Figure 48　Location of Cubbon Park STP in Bengaluru

Raw Sewage Wet Well and Pumping

Raw Influent

Fine Screen

Drum Screen

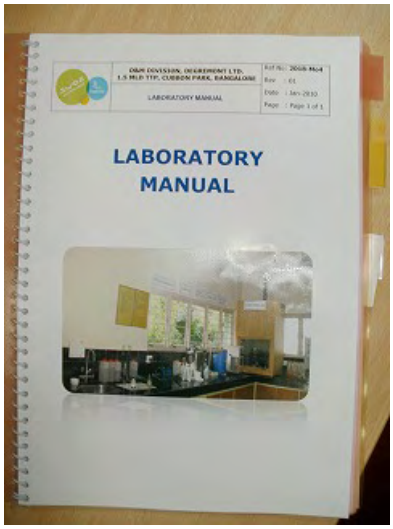
Membrane Bio Reactor

DO meter

Sodium Hypochlorite

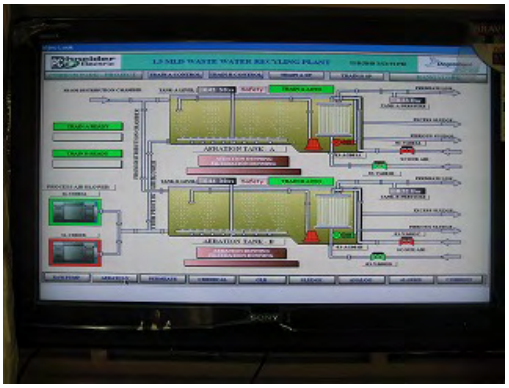
Centrifugal dehydrator

Treated Water



Laboratory Manual by DEGREMONT

Documentation management by ISO 9001



SCADA

Figure 49 Photographs of Some Components at Cubbon Park STP in Bengaluru

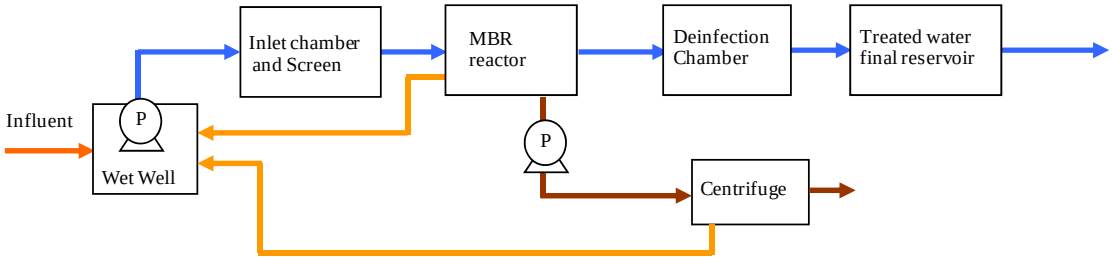


Figure 50 Schematic Diagram of Process Flow at Cubbon Park STP in Bengaluru

(B) General Observation

The operation and maintenance of this STP is contracted to DEGREMONT. As compared to other STP, the data of management index, etc. is properly checked by DEGREMONT. Water quality analysis is carried out once every day and the average values in September, 2010 are shown in Table 22.

In order to make proper operation and maintenance possible, application of a Supervisory Control and Data Acquisition (SCADA) system, preparation of various manuals, taking measures to safety-and-hygiene side, etc. are being carried out.

Table 22 Water Quality Level at Cubbon STP

Parameters	Influent		Effluent	
	Design	Average	Design	Average
pH	6.8-8.0	6.8	6.5-8.0	7.4
BOD (mg/l)	330	188	<4	1.5
TSS (mg/l)	450	173	<3	0.10
COD (mg/l)	660	402	-	7
Turbidity (NTU)	-	184	<2	0.0
Total Coli (MPN/100ml)	10^9-10^{10}	-	2.3	B.D.L.
Faecal Coli (MPN/100ml)	-	-	B.D.L.	B.D.L.

B.D.L. : Below Detection Limit

Parameters	Aeration tank (A)	Aeration tank (B)
	Average	Average
pH	7.4	7.7
MLSS (mg/l)	8,463	8,902
SVI	99	98

19. Perungudi STP, Chennai (Tamilnadu)

(A) Outline of STP

The STP has a capacity of 54MLD. Influent contains domestic wastewater and septic tank sludge. This STP uses activated sludge process.

Septic tank sludge is withdrawn from each septic tank, and is carried to STP on a vacuum vehicle. Septic tank sludge is fed into the 1,200-mm raw sewage pipe from a pumping station, and inflow water mixed with septic tank sludge goes into inlet camber.

The STP includes inlet chamber, screen, grit chamber channel, primary clarifier, aeration tank, secondary clarifier, digester, centrifuge, etc.

Inlet chambers have an automatic screen with aperture of 25 mm. Although an ultrasonic type water level meter is installed at grit chamber exit, but flow meter is out of order. Influent volume is checked once every hour by viewing. The influent goes into reaction tank after passing through two primary clarifiers. Although there are 16 surface aerators in the reaction tank, five sets of them are broken down in the existing condition.

The excess sludge withdrawn from secondary clarifier is returned to primary clarifier and to the entrance of aeration tank. The mixed sludge withdrawn from primary clarifier is digested using digester after concentration in thickener. Digested sludge is treated by centrifuge. Gas obtained from digester is used for power generation after desulfurization.

Figure 51 Location of Perungudi STP in Chennai

Injection of septic tank sludge

Parshall flume

Primary sedimentation tank

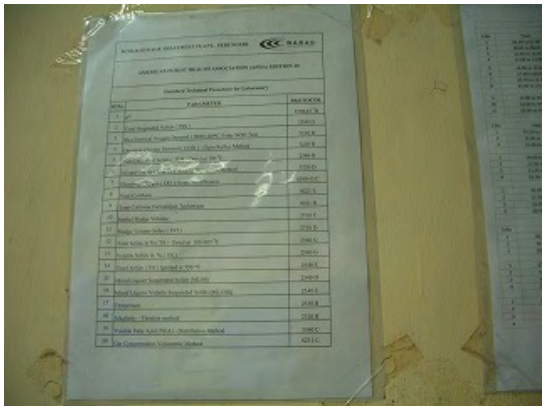
Aeration tank

Final sedimentation tank

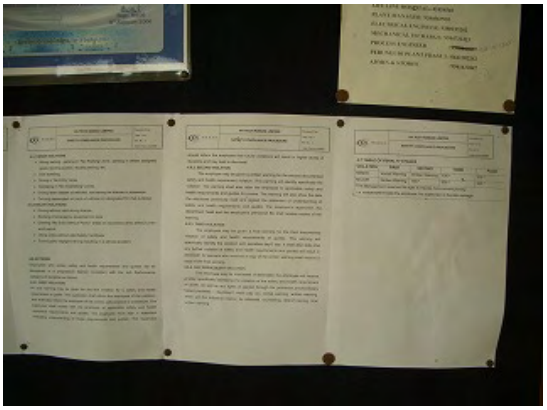
Digester tank

Centrifugal dehydrator

Power generator of digestion gas



Manual list



Safety compliance procedure

Figure 52 Photographs of Some Components at Perungudi STP in Chennai

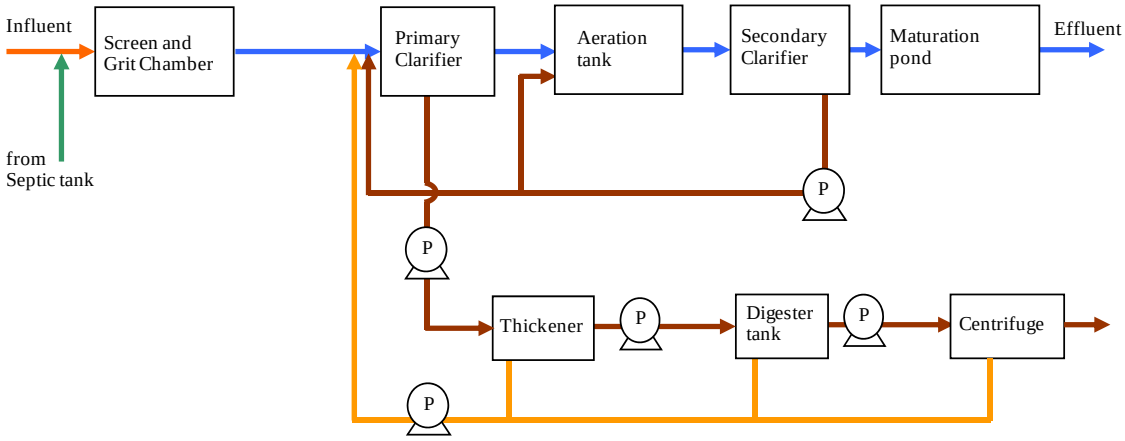


Figure 53 Schematic Diagram of Process Flow at Perungudi STP in Chennai

(B) General Observation

The operation and maintenance of this STP is contracted to WABAG. Water quality analysis is carried out once every day and the average values in May, 2010 are shown in Table 23. The monthly average flow of influent is 67 MLD which is over the design value.

Table 23 Water Quality Level at Perungudi STP

	Sewage inflow to STP MLD	Raw Sewage			Treated effluent			
		BOD mg/L	TSS mg/L	COD mg/L	BOD mg/L	TSS mg/L	COD mg/L	pH
Design	54	460	690	1,570	≤20	≤30	<250	6.5 - 8.0
MAX	75	320	410	864	18	26	96	8
MIN	57	240	325	655	16	23	62	8
AVG	67	292	379	783	17	25	79	7.69

In order to carry out more proper operation management, analysis of septic tank sludge quality and measurement of its quantity are important.

Around the STP, bad odor like sewage is strongly recognized. The covering of facilities and deodorization equipment will be needed from now on.

Surface aerator and water gauge are broken down, and are neglected. Equipments are also intensely corroded. It is required to form a repair plan using check results and to repair equipments appropriately.

20. Nesapakkam STP, Chennai (Tamilnadu)

(A) Outline of STP

The STP has a capacity of 40MLD. This STP uses activated sludge process. This STP was constructed in 2006 and the private corporation (BHEL: Bharat Heavy Electricals Limited) which carried out design and construction is doing maintenance management. The contract term of maintenance management is ten years.

Influent contains domestic wastewater and septic tank sludge. Septic tank sludge is withdrawn from septic tank, and septic tank sludge is carried to STP using vacuum vehicle.

Inlet chamber have an automatic screen. An ultrasonic type flow meter is installed at grit chamber exit. The inlet flow is checked by this flow meter. Influent goes into reaction tank after passing through the primary clarifier. There are 9 surface aerators in the reaction tank.

The excess sludge withdrawn from the secondary clarifier is returned to primary clarifier and aeration tank entrance. The mixed sludge withdrawn from the primary clarifier is digested with digester after concentration in a thickener. The display of digester temperature showed 42.34º Celsius. Digested sludge is treated by the centrifuge. Gas from digester is used for power generation after desulfurization.

Components of this STP are listed below in Table 24.

Table 24　Components of 40MLD STP at Nesapakkam in Chennai

Components	Units	Dimension
Inlet Chamber	1	6.3×3.0×2.70m
Screen Chamber (Mechanical)	1	2.79×1.3×9m
Screen Chamber (Manual)	1	2.79×1.3×9m
Grit Collector Tank	2	10.9×10.9×1.0m
Primary Clarifier	1	42.5m dia. ×3.52m
Aeration Tank	1	45.0×45.0×4.53m
Secondary Clarifier	1	50.0m dia ×3.52m
Sludge Thickener	1	31.3m dia ×3.5m
Sludge Digester	1	31.5m dia ×9.9m
Chlorination Contact Tank	1	38.0×12.0×3.04m

Figure 54　Location of Nesapakkam STP in Chennai

Parshall flume

Pipe of recycle flow and excess sludge

Primary sedimentation tank

Aeration tank entrance

Final sedimentation tank

Flow measurement of effluent

Chlorination chamber

The gas tank of chlorine

Sludge Thickener

Centrifugal dehydrator

Power generator of digestion gas

The storage situation of fuel

Figure 55 Photographs of Some Components at Nesapakkam STP in Chennai

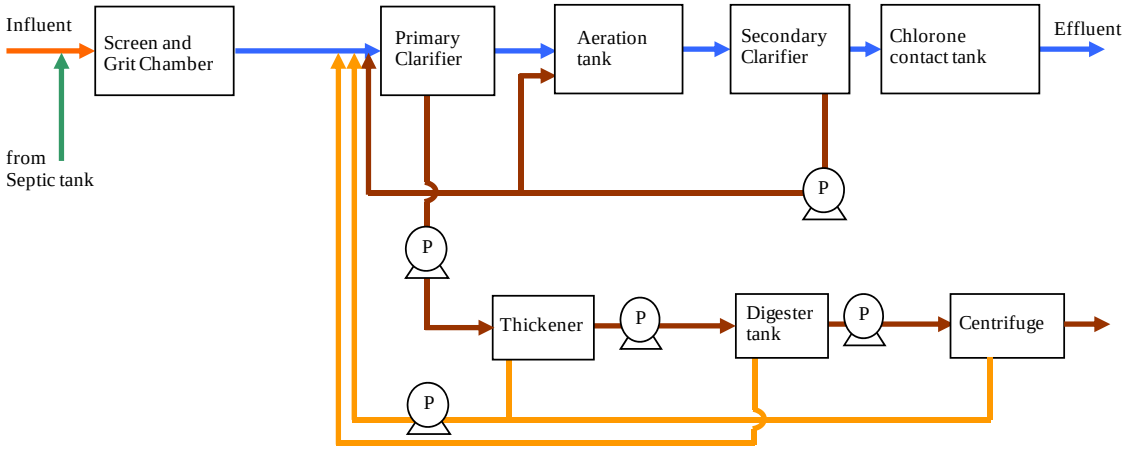


Figure 56 Schematic Diagram of Process Flow at Nesapakkam STP in Chennai

(B) General Observation

Around the STP, bad odor like sewage is strongly recognized. The covering of facilities and deodorization equipment will be needed from now on.

Equipments are also intensely corroded. It is required to prepare a repair plan using check results and to repair equipments appropriately.

Electric power consumed by all facilities is provided with power generated by gas from digester.

The sludge-liquid interface level in the secondary clarifier is high, and sludge is carrying over. Sludge is not withdrawn from thickener for a long time. Sludge generation volume is predicted from influent water quality. It is important to treat sludge appropriately based on the predicted sludge volume.

Laboratory is available at the STP to carry our water quality analysis. Typical values of water quality are presented in Table 25 below.

Table 25 Water Quality Level at Nesapakkam STP

Parameters	Design		Reportedly Observed	
	Influent	Effluent	Influent	Effluent
BOD (mg/l)	350	≤20	320	<18
COD (mg/l)	600	≤10	700	<60
TSS (mg/l)	400	≤30	450	<25

21. Chabilepurwa PS, Kanpur (Uttar Pradesh)

(A) Outline of Pumping Station

This is one of the four relay pumping stations that pumps wastewater to the 36 MLD STP in Kanpur. These four pumping stations only pump wastewater from leather factories. The combined capacity of the four pumping stations is 9 MLD.

This pumping station has five submersible pumps (415 V). Normally two are in operation, while one is a standby pump. The remaining two pumps have been hauled up on land and retained as standby.

There is one diesel standby generator of 125 kVA. Since the power situation is unsatisfactory, the standby generator is operated for about five hours a day on an average.

Catchment area

Inlet channel

Influent Tannery wastewater

Pump

Surge tank

Standby generator

Figure 57 Photographs of Facilities at Chabilepurwa Pumping Station in Kanpur

22. Gaughat PS and Sewerage System, Allahabad (Uttar Pradesh)

(A) Outline of Pumping Station

This is the oldest of the three pumping stations in the treatment area. It is the final pumping station that pumps wastewater to the 60 MLD Naini STP in Allahabad. This pumping station commenced operation in 1988.

In the planning stage, the wastewater flow was 72 MLD, but with the increase in wastewater flow, the average flow pumped per day is 90 MLD. Out of the 90 MLD flow, 60 MLD is pumped to Naini STP for treatment; the remaining 30 MLD is used for irrigation although it is untreated. In the rainy season, the maximum wastewater flow reaches 160 MLD.

Hydrogen sulfide odor seems to be permanently present at the inlet sump. Refuse scraped out by the screening equipment lies dispersed all around the inlet sump.

There are two mechanical screens and both can be operated. Every 30 minutes, the screen is operated continuously for 15 minutes. The belt conveyor for conveying the refuse is not in operation since the rollers are defective. The refuse after screening is loaded on to trucks and a truckload of refuse every week is conveyed to the landfill site.

Of the five vertical volute pumps (voltage 3,300 V), three are in operation, while two have suffered breakdown. The broken down parts are bearing and shaft. At peak hours from 1000 to 1200 hours and from 1600 to 1800 hours, two pumps operate. At times other than peak time, one pump operates. After continuous operation of six hours, the pump is inspected. Sometimes problems occur in the brush and bearing of the motor. Although the service life of the pump is considered to be 15 years, it is sometimes used for 22 years after repairs.

There are two diesel standby generators that can be operated when required. The capacities of the generators are 500 kVA and 1,000 kVA. During power failure, the power provider is called

by phone to confirm the expected power shutdown period. If the actual power shutdown period is less than 20 minutes, the standby power generator is not operated. The power failure generally does not last for a long period; it lasts generally for several tens of minutes. The average operating period of a standby generator is 30 minutes. The longest power failure period until now was 14 hours, which was about 3 years ago.

Surroundings of a screen

Garbage is neglected

Screen

Inlet sump

Pump

Standby generator

Figure 58 Photographs of Facilities at Gaughat Pumping Station in Allahabad

(B) Outline of Sewage System

There is open drain (nala) into which storm water and drain water from public wash houses flow. The gray water flows straight into the Yamuna River. There is no cover on the open drains.

Currently, the sewage flows through open channels, but sewers will be installed henceforth. Even during the study period, work of installing pipes of 1,900 mm diameter was in progress.

The management of construction of the public sewerage is being performed by Jal Nigam. Concrete slump test, gradient (gradient at the study location was 11%) and formwork, etc., are being checked. Although there is no manual for construction work and management, there is a design manual (1993).

The base of the collection chamber is constructed using bricks, while the upper covering part is made of concrete. When the domestic collection chamber and public collection chamber are connected by pipe, a part of the public collection chamber made of bricks will be broken down. Improved connection methods are necessary.

Gray water channel

Drainage from a public wash place

Gray water channel

Domestic wastewater

Sewage Channel

Collect Chamber Construction

Collect Chamber Construction

Collect Chamber Construction

Broken block

Landfill

Figure 59 Photographs of Sewerage System in Allahabad

23. Agaram PS and Sewerage System, Bengaluru (Karnataka)

(A) Outline of PS

The capacity of this pumping station is 65 MLD.

There are two mechanical screens. One screen is in operation while the other screen is under maintenance for alignment and adjustments. Since the amount of refuse that flows in is small, the screen is not operated periodically; when refuse accumulates, the screen is operated. The refuse screened out by the screen is collected in containers, and one container with refuse is transported to the landfill site every 10 days.

There are four vertical volute pumps (voltage – 415V), and all are in working condition. Until now, no major problems have occurred.

There is one diesel standby generator of 500 kVA. There is practically no power failure; the standby generator is hardly operated.

Screen

The shortage of chain adjustment of a conveyor belt

Inlet gate

Pump

Discharge valve is a electric type

Standby generator

Figure 60 Photographs of Facilities at Agaram Pumping Station in Bengaluru

(B) Outline of Sewage System

The sewer cleaning work is being implemented by the Bangalore Water Supply and Sewerage Board. Cleaning work is not carried out in a planned manner. It is carried out when there is a notification of clogging of sewer. The equipment used for cleaning sewers is high pressure jet nozzle, 7 to 8 m bamboo rods, etc. The cleaning workers do not wear gloves or helmets, but work wearing sandals only. There is a safety and hygiene problem.

All workers wear helmets when performing the work of installing man-holes in sewers of diameter 1,800 mm. However, the workers were wearing sandals or barefoot, and with bare hands when performing work. There is again a safety and hygiene problem.

High-velocity Jet Truck

Situation of Cleaning

Tool of Cleaning (Nozzle)

Tool of Cleaning (Bamboo Pole)

Manhole Construction

Manhole Construction

Manufacture of sewer pipe

Lining of sewer pipe

Figure 61　Photographs of Sewerage System in Bengaluru

24. Purasawalkam PS and Sewerage System, Chennai (Tamilnadu)

(A) Outline of Pumping Station

This pumping station commenced operation in 2007. It pumps wastewater to the Kodungaiyur STP. The capacity of this pumping station is 90 MLD.

The two mechanical screens were not in working condition. The screens and the refuse conveyor were severely corroded; they are to be completely replaced and not repaired.

All the three submersible sewage pumps can be operated. The receiving voltage is 11 kV; this is stepped down to 433 V and used for operating the pumps.

There is one diesel standby generator of 800 kVA. Power failures occur on an average ten times a month. The time for operating the standby generator is several minutes to about one hour.

Inlet chamber

The corrosion of a screen is intense

Suction well

Leakage of water from a valve

Broken electromagnetic flowmeter

Standby generator

Figure 62 Photographs of Facilities at Purasawalkam Pumping Station in Chennai

(B) Outline of Sewage System

The sewer cleaning work is being performed by the Chennai Metropolitan Water Supply & Sewerage Board. Cleaning work is not carried out in a planned manner. It is carried out when there is a complaint related to clogging of sewer. The equipment used for cleaning sewers is high pressure jet nozzles, buckets, etc. The cleaning workers do not wear helmets, but work wearing sandals only. This is a safety and hygiene problem.

High-velocity Jet Truck

Situation of Cleaning

Worker

Bucket (manual)

Bucket Car

Bucket

Figure 63 Photographs of Sewerage System in Chennai

25. Kulgaon-Badlapur (Maharashtra)

(A) Outline of Sanitation Practices

The town has a population of about 0.25 million with a water supply of about 34MLD. About 20MLD of wastewater is estimated to generate. There is no existing collection and treatment system for generated wastewater.

At present, part of the generated wastewater is handled using onsite sanitation facilities. In many cases septic tanks is used. However, about 30-40% of wastewater goes directly to the nearest drains, which finally discharges into River Ulhas.

Visit was made to septic tank used at Adarsh College. In college, there are 11,000 students and about 1,000 students use toilet every day. The toilets are of no-smell type. The urine and faces are collected separately. Provision is also there for collection of biogas. However, the biogas is still not used. Urine is diluted and used for plantations.

At present, for centralized wastewater collection and treatment, STP with capacity of 22MLD is proposed to be constructed along with collection system. Treatment process of SBR has been

selected. In the town, 5 pumping stations are to be provided for 5 sewerage zones. Also, 83kms of collection system is planned to be provided. SCADA will be used for operation. Operation and maintenance will be on turnkey basis for 3 years. The municipality will appoint engineers and during 3 years of operation and maintenance by the contractor, these engineers will be trained.

Urine collection tank for treatment of human excreta

Excrement collection tank

Big Biogas Settler

Small Biogas Settler and Gas Pipe

Treatment Tank

Effluent

Figure 64 Photographs of Facilities at Onsite System in Kulgaon-Badlapur

26. Onsite in Bengaluru

(A) Outline of Onsite sanitation facilities

This onsite sanitation facility receives the domestic wastewater which is generated by 60 persons of the nursing institution which NGO of Germany manages. The treatment capacity is 11.5 m^3 per day. Treated water and generated sludge are used effectively in order to grow vegetables and fruit. Maintenance management costs include repair of piping, gardener's salary, electricity cost of a pump that sends treated water to farmland, etc.

Main components of this facility are inlet chamber, digester, baffle reactor, and bio film process.

The retention time of the digester is 24 hours. Digester gas is used effectively as fuel, such as cooking. After the digester is cleaned once in three years, removed sludge is mixed with soil and dried for one year, and processed sludge is used effectively as manure.

Bio film process is covered with the macadam 60 cm in height. Inflow water flows into a 50cm part with a 4inch pipe from an upper end. Retention time is two days. In order to prevent generation of algae, the management in which the water surface does not go up to the macadam layer surface is required.

Typical value of water quality level is presented in Table 26 below.

Table 26 Water Quality Level at Onsite Facility in Bengaluru

Parameters	Influent	Baffle Reactor	Effluent
BOD (mg/l)	60-100	30-40	10-15

Similar project at 230 places is carried out in India. About 400 facilities of the same institutions

are working. When introducing in a city area, examination of the sludge disposal method is needed.

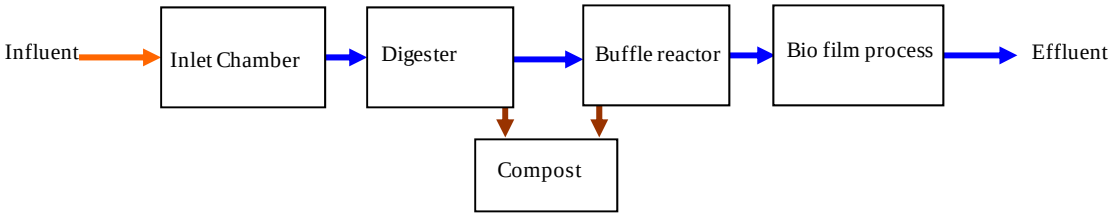


Figure 65 Schematic Diagram of Process Flow at Onsite in Bengaluru

Inlet Chamber

Treatment Tank

Biological aerated filter

Effluent

Effluent is stored for horticulture

Biogas is Used for cooking

Figure 66 Photographs of Facilities at Onsite System in Bengaluru