International Journal of Advance Research and Innovation
Vol. 6(2), Apr-Jun 2018, pp. 14-20
Doi: 10.51976/ijari.621803

Article Info
Received: 10 May 2018 | Revised Submission: 25 May 2018 | Accepted: 01 Jun 2018 | Available Online: 15 Jun 2018

A Study on Sewage Treatment and Disposal in Delhi

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ABSTRACT

Delhi, which is the capital of India and also the fastest growing metropolitan city, does not have adequate sewage treatment and disposal infrastructure. In most of the cases wastewater is let out untreated and it either seeps into the ground as a potential pollutant of groundwater or is discharged into the natural drainage system causing pollution in downstream areas. Wastewater needs to be conveyed to sewage treatment plants for treatment and treated sewage must meet the aesthetic standards of ambient environment for receiving water bodies. This paper gives an overview on sewage treatment plants (STPs) in Delhi, focusing majorly on the Okhla wastewater plants. The total treatment capacity of STPs in Delhi, was mapped against the total sewage generation and hence the gap between the two was found. This information will be very useful for further allocation of STPs and also for safeguarding the health of people and Environment

Keywords: *Delhi; Disposal; Sewage; STPs; Treatment.*

1.0 Introduction

In the past circumstances, sewage from a city or a state was less polluted but rather more today. The development in population, urbanization and the enhanced ways of life have, in any case, expanded the quality and amount of city sewage as of late. Thus proper treatment and management of sewage becomes an essential process for ensuring healthy and good quality of life of living beings. Presently sewage, before being discarded either in waterway streams or ashore, has to be properly treated, to make it safe. Sewage treatment basically incorporates expulsion of small-scale life forms, toxins or contaminants from wastewater. This is done using various technologies like in Delhi, 6 different types of technologies are used in the 35 sewage treatment plants (STPs). Despite being one of the first Indian cities to come up with a City Development Plan way back in 1962, Delhi has been ientified as the top-priority city for the work to be done to combat the magnitude of pollution in the river's 22km stretch through the city. Therefore, to improve the present situation, this paper offers solutions to various problems of sewage treatment and disposal in Delhi.

2.0 Sewage Generation in Delhi

In Delhi, out of the total population of 16.75 million in the year 2011, about 16.34 million live in urban areas. The percentage of urban population to the total population of the country, which in the year 1991 was 89.9 percent, stands at 97.5 percent in the year 2011 (Table 1).

Table 1: Urban and Rural population of Delhi

Population	Delhi		
	1991	2001	2011
Rural	949,019	944,727	419,319
Urban	8,471,625	12,905,780	16,333,916
Total	9,420,644	13,850,507	16,753,235

Due to such drastic growth in urban population of Delhi the quality and strength of sewage has also increased with time.

It was found that currently, 3909 million liter per day (MLD) of sewage is being generated in Delhi. However, available sewage treatment capacity is only 2940.66 million liter per day (MLD). Further only 74.9% of this available capacity is actually treated i.e.

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2202.56 million liter per day. So a huge gap is present between the total sewage generated in Delhi and the sewage that is actually treated i.e. 1706.44 million liter per day (MLD).

3.0 Treatment of Sewage in Delhi

Sewage treatment is the way of expelling contaminants from wastewater, essentially from domestic areas sewage. Physical, synthetic and natural procedures are utilized to expel contaminants and create treated wastewater that is more secure for the earth.

A by-product of sewage treatment is generally a semi-strong waste or slurry, called sewage sludge. The sludge needs to experience assist treatment before being appropriate for disposal on land or water.

Delhi Jal Board is in charge of treatment and transfer of waste water through a proficient system of around 7000 Km of Sewage lines crosswise over Delhi. There are 35 Sewage treatment plants in Delhi, out of which 31 were found to be operational and 4 were non-operational. Table 2 shows the break-up of STPs in Delhi.

Table 2: Break-Up of STPs in Delhi

Sl No.	Status	No. Of STPs	Installed Capacity (MLD)	Actual Treatment (MLD)
1.	Operational	31	2799.82	2202.56
2.	Non-operational	4	140.84	0
3.	Total	35	2940.66	2202.56

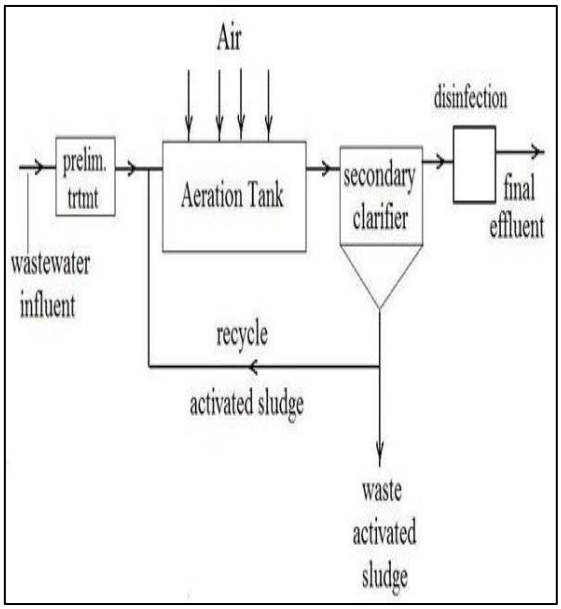
Table 3: Technologies Used in Delhi STPs

S.No.	Technology	No. of STPs
1.	Activated sludge process (ASP)	26
2.	Biofilters (BIO-FAR)	3
3.	Extended Aeration (EA)	2
4.	Moving Bed Biofilm Reactor (MBBR)	2
5.	Oxidation Pond (OP)	1
6.	Interchange Sequencing Batch Reactor (ISBR)	1

3.1 Treatment technologies used for sewage treatment

The break-up of different treatment technologies used in the different sewage treatment plants in Delhi is shown in table 3.

Fig 1: Activated Sludge Process (Flow Diagram)



Source:
https://www.researchgate.net/figure/237841340_Fig-2-1-Activated-Sludge-Process-Flow-diagram

3.1.1 Activated sludge process (ASP)

Activated-sludge technique, a sewage-treatment process in which sludge, the amassed, microbe's rich deposits of settling tanks and basins, is seeded into the approaching wastewater and the blend agitated for a few hours (4-8 hours) within the sight of an adequate air supply.

Suspended solids and numerous organic solids are adsorbed by the sludge, while organic matter is oxidized by the microorganisms.

The measures of air and sludge utilized can be differed to control the level of treatment got. The sludge is then isolated out in a settling tank.

Activated sludge plant involves:

1. Wastewater aeration in the presence of a microbial suspension,
2. Solid-liquid separation following aeration,
3. Discharge of clarified effluent,
4. Wasting of excess biomass, and
5. Return of remaining biomass to the aeration tank.

3.1.2 Extended aeration (EA)

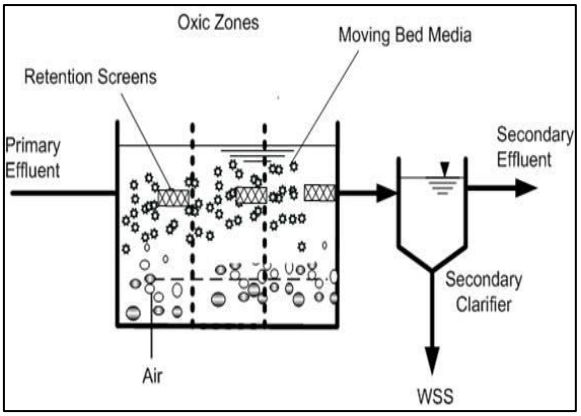
The conventional activated sludge plant has been modified to eliminate the primary sedimentation tank, and sludge digestion tank, in a process called Extended Aeration, which aims at providing an aeration tank with a longer aeration time.It is more economical for upto 1.5 lakh population, than a conventional activated sludge plant.

Figure 2: Extended Aeration (Flow diagram)
Source:
http://www.brighthub.com/environment/science-environmental/articles/66157.aspx

3.1.3 Moving bed biofilm reactor (MBBR)

It's a mix of activated sludge process (suspended growth) and bio filter processes (attached growth). Moving Bed Biofilm Reactor (MBBR) process utilizes the entire tank volume for biomass development. It utilizes basic drifting media, which are transporters of attached growth of biofilms. Biofilm carrier movement is caused by the disturbance of air bubbles. This minimal treatment framework is viable in the expulsion of BOD as well as nitrogen and phosphorus while encouraging successful solids separation.

Fig 3: A schematic of the Moving Bed Biofilm Reactor (MBBR)

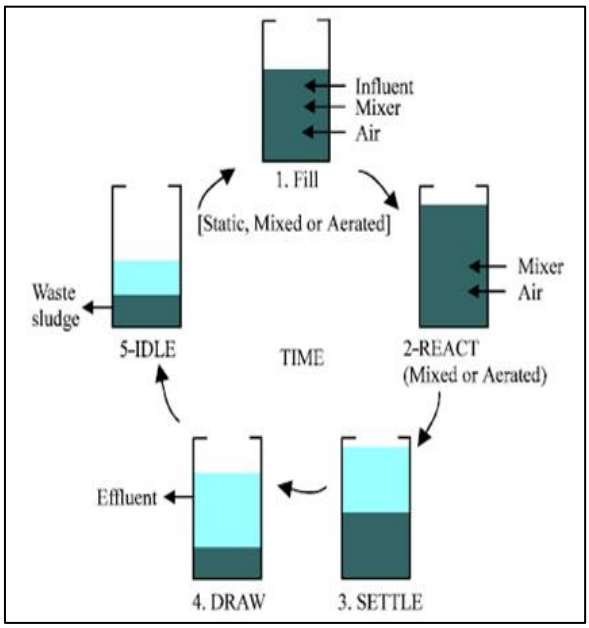


Source: http://www.aesarabia.com/moving-bed-bioreactor-mbbr/

3.1.4 Sequential batch reactor (SBR)

The sequencing batch reactor (SBR) process is a progressive suspended growth (activated sludge) process in which each major progress occur in a common tank in sequential order. The aggregate five phases happen in a single reactor by which way it diminishes the impression. SBRs can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, despite clearing TSS and BOD. The five stages of SBR are:

Fig 4: 5 Stages of Sequential Batch Reactor (SBR)



Source: *http://www.seamak.com/service_6.html*

FILL: Wastewater fills the tank, mixing with biomass that settles in the midst of the past cycle.

REACT: Air is added to the tank to enable biological growth and felicitate waste diminishment.

SETTLE: Mixing and Aeration quit in the midst of this stage to empower solids to settle.

DRAW: Clarified profluent is discharged.

IDLE: Sludge can be removed in the midst of this stage.

3.1.5 Vermifiltration technology

Vermifiltration was found as one of the new, creative and sustainable innovation. It comprises of a natural reactor containing media that filters organic material from sewage. It depends on the symbiotic connection amongst earthworms and microorganisms. Vermifilters provide an aerobic environment and wet substrate that encourages small scale living beings development as a biofilm. Micro-organisms perform biochemical degradation of organic matter present in wastewater, while earthworms expel the unsafe pathogens in wastewater by eating them up. This technology involves all the three primary, secondary and tertiary forms of treatment.

In all vermifiltration removes nearly 90% of BOD, 80% of COD and pathogens. It also reduces ammonium content.

Advantages of this technology and why it is better than other conventional technologies are:-

1) It has high treatment effeciency given the low space requirement.

2) Odourless and cost effecient technology

3) Energy is not required for aeration, so these filters can be considered 'Passive Treatment' systems.

4) Resulting vermifiltered water is clean and disinfected enough to be reused for irrigation and in parks and gardens.

The main challenge that should be tended to before vermi-filtration can be received on a substantial scale is its reliance on earthworms which ultimately depends on temperature, pH level and moisture. Additionally, detachment of earthworms by hand from the filter bed is a tedious procedure.

4.0 Disposal of Sewage Through Natural and Manmade Drains in Delhi

4.1 Natural drain

Delhi has been separated into six seepage zones (I) Northern Zone, (ii) Western Zone, (iii) Central North West and South East Zone, (iv) Central South and South East Zone, (v) East Zone and (vi) South Zone.

4.2 Manmade drains

The aggregate length of channels is 1700 km spread over 12 municipal zones. There are around 1300 channels with 339 km in Civil Lines Area and 5 km in Paharganj Sadar Area.

Table 4: The Catchment Region of the Common Depletes in the City.

S No	Catchments	Location	Length of main drains (km)	Drainage channels	Discharge (comecs)
1.	Alipur	North	140	Supplienatry Bhiwana Escape -No 6 drain new Drain	141 33
2	Kanjhawala	west	120	Mungespur	52
3	Najafgarh	Central-North, West and South West	105	Najafgarh Palam Bhupania-Chudania (from Haryana)	283 86 40
4	Khushak Barapulla	Central-South and South -East		Khushak and Barapulla drainsn(' nallah')	120
5	Trans- Yamuna	East	45	Shahdara outfall-Gazipur Trunk drain No-1	158 86
6	Mehrauli	South	5		

Table 5: Length of drains in different zone

S. No.	Zone	Number of drains	Total length of drains (km)
1	Central	41	47
2	South	127	102
3	Sadar-Paharganj	10	4.5
4	Karolbagh	47	23
5	City Zone	10	8.6
6	Civil Lines	77	339
7	Shahadara South	174	134
8	Shahadara North	197	135
9	Narela	84	83
10	Rohini	142	180
11	West	185	410
12	Najafgarh	202	228
	Total	**1296**	**1694.1**

Source: Nav Bharat Times, New Delhi, 31st July, 2006

There are two general ways of disposing of the sewage effluents:

1) Dilution i.e. disposal in water; and
2) Effluent Irrigation or disposal on land

Disposal by dilution strategy is more typical in Delhi. The greater part of the sewage release in Delhi is in the waterway Yamuna. 21 nullahs release around 850 MGD of sewage into the Yamuna consistently, of which 67 percent contamination is caused by the Najafgarh deplete alone. The Yamuna stream, frequently called Delhi's lifesaver, is panting forever. The 22-km extend along the national capital has virtually no oceanic life - on account of more than 20 drains that pour untreated sewage and other waste into the stream.

After the mid-1990s, the Delhi government has put resources into making a foundation for stream tidy up. What's more, there has been arranging and subsidizing through the Yamuna Action Plan, or YAP. In 2005, the Rs 380-crore YAP-II was endorsed for Delhi.

In 2006-07, the DJB acquainted its interceptor design with lay more than 60 km of sewers along Najafgarh, supplementary and Shahdara channels. This gigantic equipment program, in any case, did not give any idea to capturing the contamination. As indicated by a report of the Central Pollution Control Board, the current level of DO in the waterway is just around 1 mg for each litre, while it ought to be between 4 to 5 mg/l to manage life.

5.0 Status of Sewage Treatment Plants (STPs) in Delhi

35 STPs of Delhi were studied, it was found 31 out of them were operational and 4 (Kondli III, Yamuna Vihar II, Ghittorni and Timarpur) of them were found to be non-operational. After studying 35 STPs of Delhi, 6 of them (Okhla) were visited and studied in detail. One of the Delhi's major wastewater plant with 30 MGD treatment capacity, is located in Okhla. This was built under the Yamuna Action Plan-II. It not only treats sewage, but also produces electricity from sludge using biogas system.

It is fully-automated and SCADA-controlled. Estimated cost of this plant is Rs 149.5 crore. It uses Activated Sludge Process as it's treatment technology. All STPs in Delhi were studied with respect to their location, treatment capacity, technology used and reuse of treated water. A huge gap between the total sewage generated in Delhi and the sewage that is actually treated was found i.e. 1706.4 million liter per day (MLD).

The problem is not just that there is inadequate treatment capacity in Delhi, but proper management of the existing STPs is also required. So bridging the gap is not the only solution, but proper operation and management of treatment plants is required.

Numerous new treatment advancements are ascending in various districts. After comparing different treatment technologies, Vermifiltration was found as one of the new, creative and sustainable innovation. It comprises of a natural reactor containing media that filters organic material from sewage.

Fig 5: Primary Clarifier of Okhla Plant

Fig 6: Aeration Tank of Okhla Plant using ASP

Fig 7: Secondary Clarifier of Okhla Plant

It depends on the symbiotic connection amongst earthworms and microorganisms. Vermifilters provide an aerobic environment and wet substrate that encourages small scale living beings development as a biofilm. Micro-organisms perform biochemical degradation of organic matter present in wastewater, while earthworms expel the unsafe pathogens in wastewater by eating them up.

6.0 Conclusions

In the present study survey was done in Delhi area for sewage treatment and disposables.Following conclusions are drawn from the study:

1. In Delhi there are a total of 35 STPs (31 – Operational and 4 – Non Operational).
2. Around 3909 million liter per day (MLD) of sewage is being generated in Delhi. However, available sewage treatment capacity is only 2940.66 million liter per day.
3. A huge gap between the total sewage generated in Delhi and the sewage that is actually treated was found i.e. 1706.4 million liter per day (MLD).
4. STPs in Delhi are based on ASP, BIO-FAR, EA, MBBR, OP, ISBR and Vermifiltration technologies.
5. Vermifiltration was found as one of the new, creative and sustainable innovation for treatment of sewage.
6. STPs based on Vermifiltration technology involves all the three primary, secondary and tertiary forms of treatment.

Acknowledgment

Authors are thankful to CPCB for providing help to carry out the study.

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Nomenclature

MGD	million gallon per day
mg/l	milligram per litre
MLD	million litres per day
STP	sewage treatment plant