SEWAGE TREATMENT AND TECHNOLOGY

1.1 WHAT IS SEWAGE/ WASTEWATER?

Sewage/ Wastewater – is essentially the water supply of the community after it has been fouled by a variety of uses. From the standpoint of sources of generation, waste water may be defined as a combination of the liquid (or water) carrying wastes removed from residences, institutions, and commercial and industrial establishments, together with such groundwater, surface water, and storm water as may be present.

Generally, the wastewater discharged from domestic premises like residences, institutions, and commercial establishments is termed as "Sewage / Community wastewater". It comprises of 99.9% water and 0.1% solids and is organic because it consists of carbon compounds like human waste, paper, vegetable matter etc. Besides community wastewater / sewage, there is industrial wastewater in the region. Many industrial wastes are also organic in composition and can be treated physico-chemically and/or by micro-organisms in the same way as sewage.

1.2 WHY SHOULD SEWAGE BE TREATED BEFORE DISPOSAL?

Wastewater treatment involves breakdown of complex organic compounds in the wastewater into simpler compounds that are stable and nuisance-free, either physico-chemically and/or by using micro-organisms (biological treatment). The adverse environmental impact of allowing untreated wastewater to be discharged in groundwater or surface water bodies and/ or land are as follows:

1. The decomposition of the organic materials contained in wastewater can lead to the production of large quantities of malodorous gases.
2. Untreated wastewater (sewage) containing a large amount of organic matter, if discharged into a river / stream, will consume the dissolved oxygen for satisfying the Biochemical Oxygen Demand (BOD) of wastewater and thus deplete the dissolved oxygen of the stream, thereby causing fish kills and other undesirable effects.
3. Wastewater may also contain nutrients, which can stimulate the growth of aquatic plants and algal blooms, thus leading to eutrophication of the lakes and streams.
4. Untreated wastewater usually contains numerous pathogenic, or disease causing micro-organisms and toxic compounds, that dwell in the human intestinal tract or may be present in certain industrial waste. These may contaminate the land or the water body, where such sewage is disposed.

For the above-mentioned reasons the treatment and disposal of wastewater, is not only desirable but also necessary.

1.3 SEWAGE/ WASTEWATER TREATMENT: A HISTORICAL PERSPECTIVE

Before the late 1800s, the general means of disposing human excrement was the outdoor privy while the major proportion of the population used to go for open defecation. Sewage treatment systems were introduced in cities after Louis Pasteur and other scientists showed that sewage borne bacteria were responsible for many infectious diseases.

The Early attempts, in the 900s, at treating sewage usually consisted of acquiring large farms and spreading the sewage over the land, where it decayed under the action of micro-organisms. It was soon found that the land became 'sick'. Later attempts included the discharge of wastewater directly into the water bodies, but it resulted in significant deterioration of the water quality of such bodies. These attempts relied heavily on the self-cleansing capacities of land and water bodies and it was soon realized that nature couldn't act as an indefinite sink.

Methods of wastewater treatment were first developed in response to the adverse conditions caused by the discharge of wastewater to the environment and the concern for public health. Further, as cities became larger, limited land was available for wastewater treatment and disposal, principally by irrigation and intermittent filtration. Also, as populations grew, the quantity of wastewater generated rose rapidly and the deteriorating quality of this huge amount of wastewater exceeded the self-purification capacity of the streams and river bodies. Therefore, other methods of treatment were developed to accelerate the forces of nature under controlled conditions in treatment facilities of comparatively smaller size.

In general from about 1900 to the early 1970s treatment objectives were concerned with:-

1. The removal of suspended and floatable material from wastewater.
2. The treatment of biodegradable organics (BOD removal).
3. The elimination of disease-causing pathogenic micro-organisms.

From the early 1970 to about 1990s, wastewater treatment objectives were based primarily on aesthetic and environmental concerns. The earlier objectives of reduction and removal of BOD, suspended solids, and pathogenic micro-organism's continued, but at higher levels. Removal of nutrients such as Nitrogen and Phosphorus also began to be addressed, particularly in some of the streams and lakes.

Major initiatives were taken around the globe, to achieve more effective and widespread treatment of wastewater to improve the quality of the surface waters. This effort was a result of:

1. *An increased understanding* of the environmental effects caused by wastewater discharges;
2. *A developing knowledge* of the adverse long term effects caused by the discharge of some of the specific constituents found in wastewater.

Since 1990, because of increased scientific knowledge and an expanded information base, wastewater treatment has begun to focus on the health concerns related to toxic and potentially toxic chemicals released into the environment. The water quality improvement objectives of the 1970s have continued, but the emphasis has shifted to the definition and removal of toxic and trace compounds, that could possibly cause long-term health effects and adverse environmental impacts. As a consequence, while the early treatment objectives remain valid today, the required degree of treatment has increased significantly, and additional treatment objectives and goals have been added.

1.4 UNIT OPERATIONS AND PROCESSES IN SEWAGE TREATMENT

The degree of treatment can be determined by comparing the influent wastewater characteristics to the required effluent wastewater characteristics after reviewing the treatment objectives and applicable regulations.

The contaminants in wastewater are removed by physical, chemical, and biological means. The individual methods usually are classified as physical unit operations, chemical unit processes, and biological unit processes, Although these operations and processes occur in a variety of combinations in treatment systems, it has been found advantageous to study their scientific basis separately because the principles involved do not change.

1.4.1 Physical Unit Operations

Treatment methods in which the application of physical forces predominates are known as physical unit operations. Screening, mixing, flocculation, sedimentation, floatation, filtration, and gas transfer are examples of physical unit operations.

1.4.2 Chemical Unit Processes

Treatment methods in which the removal or conversion of contaminants is brought about by the addition of chemicals or by other chemical reactions are known as chemical unit processes. Precipitation and adsorption are the most common examples used in wastewater treatment. In chemical precipitation, treatment is accomplished by producing a chemical precipitate that will settle. In most cases, the settled precipitate will contain both the constituents that may have reacted with the added chemicals and the constituents that were swept out of the wastewater as the precipitate settled. Adsorption involves the removal of specific compounds from the wastewater on solid surfaces using the forces of attraction between bodies.

1.4.3 Biological Unit Processes

Treatment methods in which the removal of contaminants is brought about by biological activity are known as biological unit processes. Biological treatment is used primarily to remove the biodegradable organic substances (colloidal or dissolved) in wastewater. Basically, these substances are converted into gases that can escape to the atmosphere and into biological cell tissue that can be removed by settling. Biological treatment is also used to remove nutrients (nitrogen and phosphorus) in wastewater.

1.5 CLASSIFICATION OF SEWAGE/ WASTEWATER TREATMENT METHODS

The unit operations and unit processes mentioned above are grouped together to provide various levels of treatment described below: -

1.5.1 Preliminary Wastewater Treatment

Preliminary wastewater treatment is the removal of such wastewater constituents that may cause maintenance or operational problems in the treatment operations, processes, and ancillary systems. It consists solely of separating the floating materials (like dead animals, tree branches, papers, pieces of rags, wood etc.) and the heavy settleable inorganic solids. It also helps in removing the oils and greases, etc. from the sewage. This treatment reduces the BOD of the wastewater, by about 15 to 30%.

Examples of preliminary operations are:

- Screening and communition for the removal of debris and rags.
- Grit removal for the elimination of coarse suspended matter that may cause wear or clogging of equipment.
- Floatation / skimming for the removal of oil and grease.

1.5.2 Primary wastewater treatment

In primary treatment, a portion of the suspended solids and organic matter is removed from the wastewater. This removal is usually accomplished by physical operations such as sedimentation in Settling Basins. The liquid effluent from primary treatment, often contains a large amount of suspended organic materials, and has a high BOD (about 60% of original). Sometimes, the preliminary as well as primary treatments are classified together, under primary treatment.
The organic solids, which are separated out in the sedimentation tanks (in primary treatment), are often stabilized by anaerobic decomposition in a digestion tank or are incinerated. The residue is used for landfills or as a soil conditioner. The principal function of primary treatment is to act as a precursor to secondary treatment.

1.5.3 Secondary Wastewater Treatment

Secondary treatment involves further treatment of the effluent, coming from the primary sedimentation tank and is directed principally towards the removal of biodegradable organics and suspended solids through biological decomposition of organic matter, either under aerobic or anaerobic conditions. In these biological units, bacteria will decompose the fine organic matter, to produce a clearer effluent.

The treatment reactors, in which the organic matter is decomposed (oxidized) by aerobic bacteria are known as ***Aerobic biological units***; and may consist of:

- **Filters** (intermittent sand filters as well as trickling filters),
- **Aeration tanks,** with the feed of recycled activated sludge (i.e. the sludge, which is settled in secondary sedimentation tank, receiving effluents from the aeration tank), and
- **Oxidation ponds and aerated lagoons.**

Since all these aerobic units, generally make use of primary settled sewage; they are easily classified as secondary units.

The treatment reactors, in which the organic matter is destroyed and stabilized by anaerobic bacteria, are known as ***Anaerobic biological units*** and may consists of

- **Anaerobic lagoons,**
- **Septic tanks,**
- **Imhoff tanks,** etc.

Out of these units, only anaerobic lagoons make use of primary settled sewage, and hence, only they can be classified under secondary biological units. Septic tanks and Imhoff tanks, which use raw sewage, are not classified as secondary units.

The effluent from the secondary biological treatment will usually contain a little BOD (5 to 10% of the original), and may even contain several mg/l of DO. The organic solids/ sludge separated out in the primary as well as in the secondary settling tanks is disposed off by stabilizing under anaerobic conditions in a Sludge digestion tank.

1.5.4 Tertiary/ Advanced Wastewater Treatment and Wastewater Reclamation

Advanced wastewater treatment, also called tertiary treatment is defined as the level of treatment required beyond conventional secondary treatment to remove constituents of concern including nutrients, toxic compounds, and increased amounts of organic material and suspended solids and particularly to kill the pathogenic bacteria. In addition to the nutrient removal processes, unit operations or processes frequently employed in advanced wastewater treatment are chemical coagulation, flocculation, and sedimentation followed by filtration and chlorination. Less used processes include ion exchange and reverse osmosis for specific ion removal or for the reduction in dissolved solids.

Tertiary treatment is generally not carried out for disposal of sewage in water, but it is carried out, while using the river stream for collecting water for re-use or for water supplies for purposes like industrial cooling and groundwater recharge.

1.5.4.1 Nutrient Removal or Control

The removal or control of nutrients in wastewater treatment is important for several reasons:

- Wastewater discharges to confined bodies of water cause or accelerate the process of eutrophication.

- Wastewater discharges to flowing streams tax oxygen resources for the removal of Nitrogenous BOD thereby depleting the aquatic life.
- Wastewater discharges when used for groundwater recharging that may be used indirectly for public water supplies could cause health problems like blue baby diseases in children.

The nutrients of principal concern are nitrogen and phosphorus and they can be removed by biological, chemical, or a combination of processes. In many cases, the nutrient removal processes are coupled with secondary treatment; for example, metal salts may be added to the aeration tank mixed liquor for the precipitation of phosphorus in the final sedimentation tanks, or biological denitrification may follow an activated sludge process that produces a nitrified effluent.

1.5.4.2 Toxic Waste Treatment / Specific Contaminant Removal

Physico-chemical treatment such as chemical coagulation, flocculation, sedimentation, and filtration reduces many toxic substances such as heavy metals. Some degree of removal is also accomplished by conventional secondary treatment. Wastewaters containing volatile organic constituents may be treated by air stripping or by carbon adsorption. Small concentrations of specific contaminants may be removed by ion exchange.

1.6 FACTORS AFFECTING SELECTION AND DESIGN OF SEWAGE/ WASTEWATER TREATMENT SYSTEMS

The collection, treatment and disposal of liquid waste (sewage) is referred to as Sewerage. Sewage systems include all the physical structures required for collection, treatment and disposal of the wastes. In other words, discharged waste water's that are collected in large sewerage networks, transporting the waste from the site of production to the site of treatment comprise Sewage treatment networks (Sewerage system).

The most important factors that should be borne in the mind before the selection and design of any sewage/ wastewater treatment system are:

1. ***Engineering Factors***
    - Design period, stage wise population to be served and expected sewage flow and fluctuations.
    - Topography of the area to be served, its slope and terrain; Tentative sites available for treatment plant, pumping stations and disposal works.
    - Available hydraulic head in the system upto high flood level in case of disposal into a river or high tide level in case of coastal discharges.
    - Groundwater depth and its seasonal fluctuations affecting construction, sewer infiltration.
    - Soil bearing capacity and type of strata to be met in construction.
    - On site disposal facilities, including the possibilities of segregating sullage and sewage and reuse or recycling of sullage water within the households.

2. ***Environmental Factors***
    - Surface water, groundwater and coastal water quality where wastewater has to be disposed after treatment
    - Odour and mosquito nuisance which affects land values, public health and well being.
    - Public health considerations by meeting the requirements laid down by the regulatory agencies for effluent discharge standards, permissible levels of microbial and helminthic quality requirements and control of nutrients, toxic and accumulative substances in food chain.

3. Process considerations

- Wastewater flow and characteristics.
- Degree of treatment required.
- Performance characteristics.
- Availability of land, power requirements, equipments and skilled staff for handling and maintenance.

4. Cost considerations

- Capital costs for land, construction, equipments etc.
- Operating costs including staff, chemicals, fuels and electricity, transport, maintenance and repairs etc.

REVIEW OF STATUS IN DELHI

Delhi, the capital city of India which is situated on the banks of river Yamuna, is home to more than 1.4 crore people. Proliferating population, uncontrolled and haphazard expansion beyond capacity and lack of planning have resulted in a serious environmental crisis, so much so, that today Delhi is one of the most polluted cities in the world.

The demand for natural resources like water and land is rising exponentially, thereby causing serious environmental degradation. The problem of management, treatment and disposal of waste especially liquid waste (sewage) is critical, since this waste water will consequently find its way into the groundwater or surface water, and it will directly affect the health of the ecological systems dependent on it. Hence, wastewater treatment is a necessity and not an option.

2.1 SOME FACTS:

- Domestic wastewater generated is 1936 MLD emanating from a population of 14 million individuals.
- Total quantity of sewage generated in Delhi is 2871 MLD.
- The wastewater (sewage) treatment capacity of Delhi is 1523 MLD (512.4 MGD). Thus a huge gap of around 1350 MLD exists between the wastewater generated and the treatment capacity of all sewage treatment plants in Delhi.
- An estimated 2249 MLD of wastewater drains into the Yamuna river daily through the 22 major drains in Delhi.
- The extent of environmental imbalance is so severe that the water quality of Yamuna river that should ideally lie in the category 'B' (fit for bathing, swimming and recreation) as defined by CPCB, whereas it actually falls under category 'E' (theoretically unfit even for agriculture).
- About 50% of the total pollution in Yamuna is from Delhi, which is just 1% of the total catchment area of Yamuna (a mere 22 km of the 1200 km stretch of Yamuna).

(*Source:* ***Delhi Jal Board*** *(DJB) and* ***TERIvision****, June 2002, Issue No. 46*)

2.2 WASTE WATER GENERATION IN DELHI

Delhi generates large quantities of sewage. At present, the total quantity of sewage generated is 2871 mld whereas the total capacity of the sewage treatment plants in Delhi is 1478 mld. The remaining 48% untreated sewage (1393 mld) finds its way into the Yamuna river through the 19 major drains which carry sewage and industrial effluents from the city. As a result, the quality of water in the river has been deteriorating and the water in the river is at present unfit for drinking (even for animals) and for use in agriculture.

The sewerage facilities cover only about 75% of the population. The sewage system is non-existent in large parts of the trans-Yamuna area, all the resettlement colonies, and illegal settlements.

The Conventional method for estimation of generated wastewater is, derived at 80% of the water supplied. However, this may not be realistic in the areas like Delhi, where huge amount of ground water is simultaneously extracted and utilised. Therefore, all the major drains, sewage treatment plants have been monitored to derive the actual wastewater generation in the National Capital Territory - Delhi. This study reveals that 2546.88 MLD of sewage is generated in Delhi and of which, only 885.3 MLD of sewage is collected through sewerage network for treatment and rest 1661.84 MLD of sewage flow in storm water drains, thus, making these open sewers, and in turn causes foul smell and ground water contamination all along the drain and ultimately polluting disposal sink i.e. sacred river Yamuna. The Delhi has 1153.16 MLD of sewage treatment capacity, whereas, only 885.3 MLD is collected through sewerage network and treated in treatment plants.

Within this backdrop, it is estimated that about 1030 MLD of water is extracted in addition to ground water extraction of 306 MLD by the Delhi Jal Board. This huge extraction of ground water may be the sole cause for increased salinity and contamination of aquifer. The effort have been made to find the cumulative pollution load addition to river Yamuna (23 kms stretch from Wazirabad Barrage to Okhla Barrage) at various points by the major drains carrying wastewater from National Capital Territory of Delhi.

2.2.1 Delhi's Contribution to Pollution in Yamuna

The Yamuna catchment area of the National Capital Territory is one per cent of the river's total catchment area but it generates more than 50% of the pollutants found in the Yamuna. The crucial stretch is a mere 22-km-long portion of its 1200-kilometer journey. Wastewater with little or no oxygen flows through this stretch. According to the statistics, Delhi is the largest contributor of pollution to river Yamuna. TERI studies say that more than 70% of the 84 districts that make up the Delhi sub-basin are water–stressed due to depletion and degradation of quality of ground and surface water resources. Delhi receives relatively clean water and converts it into a deadly concoction of disease-bearing water for the people who live downstream.

Eighty per cent of the districts suffer because of this 22-km stretch where effluents pour into the river. Yamuna before the Wazirabad stretch has appreciable levels of dissolved oxygen, low biochemical oxygen demand and the water is extensively used for irrigation purposes. Haryana, Himachal Pradesh and parts of Uttar Pradesh use 6000 million cubic metres of water every year for irrigation. The scene changes dramatically once the waters reach Delhi. None of the cities downstream generate more than 1000 Mld (million liters per day) of wastewater. In contrast, Delhi alone generates 2100 Mld of wastewater. Bacteriological count – an indicator of the presence of pathogens – is under permissible level upto Delhi. The Delhi region makes this count dangerously high. This means that Delhi could be responsible for all water-borne diseases caused by use of Yamuna waters beyond Delhi.

2.3 PRESENT SCENARIO OF SEWAGE TREATMENT PLANTS IN DELHI

Delhi has 21 plants on plan out of which 17 are working with different capacities and 4 are yet to be constructed or are being constructed.

The sewage treatment capabilities of various treatment plants are given below:

Sewage Treatment Capabilities of various Sewage Treatment Plants

(I) Delhi Jal Board		Addition by (capacity in MGD)				
S. No.	**Name of Plant**	**Mar.2002**	**Mar. 2003**	**March 2004**	**March 2005**	**Dec. 2005**
1.	Yamuna Vihar	10	10	25	--	--
2.	Kondi	45	--	45	--	--
3.	Coronation Pillar	40	--	--	--	--
4.	Timar Pur	06	--	--	--	--
5.	Keshopur	72	--	--	--	--
6.	Nilothi	40	--	--	--	--
7.	Okhla	140	--	--	30	--
8.	Vasant Kunj	05	--	--	--	--
9.	Ghitorni	05	--	--	--	--
10.	Delhi Gate	2.2	--	--	15	--
11.	S.N.H. Nala	2.2	--	--	--	--
12.	Papankalan	20	--	--	20	--
13.	Rohini	--	15	--	--	--
14.	Najafgarh	05	--	--	--	--
15.	Narela	10	--	--	--	--
16.	Mehrauli	--	5	--	--	--
17.	Rithala	80	--	--	30	--
18.	Cantonment	--	--	--	8	--
19.	Barapulla Nala	--	--	--	20	--
20.	Narela Sub City-I	--	--	--	--	20
21.	Rohini Phase I	--	--	--	--	20
Total		**482.4**	**30**	**70**	**123**	**40**

SOURCE: Delhi Jal Board Website: www.delhijalboard.com

Status of Sewage Treatment Plant in Delhi (Total capacity Vs Actual Flow)

Sewage Treatment Plant	Total Capacity (Million litres per day)	Actual Flow (Million litres per day)
Mehrauli	22.7	Nil
Vasant Kunj	22.7	18.16
Okhla	635.0	594.74
Najafgarh	22.7	Nil
Papan Kalan	90.8	40.9
Keshopur	272.4	363.2
Nilothi	181.6	Under Construction
Coronation Pillar	181.6	127.12
Rohini	68.1	Under Construction
Narela	45.4	2.27
Rithala	363.2	249.7
Vamuna Vihar	45.4	36.32
Kondli	204.3	99.88
Sen Nursing Home	10.0	11.95
Delhi Gate Rajghat	10.0	11.90
Timarpur Oxidation Pond	27.24	4.54

SOURCE: Delhi Jal Board Website: www.delhijalboard.com

WASTEWATER TREATMENT TECHNOLOGIES ADOPTED AT SEWAGE TREATMENT PLANT's OF DELHI JAL BOARD (DJB)

The various treatment technologies used to treat wastewater at the sewage treatment plants of Delhi Jal Board (DJB) are discussed here. Although, there are 17 Sewage Treatment Plants under DJB, the technologies adopted at these plants can be categorized into 5 main type's i.e.

1. Conventional Activated Sludge Process
2. High rate Aeration with Biofiltration
3. Extended Aeration Process
4. Physico-Chemical Treatment with Biofiltration
5. Trickling Filters

The following table provides a list of the technologies along with the treatment plants using that technology: -

List of technologies with the plants being run on it

S.NO.	TECHNOLOGY	SEWAGE TREATMENT PLANTS
1.	Conventional Activated Sludge Process	A. Rihala Phase-I B. Okhla C. Kondli D. Pappankalan E. Nilothi F. Narela G. Rohini H. Yamuna Vihar Phase-I I. Yamuna Vihar Phase-II J. Keshopur Phase-III K. Coronation Pillar Phase-II L. Coronation Pillar Phase-III
2.	High rate Aeration with Biofiltration	A. Rithala Phase-II
3.	Extended Aeration Process	A. Najafgarh B. Vasant Kunj C. Keshopur Phase-II D. Mehrauli E. Ghitorni F. Timarpur
4.	Physico-Chemical Treatment with Biofiltration	A. Sen Nursing Home B. Delhi Gate Nallah
5.	Trickling Filters	A. Coronation Pillar-I

SOURCE: Delhi Jal Board

An example of four of the treatment technologies followed at particular plants along with dimensions of all the units, efficiency of the plant, the residuals generated, capital cost, construction cost, Operational and maintenance cost and the land required has been provided here. The fact sheets about four STP's have been presented. The fact sheet contains an overview or a summary of each type of treatment technology. Altogether the line diagrams of all the treatment plants have been drawn. This depicts the flow direction and all the units present in the plant.

3.1 SEWAGE TREATMENT PLANT AT SEN NURSING HOME

CAPACITY: - 20 MLD

TECHNOLOGY USED:- Physico-chemical treatment

This technology comprises:
Pretreatment viz. fine and coarse screening/ aerated degritting: 1 unit
Oil and grease trap : 1unit
Biological aerated filters: 8 units
Sludge dewatering on filter press: 2 units

TECHNOLOGY STATUS:- Latest and proven state of art technology
LAND REQUIREMENTS:- 0.4 ha

ENERGY REQUIREMENTS:- 2200 kwh/d

WATER QUALITY:-

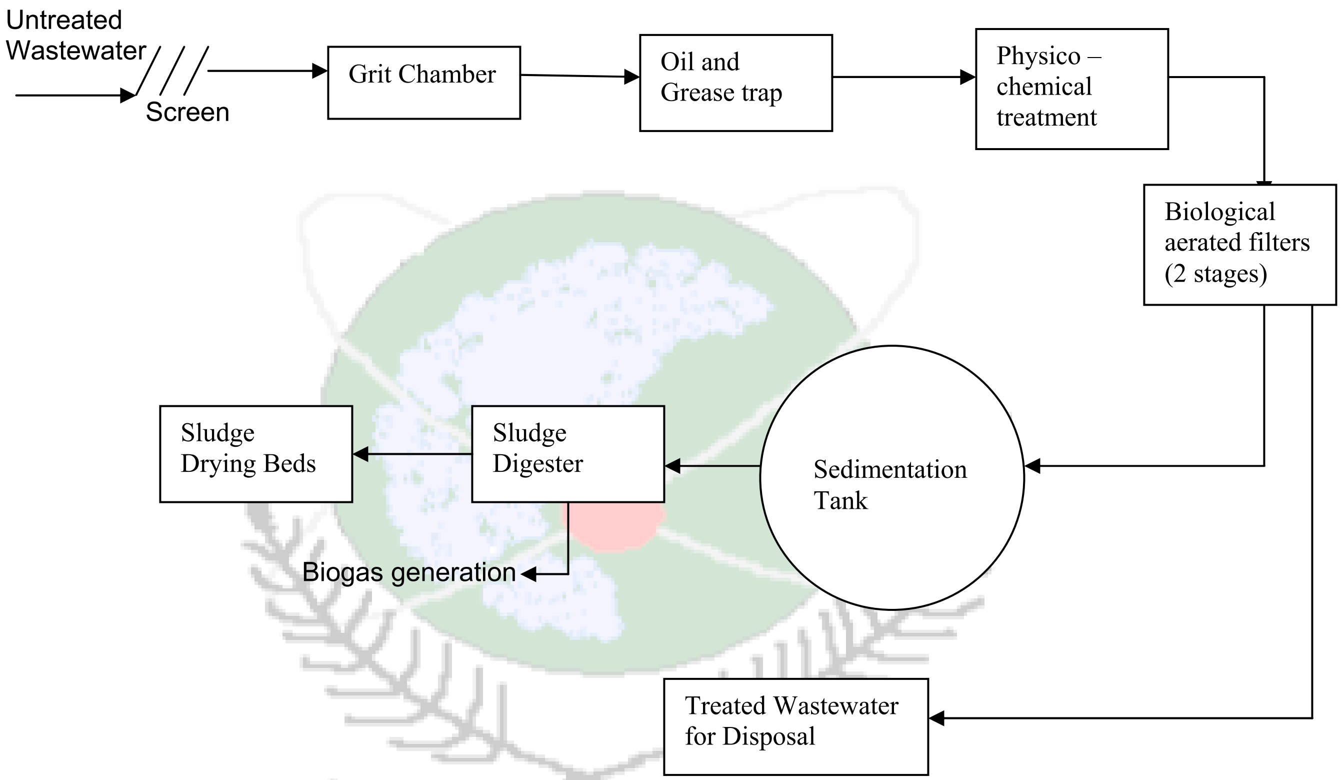
Parameter	**Influent(mg\l)**	**Effluent(mg\l)**
BOD5	270	10
Suspended solids	539	15

ENVIRONMENTAL IMPACTS:- The grit material is thrown directly to a nearby nallah.

APPLICATIONS:- Used for treating domestic and biodegradable industrial waste water.

SALIENT FEATURES OF THE PLANT:-
- Substantial land saving.
- Higher removal efficiency
- Higher quality treated effluent released
- The treated effluent is used as a coolant in a nearby Power Plant.

Figure 3.1: LINE DIAGRAM OF WASTEWATER TREATMENT SCHEME AT SEN NURSING HOME



3.2 SEWAGE TREATMENT PLANT AT VASANT KUNJ

Capacity: 10 mld

Technology used: Extended Aeration

This technology comprises:
Pretreatment viz. screening, degritting : 2 units
Aeration: 2 units
Clarification: 1 units
Sludge Dewatering on sludge drying beds: 8 units

Technology status: traditional and proven state of the art technology

Land requirement: 2.2 hectares

Energy requirement: 6768 kwh/d

Water quality:

Parameter	Influent (mg/l)	Effluent (mg/l)
BOD_5	200	20
Suspended Solids	400	30

Operating problems: nil

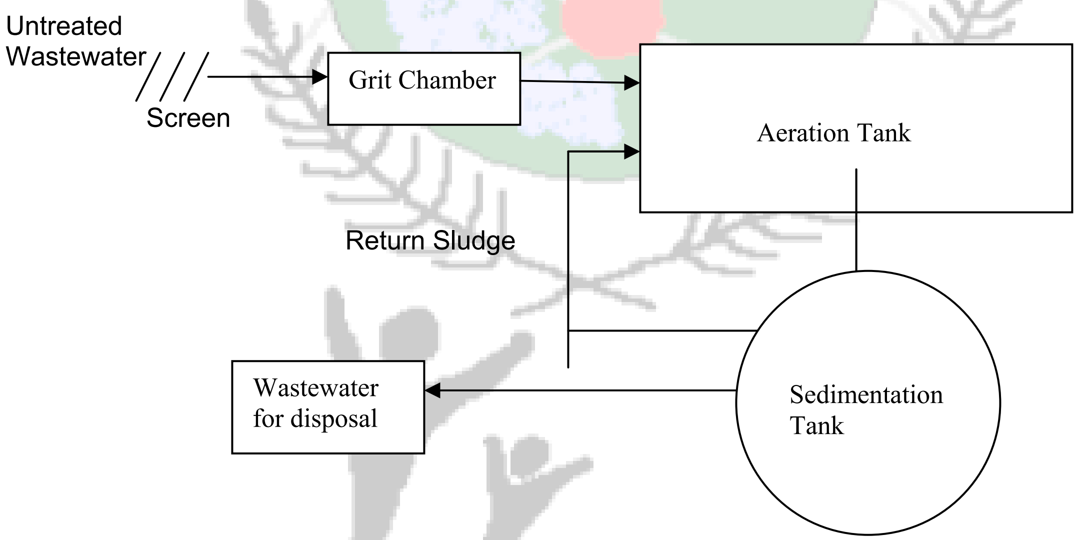
Applications: used for treating domestic wastewater.

Salient features:

- Decentralized system of treatment
- Minimal operation and maintenance cost

Residuals generated: grit, dried sludge cakes.

Figure 3.2: LINE DIAGRAM OF WASTEWATER TREATMENT SCHEME AT VASANT KUNJ



3.3 SEWAGE TREATMENT PLANT AT OKHLA

CAPACITY: - 16 MGD

TECHNOLOGY USED: - Conventional activated sludge process
This technology comprises:
Pretreatment viz. screening : 4 unit
Aerated grit chamber : 2 units
Primary Clarifier : 2 units
Aeration tank : 2 units
Secondary Clarification : 2 units
Sludge dewatering on sludge drying beds: 8units

TECHNOLOGY STATUS: - Conventional technology used

LAND REQUIREMENTS:- 11 ha

ENERGY REQUIREMENTS:- 16486 kwh/d

WATER QUALITY:-

Parameter	Influent(mg\l)	Effluent(mg\l)
BOD5	200	20
Suspended solids	400	30

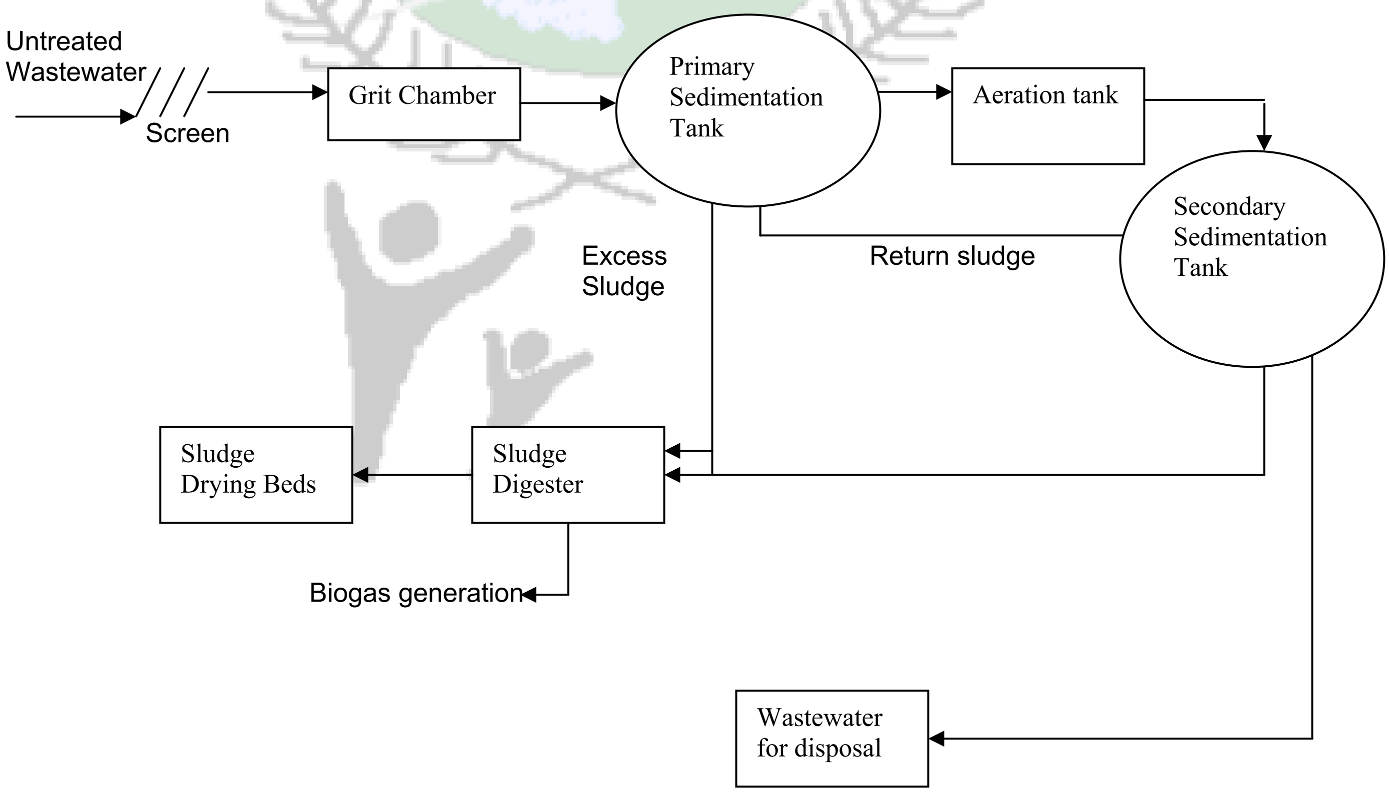
ENVIRONMENTAL IMPACTS:- Smell nuisance

APPLICATIONS: - Used for treating domestic and biodegradable industrial waste water.

SALIENT FEATURES OF THE PLANT:-

- Biogas is being supplied to the residential area nearby for domestic use.

Figure 3.3: LINE DIAGRAM OF WASTEWATER TREATMENT SCHEME AT OKHLA



3.4 SEWAGE TREATMENT PLANT AT RITHALA, PHASE-II

CAPACITY:- 40MGD

TECHNOLOGY USED: - High rate aeration and biofiltration

This technology comprises:

Pretreatment viz. screening / aerated degritting and degreasing: 2 units
Aeration (High load activated sludge process) : 4 units
Clarification: 4 units
Biofiltration: 20 units
Sludge thickening (using modern floatation technology): 2 units
Sludge digestion (using gas mixing technology): 4 units
Sludge dewatering
On mechanical belt filter press (during monsoon): 4 units
On Sludge drying beds (rest of the year) : 43 units
Electricity and Heat production: 3 units of Bio-gas production

TECHNOLOGY STATUS:- Latest and proven state of Art technology

LAND REQUIREMENT:- 13.6 hectares

ENERGY REQUIREMENT:- 33,800 kwh/d

WATER QUALITY:-

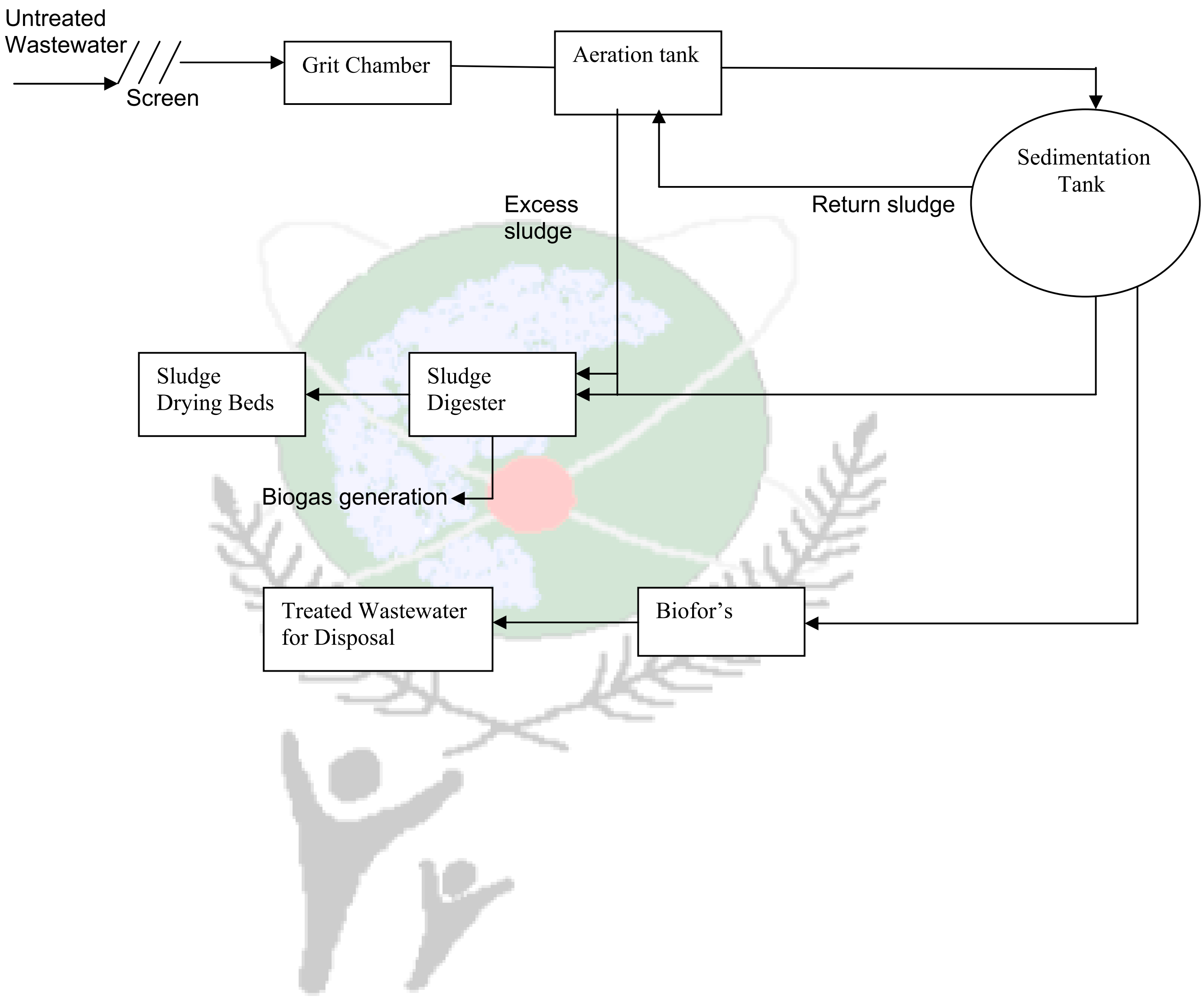
Parameter	Influent (mg/l)	Effluent (mg/l)
BOD5	200	15
Suspended Solids	410	20

APPLICATIONS:- Used for treating domestic and biodegradable industrial wastewater. The main advantage of this system is the lesser energy requirement as compared to the conventional system and higher quality of treated effluent.

SALIENT FEATURES OF THE PLANT:-

- Minimal investment and Operational costs
- Substantial land savings
- Plant is self sustaining energy –wise.

Figure 3.4 LINE DIAGRAM OF WASTEWATER TREATMENT SCHEME AT RITHALA II



ALTERNATIVE TECHNOLOGIES TO SEWAGE TREATMENT

4.1 ONSITE SANITATION OPTIONS

The Conventional off-site excreta disposal and treatment method of water borne sewerage is an expensive option which is not affordable by low income communities and rural people. This is why a number of other onsite sanitation technologies were developed, practiced and popularized in due course of time. The most important among the two pit pour flush toilet technology developed and popularized by ***Sulabh International Social Service Organisation***.

Some important on-site sanitation techniques are listed below:

1) Septic tank
2) Two pit pour flush toilets
3) Trench latrine
4) Bore hole latrine
5) Dug well latrine
6) Aqua privy
7) Ventilated improved pit latrine (VIP)

Sulabh International, an NGO working in the field of sanitation from the last 33 years has also developed a few technologies to treat liquid waste/ sewage, besides the conventional techniques in sewage treatment plants. A brief review of these is presented below.

4.2 SULABH EFFLUENT TREATMENT (SET) SYSTEM

Sulabh is maintaining over 5500 public toilet complexes spread all over the country, out of which 104 are linked with biogas plants. Therefore it was an important task for the organisation to make the effluent free from odour, colour and pathogens, so that it could be safely used for agricultural purposes. After a series of experiments, the organisation developed a new and convenient technology by which effluent of human excreta based biogas plant turns into a colourless, odourless and pathogen-free liquid manure. The technology is based on filtration of effluent through activated charcoal followed by ultraviolet (UV) rays. The filtration unit makes it colourless, odourless and free from organic particles and UV eliminates bacteria. It reduces BOD, COD of the waste water drastically. Since the wastewater is from human wastes , its BOD (Biochemical Oxygen Demand) is around 200 mg/l, that comes down to <10 mg/l after treatment – safe for aquaculture, agriculture purposes, gardening or discharge into any water body. It can also be used for floor cleaning of public toilets in drought prone areas.

Biogas from human excreta is being used for different purposes e.g. cooking, lighting, electricity generation and body warming. Besides, the liquid effluent can be used as fertilizer, as it contains good percentage of nitrogen, potassium and phosphate.

ADVANTAGES OF DECENTRALISED SYSTEM OF BIOGAS PLANT WITH SET TECHNOLOGY:

- Costs on collection of sewage and operation and maintenance of the system are very slow.
- No manual handling of human excreta is required.
- Aesthetically and socially accepted.
- Biogas is used for different purposes.
- Treated effluent is safe to reuse as agriculture, gardening, or discharged into any water body.
- In draught prone areas treated effluent can be used for cleaning of floor of public toilets.
- If discharged into sewer, pollution load on STP will be much lowered.

Thus, the decentralized system of sewage treatment through biogas technology is effective to minimize financial burden to combat the pollution.

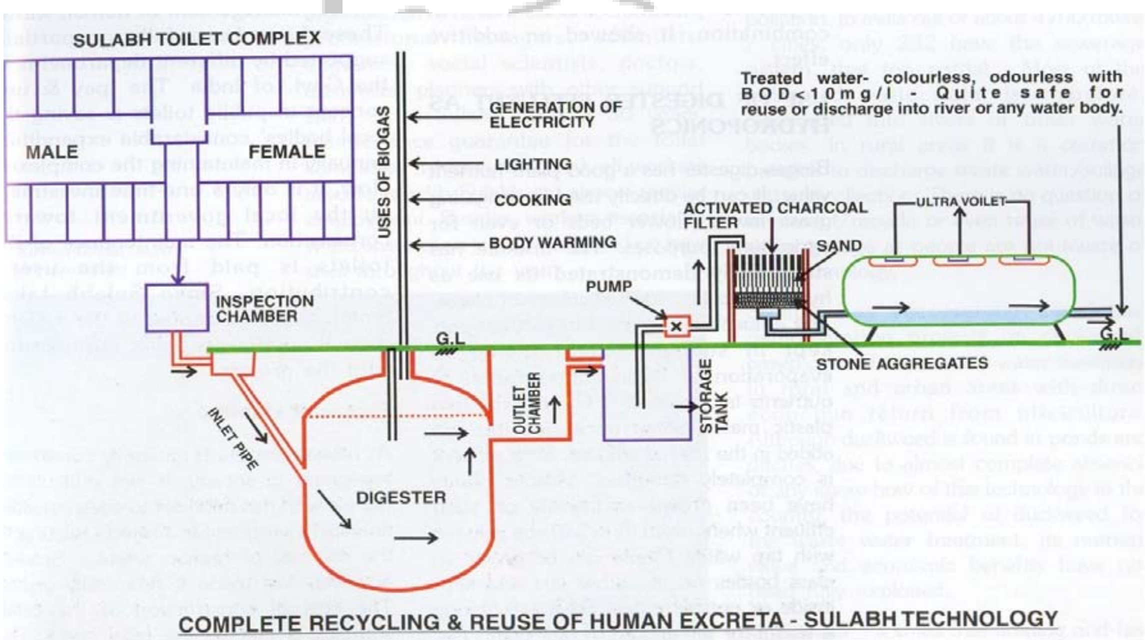
4.3 DUCKWEED- BASED WASTE WATER TREATMENT

One of the major problems with waste water treatment methods is that none of the available technologies has a direct economic return. The available technologies are unaffordable due to high capital and maintenance costs. Due to no economic return, local authorities are generally not interested in taking up treatment of waste water, thereby causing severe health hazards and environmental pollution. In India out of about 4700 towns/cities, only 232 have the sewerage system, that too partial. Most of the untreated waste water is, therefore, discharged into rivers or other water bodies. In rural areas it is a common practice to discharge waste water/ sullage without collection. There is no question of treatment/recycle or even reuse of waste water/sullage as people are not aware of this technology.

Sulabh has successfully developed demonstration projects on duckweed-based cost-effective waste water treatment in rural and urban areas with direct economic return from pisciculture. Although duckweed is found in ponds and ditches, due to almost complete absence of any know-how of this technology in the country, the potential of duckweed for the waste water treatment, its nutrient value and economic benefits have not been fully exploited.

Duckweed – a small free-floating and fast growth aquatic plant-has great ability to reduce the BOD, COD, suspended solids, bacterial and other pathogens from waste water. It is a complete feed for fish and due to the high content of proteins and vitamins A and C, it is also a highly nutritious feed for poultry and domestic animals. The yield of fish increases by 2 to 3 times when fed with duckweed, than that with other conventional feeds in ponds. Reduction of BOD, COD in effluents varies from 80-90% at the retention time of 7-8 days. The first project funded by the ministry of Environment & Forests, Govt. of India, was successfully completed in collaboration with the Central Pollution Control Board, New Delhi. Based on the outputs of the project, CPCB has made guidelines on the use of duckweed for the waste water treatment.

SULABH EFFLUENT TREATMENT TECHNOLOGY



COMPLETE RECYCLING & REUSE OF HUMAN EXCRETA - SULABH TECHNOLOGY