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A Research on Optimized Design of Sewage Treatment Plant (STP)

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ABSTRACT

We are aware that a lot of damage is done to environment in the manufacture of cement. It involves lot of carbon emission associated with other chemicals. The researches has shown that every one ton of cement manufacture releases half ton of carbon dioxide, so there is an immediate need to control the usage of cement.

The need for wastewater treatment plants based on appropriate technologies and working effectively is rising rapidly on global scale, especially in those regions where availability of pure water is in challenging phase. Construction of sewage treatment plants (STPs) based on latest emerging treatment technologies in different parts of India is necessary to reduce problem of water pollution.

Up flow anaerobic sludge blanket (UASB) process was one of the most widely used technologies for sewage treatment in developing countries particularly in India. The reason for its wide publicity and implementation is its zero energy requirements and production of biogas as a valuable energy resource. Despite their popularity, past one decade has witnessed decline in the UASB implementation. There has been criticism from various sections on the performance of UASB Reactors. Moving Bed Bio-film Reactor (MBBR) technology has benefits provided by both fixed film and activated sludge processes. The MBBR process follows continuous flow patterns. Several, small in size, high density polyethylene (HDPE) carrier elements are added to provide sites for active bacteria attachment in a suspended growth medium. Moving Bed Bio film Reactor.

(MBBR) process improves reliability, simplify operation and require less space than traditional wastewater treatment system. The Sequence Batch Reactor (SBR) technology is an emerging advanced wastewater treatment technology that has come into practice in recent times in many parts of the world. Sequence batch reactor (SBR) technology is being used successfully to treat both municipal and industrial waste waters, particularly in areas characterized by low or varying flow patterns.

The main focus of present study was to assess performance of two sewage treatment plants based on MBBR technologies. The performance of STPs at jhajjar town was evaluated. Waste water samples were analysed for pH, BOD, COD, TSS, turbidity, nitrate, phosphate, total nitrogen (TN) and total phosphorous (TP). The results indicated consistently good performance of the existing treatment plants. The treated effluents from the two plants meet the discharge standards with reference to compulsory parameters pH, BOD, COD and TSS. Treated effluent is finally disposed in Jhajjar link drain which is further disposed in drain No.8 from which agriculturist meet out their irrigation demand also due to shortage of irrigation water availability in area moreover sludge generated utilized as manure. But regarding optimized design of STP territory treatment is seemed to be good, economical and need to be preferred as per latest guideline of honorable of National Green Tribunal (NGT).

Territory treatment process can remove more than 99% of all the impurities from sewage, producing effluent of almost drinking quality, Territory treatment is the final cleaning process that improves waste water quality before it is reused, recycled or discharge in the environment The treatment removes remaining inorganic compound and substances, such as nitrogen and phosphorus BOD is reduced up to 10 as per guidelines of honorable of National Green Tribunal (NGT)

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INTRODUCTION

The utilization of sugarcane bagasse debris in concrete expanded the normal measure of compressive quality when contrasted with the typical quality cement. The result of this work shows that most extreme quality of cement could be accomplished. Pollution in its broadest sense includes all changes that curtail natural utility and exert deleterious effect on life. The crisis triggered by the rapidly growing population and industrialization with the resultant degradation of the environment causes a grave threat to the quality of life. Degradation of water quality is the unfavorable alteration of the physical, chemical and biological properties of water that prevents domestic, commercial, industrial, agricultural, recreational and other beneficial uses of water. Sewage and sewage effluents are the major sources of water pollution. Sewage is mainly composed of human fecal material, domestic wastes including wash-water and industrial wastes. The growing environmental pollution needs for decontaminating waste water result in the study of characterization of waste water, especially domestic sewage. In the past, domestic waste water treatment was mainly confined to organic carbon removal. Recently, increasing pollution in the waste water leads to developing and implementing new treatment techniques to control nitrogen and other priority pollutants.

Sewage Treatment Plant is a facility designed to receive the waste from domestic, commercial and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water receiving systems. It includes physical, chemical, and biological processes to remove various contaminants depending on its constituents. Using advanced technology it is now possible to re-use sewage effluent for drinking water.

The present study comprises the study on quality of domestic waste water that is discharged from the Area of Jhajjar town. through the kitchen outlets and bathroom effluents etc. The study includes characterization tests for pH value, BOD, COD ,TSS, acidity, alkalinity, chloride, residual chlorine, turbidity & DO.

Objective of the work

The principal objective of waste water treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. An environmentally-safe fluid waste stream is produced. No danger to human health or unacceptable damage to the natural environment is expected. Sewage includes household waste liquid from toilets, baths, showers, kitchens, sinks and so forth that is disposed of via sewers. Sewage also includes liquid waste from industry and commerce.

The objectives of the study are:

1. Physical, chemical and biological characterization of the domestic waste water STP-5.0 MLD capacity based on Moving Bed Biofilm Reactor (MBBR) technology located at Sampla Road bye pass, Jhajjar town and (5.5 MLD) Kosli Road bye pass Jhajjar town Comparison with the prescribed standard
2. Design of the sewage treatment plant.

For determination of inorganic non-metallic constituents we determined the:

- Alkalinity
- Acidity
- Chloride
- Residual Chlorine
- Sulphate
- pH. of the sample
- Biochemical Oxygen Demand
- viii Dissolved Oxygen

LITERATURE REVIEW

Physical characteristic of waste water:

Odour: It depends on the substances which arouse human receptor cells on coming in contact with them. Pure water doesn't produce odour or taste sensations. Thus waste water which contains toxic substances has pungent smell which makes it easy to distinguish. Odour is recognized as a quality factor affecting acceptability of drinking water. The organic and inorganic substance contributes to taste or odour. The ultimate odour tasting device is the human nose. The odour intensity is done by threshold odour test

Taste: The sense of taste result mainly from chemical stimulation of sensory nerve endings in tongue. Fundamental sensations of taste are, by convention more than by research evidence, salt, sweet, bitter, and sour. The rating involves the following steps: a) dilution series including random blanks is prepared b) initial tasting of about half the sample by taking water into mouth and holding it for several seconds and discharging it without swallowing. c) Forming an initial judgment on the rating scale d) a final rating made for the sample e) rinsing mouth with taste and odour free water f) resting.

Colour: Colour in water results from the presence of natural metallic ions such as Fe or Mg, humus and peat materials, planktons and weeds. It is removed to make water suitable for general and industrial applications. After turbidity is removed the apparent colour and that due to suspended matter is found out.

Tristimulus, Spectroscopic and Platinum cobalt method is used.

Total solids: It refers to matters suspended or dissolved in water and waste water. Solids affect the water or effluent quality adversely in a number of ways. Water with highly dissolved solids are not palatable and may cause physiological reaction in transient consumer.

Turbidity: Clarity of water is important in producing products destined for human consumption and in many manufacturing uses. It is caused by suspended matter such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds. Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample. The standard method for determination of turbidity has been based on the Jackson candle turbidimeter and Nephlometer.

Chemical characteristic of waste water:

Chemical characteristics of water state the presence of metals their treatment, the determination of inorganic non-metallic constituents and the determination of organic constituents. Here goes a brief description of all the experiments we have performed.

Biological characteristic of waste water:

Water quality has a key role in deciding the abundance, species composition, stability, productivity and physiological condition of indigenous populations of aquatic communities. Their existence is an expression of the quality of the water. Biological methods used for evaluating water quality include the collection, counting and identification of aquatic organisms. Most microorganisms known to microbiologists can be found in

OPTIMIZATION IN DESIGN OF EXISTING SEWAGE TREATMENT

Sewage treatment is the process of removing contaminants from municipal wastewater, containing mainly household sewage plus some industrial wastewater. Physical, chemical, and biological processes are used to remove contaminants and produce treated wastewater that is safe enough for release into the environment. It includes physical, biological and sometimes chemical processes to remove pollutants. Its aim is to produce an environmentally safe sewage water, called effluent, and a solid waste, called sludge or bio solids, suitable for disposal or reuse. Reuse is often for agricultural purposes, but more recently, sludge is being used as a fuel source.

Water from the mains, used by manufacturing, farming, houses (toilets, baths, showers, kitchens, sinks), hospitals, commercial and industrial sites, is reduced in quality as a result of the introduction of contaminating constituents. Organic wastes, suspended solids, bacteria, nitrates, and phosphates are pollutants that must be removed.

Sewage can be treated close to where it is created (in septic tanks and their associated drain fields or sewage treatment plants), or collected and transported via a network of pipes and pump stations to a municipal treatment plant. The former system is gaining popularity for many new ECO towns, as 60% of the cost of mains sewerage is in the pipe work to transport it to a central location and it is not sustainable. It is called 'Decentralization' of sewage treatment systems.

Sewage is partly decomposed by anerobic bacteria in a tank without the introduction of air, containing oxygen. This leads to a reduction of Organic Matter into Methane, Hydrogen Sulphide, Carbon Dioxide etc. It is widely used to treat wastewater sludge and organic waste because it provides volume and mass reduction of the input material to a large extent. The methane produced by large-scale municipal anerobic sludge treatment is currently being examined for use in homes and industry, for heating purposes. Septic tanks are an example of an anerobic process, but the amount of methane produced by a septic tank (it is only the SLUDGE at the bottom that produces methane) serving less than 100 people is miniscule. In addition to this, septic tank effluent still contains about 70% of the original pollutants and the process smells very badly, due to the Hydrogen Sulphide, if not vented correctly. The effluent produced by this process is highly polluting and cannot be discharged to any watercourse. It must be discharged into the Aerobic layer of the soil (within the top metre of the ground) for the aerobic soil bacteria to continue the sewage treatment via the aerobic process below.

Aerobic Sewage Treatment

In this process, aerobic bacteria digest the pollutants. To establish an aerobic bacterial colony you must provide air for the bacteria to breathe. In a sewage treatment plant, air is continuously supplied to the Biozone either by direct Surface Aeration using Impellers propelled by pumps which whisk the surface of the liquid with air, or by Submerged Diffused Aeration using blowers for air supply through bubble diffusers at the bottom of the tank.

Primary Treatment

This is usually Anerobic. First, the solids are separated from the sewage. They settle out at the base of a primary settlement tank. The sludge is continuously being reduced in volume by the anerobic process, resulting in a vastly reduced total mass when compared to the original volume entering the system.

Secondary Treatment

This is Aerobic. The liquid from the Primary treatment contains dissolved and particulate biological matter. This is progressively converted into clean water by using indigenous, water-borne aerobic micro-organisms and bacteria which digest the pollutants. In most cases, this effluent is clean enough for discharge directly to rivers.

Tertiary Treatment

In some cases, the effluent resulting from secondary treatment is not clean enough for discharge. This may be because the stream it is being discharged into is very sensitive, has rare plants and animals or is already polluted by someone's septic tank. The Environment Agency may then require a very high standard of treatment with a view to the new discharge being CLEANER than the water in the stream and to, in effect, 'Clean it up a bit'. It is usually either Phosphorous or Ammoniacal Nitrogen or both that the E.A. want reduced.

As the wastewater reaches the tertiary treatment stage, it still has residual suspended matter and fine particulates. Further, it has a relatively high level of nutrients such as nitrogen and phosphorus and has microbes and odor in it. During tertiary treatment process, different methods are used to remove all these contaminants and properties from wastewater.

RESULTS

Tabulation for physical and chemical characteristics in different time

Time → Property	8 a.m.	12 p.m.	1-2 p.m.	5-6 p.m.	Permissible Value
Turbidity (NTU)	32	45	50	38	5
pH	8.76	8.01	8.22	8.4	5.5-9.0
Acidity (mg/l)	1.8	2.6	3	1.3	
Alaklinity (mg/l)	42	45	158	78	600
Chloride (mg/l)	11	17	20	15	1000
Residual Chlorine (mg/l)	2	2	2	2	1
Hardness (mg/l)	23	38	40	30	200
Total Solids (mg/l)	200	240	420	600	2000

SAMPLE TESTED AT ALL LABS Circle Name: Jhajjar Circle Division Name: Jhajjar PHED No. 3										
Sr. No.	Dates	Lab Name	Division Name	STP Name	Sampling Point	Results				Remarks
	Sample Received, Sample Tested					BOD (mg/Litr)	COD (mg/Litr)	TSS (mg/Litr)	pH	
						Permissble Limit				
						30 mg/Ltr	250 mg/Ltr	100 mg/Ltr.	5.5 - 9.0	
	Jhajjar Circle									
	Jhajjar PHED No. 3									
	Badli PHESD		Jhajjar PHED No. 3							
	Bahadurgarh PHESD No. 4									
			Jhajjar PHED No. 3							
	Jhajjar PHESD No. 5									
1	01/06/2019, 04/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	14	126	24	7.9	Within Permissible Limit
2	03/06/2019, 06/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	20	140	12	7.8	Within Permissible Limit
3	05/06/2019, 08/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	22	152	24	7.32	Within Permissible Limit
4	07/06/2019, 10/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	24	164	22	7.8	Within Permissible Limit
5	10/06/2019, 13/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	20	154	20	7.24	Within Permissible Limit
6	12/06/2019, 15/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	16	136	14	7.6	Within Permissible Limit
7	14/06/2019, 17/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	14.8	112	18	7.32	Within Permissible Limit
8	17/06/2019, 20/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	22	134	18	7.20	Within Permissible Limit
9	19/06/2019, 22/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	16	142	16	7.28	Within Permissible Limit
10	21/06/2019, 24/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	16	98	62	7.40	Within Permissible Limit
11	23/06/2019, 26/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	14	96	90	7.7	Within Permissible Limit
12	28/06/2019, 30/06/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	18	118	27	7.8	Within Permissible Limit
13	01/07/2019, 04/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	15	125	29	7.5	Within Permissible Limit
14	03/07/2019, 06/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	17	135	20	7.4	Within Permissible Limit

15	05/07/2019, 08/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	10	122	25	7.36	Within Permissible Limit
16	08/07/2019, 10/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	14	118	28	7.8	Within Permissible Limit
17	10/07/2019, 13/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12.8	142	17	7.8	Within Permissible Limit
18	12/07/2019, 15/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12	116	20	78	Not Within Permissible Limit
19	14/07/2019, 17/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	18	148	39	7.40	Within Permissible Limit
20	16/07/2019, 19/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	18	152	16	7.8	Within Permissible Limit
21	18/07/2019, 21/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	18	154	20	7.68	Within Permissible Limit
22	22/07/2019, 25/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12.8	124	16	7.38	Within Permissible Limit
23	24/07/2019, 27/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	18	148	16	7.6	Within Permissible Limit
24	26/07/2019, 29/07/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	18.4	162	32	7.8	Within Permissible Limit
25	29/07/2019, 01/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12	108	18	7.8	Within Permissible Limit
26	30/07/2019, 02/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12	142	14	7.24	Within Permissible Limit
27	31/07/2019, 03/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	14	124	20	7.9	Within Permissible Limit
28	02/08/2019, 05/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	18	152	20	7.14	Within Permissible Limit
29	06/08/2019, 09/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	16.4	162	32	7.8	Within Permissible Limit
30	08/08/2019, 11/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12	135	18.10	7.42	Within Permissible Limit
31	10/08/2019, 13/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	16	134	18	7.10	Within Permissible Limit
32	12/08/2019, 15/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	11	104	16	7.36	Within Permissible Limit
33	14/08/2019, 17/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	11.40	112	18	7.36	Within Permissible Limit
34	16/08/2019, 19/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12	98	19	7.40	Within Permissible Limit

35	18/08/2019, 21/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	11.50	116	18	7.30	Within Permissible Limit
36	20/08/2019, 23/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	14	118	18	7.8	Within Permissible Limit
37	22/08/2019, 25/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	16	120	16.94	7.20	Within Permissible Limit
38	24/08/2019, 27/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12.4	126	18	7.50	Within Permissible Limit
39	27/08/2019, 30/08/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	14	132	20	7.38	Within Permissible Limit
40	29/08/2019, 01/09/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	16	124	20	7.50	Within Permissible Limit
41	31/08/2019, 03/09/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5 MLD	Effluent	12	98	16	7.7	Within Permissible Limit
42	02/01/2019, 05/01/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5.5 MLD	Effluent	14	86	38	8.0	Within Permissible Limit
43	04/01/2019, 07/01/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5.5 MLD	Effluent	14	120	20	7.8	Within Permissible Limit
44	06/01/2019, 09/01/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5.5 MLD	Effluent	14	124	30	7.10	Within Permissible Limit
45	08/01/2019, 11/01/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5.5 MLD	Effluent	14	128	20	7.10	Within Permissible Limit
46	10/01/2019, 13/01/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5.5 MLD	Effluent	12.8	128	30	30	Not Within Permissible Limit
47	16/01/2019, 19/01/2019	Site Lab	Jhajjar PHED No. 3	STP-JJR-Jhajjar-5.5 MLD	Effluent	14	116	36	7.6	Within Permissible Limit

Conclusion

1. The waste water have high BOD, Turbidity and total dissolved solids. Our aim is to make this water safe for disposal in natural environment or to use it for other purposes.
2. The DO content of waste water recorded is found to be low value due to the presence of higher organic matter and an increased BOD and COD.
3. This increased BOD and COD value indicate the polluted nature of the discharge. We've to treat it at least below to 20ppm.
4. Higher quantity of of inorganic nutrients like nitrogen & phosphors was found present in the waste water.
5. The waste water has a range of 7.5 – 8.5.
6. Most Probable Number value was higher again indicating the polluted nature of the waste water.
7. Disposal without any treatment into fresh water body may impose the danger of eutrophication as well as serious problems of health and hygienic.
8. Long term leaching of waste water may alter the soil characteristics as well as may influence the quality of ground water.
9. By adopting the procedure of Tertiary treatment of waste water we can reduce and optimized the operation and maintenance cost of STP as well as convenient and economical also.
10. The treated wastewater can be utilized for purposes like gardening, washing vehicles and cleaning garages, etc.

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