flask, 125 ml

7 Liquid Funnel, Glass

8 Filter Paper, 11 cm dia .

9 Water bath, capable of maintaining 80^0 C.

10 Distlling adaptor with drip tip. Setup of distillate recovery apparatus .

11 Desiccator .

12 Glass Beaker .

13 Centrifuge Appratus

14 Water Bath

Procedure:

Sample Analysis: Take 200ml of sample in a glass beaker. Adjust the pH of the solution to pH less than equal to 2.0 with HCl. Using liquid funnel transfer the sample to Separatory funnel.Rinse the sample beaker with 30 ml of n-Hexane and pour it into the separatory funnel. Shake & mix well and let layer separate, repeat the above process 2-3 times.

Drain aqueous layer and small amount of organic layer in to the flask. Drain the solvent layer through a funnel containing filter paper & 10gm of Na_2SO_4. If a clear solvent cannot be obtained, transfer the solvent layer into a glass centrifuge tube and centrifuge for 5min at approximately 2400rpm. Transfer centrifuged material into a funnel containing filter paper & 10gm of Na_2SO_4.Rinse the filter paper and Sodium sulphate with n-Haxane.Condition the flat bottom flask by heating & desiccating, take its initial weight. Recombine the aqueous layers and transfer into a round bottom flask. Fit the distillation flask with distillation adapter; distill solvent from flask in a water bath at 85 ^{0} C and collect the solvent on the other side. when solvent condensation stops, immediately draw air through flask for 1 minute with an applied vacuum.Remove the flask from bath and wipe outside surface of the flask. Cool it in the desiccator till weight becomes constant & take its final weight.

RESULTS
AND
DISCUSSIONS

Analysis results of the waste water samples are presented in Table-1. The result of final effluent is compared with the prescribed limit.

Table -1 analysis results of the waste water samples

Sample location	pH	TSS mg/l	BOD 5 days at 20ºc,mg/l	COD mg/l	Oil&grease mg/l	Ammonical Nitrogen mg/l
Inlet to STP	5.7	275	283.3	545.6	8.0	61.0
Outlet of tube settler and inlet to chlorination tank	6.1	39.8	87.4	142.4	8.0	46.7
Outlet to chlorination tank and inlet to filter unit	6.5	64.6	46.3	119.3	>4.0	20.3
Outlet of STP discharged to outside	6.92	60.00	29.5	88.3	>4.0	18.6

Table-2 Analysis result of the waste water samples(After 15 days)

Sample location	pH	TSS mg/l	BOD mg/l	COD mg/l	Oil&grease mg/l	Ammonical Nitrogen Mg/l
Inlet to STP	6.5	305	358.7	560.8	7.0	64.5
Outlet of tube settler and inlet to chlorination tank	6.41	38.2	86.1	157.1	6.0	42.4
Outlet to chlorination tank and inlet to filter unit	6.70	62.0	48.9	127.3	>4.0	22.7
Outlet of STP discharged to outside	6.85	54.0	22.4	93.0	>4.0	17.1

Table-3 Analysis result of the waste water samples(After 1 month)

Sample location	pH	TSS mg/l	BOD mg/l	COD mg/l	Oil&grease mg/l	Ammonical Nitrogen Mg/l
Inlet to STP	6.77	325	328.7	460.8	8.0	61.5
Outlet of tube settler and inlet to chlorination tank	6.92	75.2	87.1	142.9	8.0	45.4
Outlet to chlorination tank and inlet to filter unit	6.87	68.0	49.9	121.5	>4.0	27.7
Outlet of STP discharged to outside	7.00	65	23.4	92.4	>4.0	18.1

Table-4 Analysis result of the waste water samples(After 1 and 1/2 month)

Sample location	pH	TSS mg/l	BOD mg/l	COD mg/l	Oil&grease mg/l	Ammonical Nitrogen Mg/l
Inlet to STP	6.74	320	327.9	460.2	9.0	62.0
Outlet of tube settler and inlet to chlorination tank	6.94	74.9	86.8	143.1	8.0	44.9
Outlet to chlorination tank and inlet to filter unit	6.85	68.3	50.1	122.1	>4.0	26.8
Outlet of STP discharged to outside	7.03	64	23.9	93.8	>4.0	17.5

Discussion:

Water quality of the inlet to STP indicates the water quality of sewage being treated in the treatment system.Water quality of outlet of tube settler indicates the efficiency of the tube settler unit in decreasing the BOD load of the waste.The outlet of tube settler is inlet of the chlorination tank.outlet of the chlorination tank is fed into the media filter unit for final treatment.outlets of these three unit indicate the successive efficiency of the treatment system.BOD content ,a major criteria parameter in a sewage treatment system has been observed to be decreased by 73% after the tube settler ,further decreased by 44 % in the chlorination tank and further decreased by 28% in the media filter unit.

The final effluent conforms to the prescribed discharge limit with respect to all the prescribed parameters.

Similar observation is observed in case of the parameter COD system has been observed to be decreased decreased by72 % after the tube settler,further decreased by 17 % in the chlorination tank and further decreased only by 26 % in the media filter unit.

So far the efficiency of ammonical nitrogen removal is concerned,it has been decreased only by 27 % after the tube settler ,further decreased only by 19% in the chlorination tank and further decreased by 25% in the media filter unit.

conclusion

Conclusion:

Water quality of inlet to STP,outlet of tube settler ,outlet of the chlorination tank and outlet of media filter unit were analysed to assess the efficiency of the STP established at Hi-Tech hospital Bhubaneswar.Outlets of these three unit indicate the successive efficiency of the treatment system.BOD content ,a major criteria parameters in a sewage treatment system has been observed to be decreased by79 % after the tube settler,further decreased by 44% in the chlorination tank and further decreased by 28% in the media filter unit.The final effluent conforms to the prescribed discharge limit with respect to all the prescribed parameters .however ,the bacteriological analysis of the final outlet discharged to outside revealed that chlorination of the waste water was not adequeate enough to disinfect the waste water prior to disposal

1.1 Summary

In summary, wastewater treatment process is one of the most important environmental conservation processes that should be encouraged worldwide. Most wastewater treatment plants treat wastewater from homes and business places. Industrial plant, refineries and manufacturing plants wastewater is usually treated at the onsite facilities. These facilities are designed to ensure that the wastewater is treated before it can be released to the local environment. Some of the water is used for cooling the machines within the plants and treated again. They try to ensure that nothing is lost. It illegal for disposing untreated wastewater into rivers, lakes, oceans or into the environment and if found culpable one can be prosecuted.

Future Work

The first expectation is that the **effectiveness and efficiencies of treatment systems** would allow for a lot less waste and better use of resources. We hope to see new emerging innovative technologies applied in the industry leading to a reduction in energy costs.

As populations grow in our towns and cities, we are seeing vacant land becoming a lot less accessible – space would have to be utilised more efficiently. A wastewater treatment plant in the future would have to incorporate new methods which consume a much smaller footprint.

Due to the increased concern on global warming there is more awareness about emissions of greenhouse gases worldwide. **Wastewater treatment plants generate greenhouse gases** by consuming large amounts of energy from electrical utilities to operate the plant in addition to the facilities generating CO_2 that is lost to the atmosphere. Tomorrow's treatment plants would have to look at reducing their electrical energy consumption and create processes in which emissions are reduced.

Perhaps one day, water supply issues will be reversed with better water treatment solutions and delivery systems. The public is increasingly concerned about whether we remove all of the harmful pathogens in water, particularly in areas downstream of major river systems. **Innovative bacteria growing methods** will advance even further going forward to make us less energy dependent and more efficient.

It is hard to tell, of course, how the world will look 20 years from now. But if we do not try imagining it today, the alternative may find us unprepared in the future. The time to plan andinnovate is now.

References

This section begins on a fresh page bearing the heading REFERENCES in capital letters, centered without punctuation, 3.0 cm from the top. The lists of references begin four spaces below the heading and are single spaced in the same citation but double-spaced between citations. This list must include all the references that candidates have cited in the text of the dissertation.

Use the *Reference* paragraph style to enter and cross-reference document references. Books [1], standards [2], reports [3], journal articles [4], conference papers [5], and web pages [6] are conventionally presented in slightly different ways.

[1] Greene, D. and Williams, P. C. *Linear Accelerators for Radiation Therapy*, Second Edition. IOP Publishing Ltd., Bristol and Philadelphia, 1997.

[2] ISO. *Language Of Temporal Ordering Specification*, ISO 8807, International Organization for Standardization, Geneva, 1989.

[3] Jacobson, J. and Andersen, O., editors. *Software Controlled Medical Devices*. SP Report 1997:11, Swedish National Testing and Research Institute, Sweden, 1997.

[4] Turner, K. J. The Rules for Sailing Races on PDAs, *J. Navigation*, 23(5):114-240, May 2002.

[5] Ji, H. and Turner, K. J. Specification and Verification of Synchronous Hardware using LOTOS. In Wu, J. Chanson, S. T. Gao, Q. editors, *Proc. Formal Methods for Protocol Engineering and Distributed Systems* (FORTE XII/PSTV XIX), pages 295-312, Kluwer Academic Publishers, London, UK, October 1999.

[6] University of Stirling. Computing Science and Mathematics Research Home Page, http://www.cs.stir.ac.uk/research, April 2002.

Appendix

Have one or more appendices containing detail, bulky or reference material that is relevant though supplementary to the main text: perhaps additional specifications, tables or diagrams that would distract the reader if placed in the main part of the dissertation. This section may contain supplementary illustrative materials like original data, questionnaires, formulas and quotations too long for inclusion in the text or not immediately essential to the understanding of the subject. A description of lengthy experimental methods or the list of names of participants may be included. Make sure that you place appropriate cross-references in the main text to direct the reader to the relevant appendices.

This section may be divided into Appendix A, Appendix B, etc and centered. Each appendix with its title should be listed separately in the Table of Contents as a first order subdivision under the heading APPENDICES.