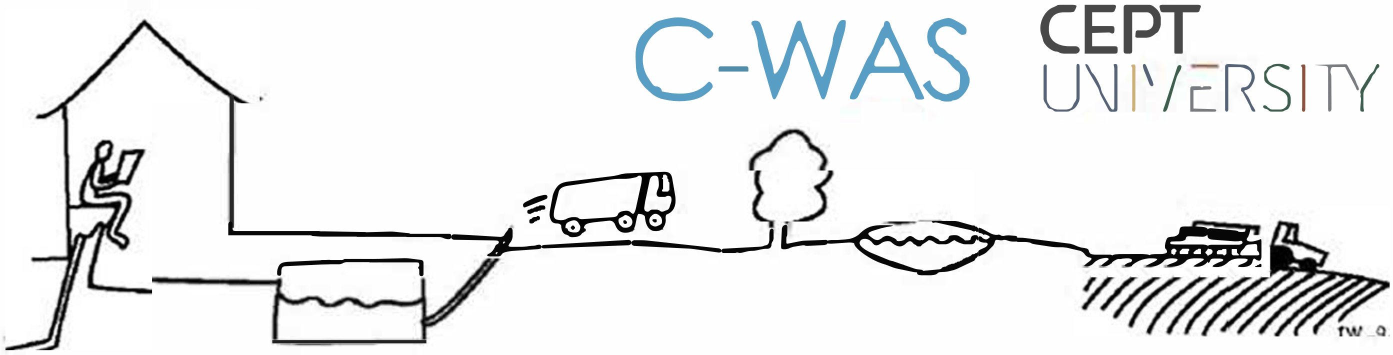
Training ON Faecal Sludge and Septage Management

Options for Septage Treatment

Prepared for
Sanitation Capacity Building Platform of
National Institute of Urban Affairs (NIUA)
August 2017

C-WAS

CEPT UNIVERSITY



1.1 BACKGROUND

Most cities in India do not have a networked sewerage system, and those which have a sewerage system do not have full coverage or adequate wastewater treatment facilities. On-ground reality points towards wide prevalence of on-site sanitation systems. However, poor regulation and absence of monitoring of on-site systems at local level has resulted in unsafe disposal of grey and black water.

According to the National Urban Sanitation Policy of Government of India (GoI), one of the policy goals is integrated city wide sanitation which includes safe and sanitary disposal of 100% human excreta either through conventional or non-conventional means. Also advisory on septage management by MoUD recommends periodic desludging of septic tanks, adequate and safe transportation of septage and its proper treatment before reusing the septage.

1.2 OUR STUDY

Various types of options are available for the treatment of Septage. Each option have their own advantages and disadvantages. Hence care should be taken while selecting an appropriate option for the treatment of Septage based on local site conditions, level of treatment required, cost factor, expertise for construction and operation, etc. Comparing various options will provide better idea for selection of suitable treatment technology.

While reviewing various options for the Septage treatment, it was observed that treatment options could broadly be divided into two types . One is from Septage to Compost and another is from Septage to Energy.

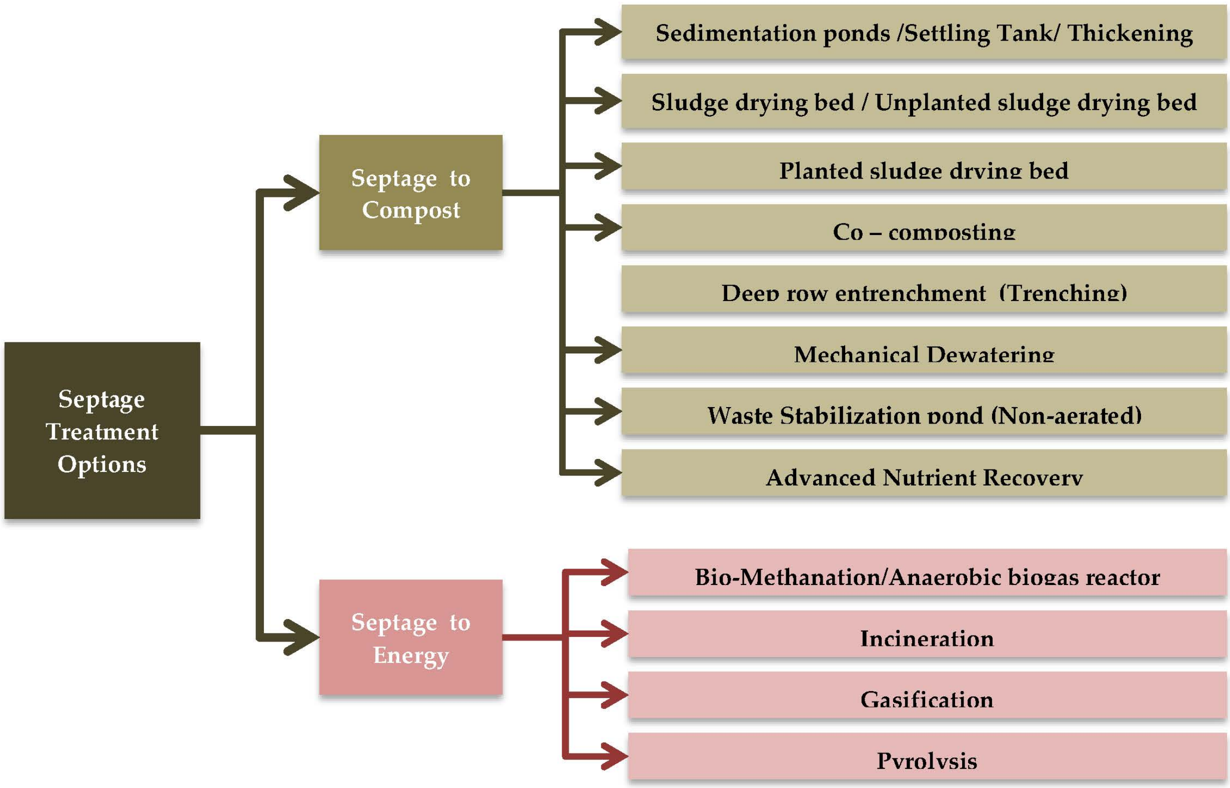
1.2.1 Septage to Compost

This option details out various technologies for conversion of Septage to dried sludge. Dried sludge can be used as Compost for agriculture purposes. Compost from Septage can be used as a soil amendment to reclaim land or can be used in landscaping or horticulture. Treatment options vary from simple technology to advanced hi-end technology.

1.2.2 Septage to Energy

This option describes technologies available for conversion of Septage to Energy. Septage is a source of energy because of presence of high organic matter. Various technologies are developed across the world for conversion of Septage to different forms of Energy like bio-gas, heat, bio-char, bio-oil, etc. Such energy can be used in production of Electricity, heat and as transportation fuel. Thus waste is converted to valuable asset through these technologies.

Figure 3: Different types of Septage treatment options



1.3 COMPARISON OF TREATMENT OPTIONS

1.3.1 Septage to Compost

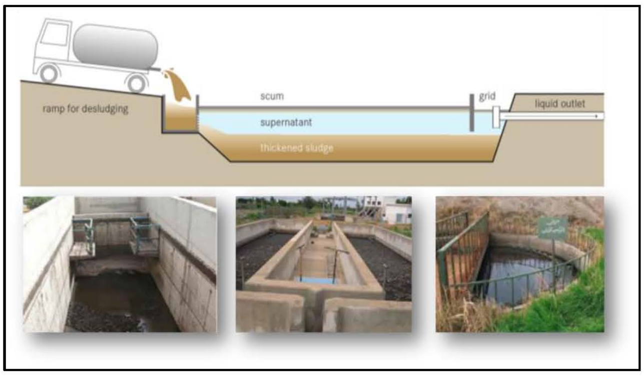
Different considerations are taken into account while comparing treatment options from Septage to compost which are detailed out below.

1.3.1.1 Technical Description

1. Sedimentation ponds /Settling Tank/ Thickening ponds

Sedimentation or Thickening Ponds are simple settling ponds that allow the sludge to thicken and dewater. The effluent is removed and treated, while the thickened sludge can be treated in a subsequent technology. Settling tanks provide a liquid retention time of a few hours (enough to ensure quiescent settling of settleable solids).

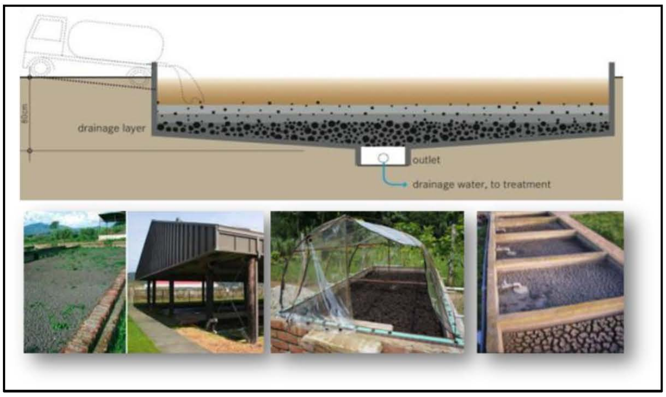
Figure 4: Sedimentation ponds /Settling Tank/ Thickening ponds



Here Input is faecal sludge and output is dried Septage and effluent,which can be used in agriculture, arboriculture and pastures. This treatment option can be coupled with sludge drying bed or co-composting for treatment of thickened sludge. It can be implemented at neighbourhood level or city level. This technology is affected by seasonal changes and can be efficiently used in hot and temperate climate.

The discharging area must be maintained and kept clean. The thickened sludge must be removed mechanically when the sludge has thickened sufficiently. Septage and effluent may require further treatment.

2. Sludge drying bed / Unplanted sludge drying bed

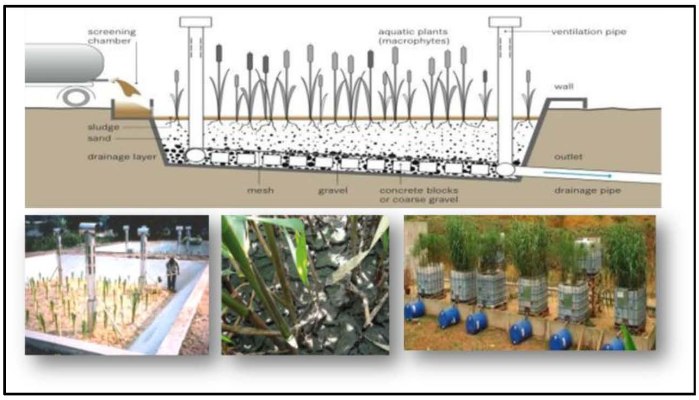


An Unplanted sludge Drying Bed is a simple, permeable bed that, when loaded with sludge, collects percolated leachate and allows the sludge to dry by evaporation. Approximately 50% to 80% of the sludge volume drains off as liquid. The bottom of the drying bed is lined with perforated pipes that drain away the leachate. On top of the pipes are layers of sand and gravel that support the sludge and allow the liquid to infiltrate and collect in the pipe.

In this technique input is faecal sludge and output is treated sludge and effluent, which can be used in agriculture, arboriculture and pastures. It can be implemented at neighbourhood level or city level. This technology is affected by seasonal changes and can be used in hot and temperate climate. Excessive rain may prevent the sludge from proper settling and thickening.

Dried sludge must be removed every 10 to 15 days. Sand must be replaced when the layer gets thin. Treated Septage and leachate may require further treatment based on output quality.

3. **Planted sludge drying bed**



Planted sludge Drying Bed is similar to an Unplanted sludge Drying Bed with the benefit of increased transpiration. The key feature is that the filters do not need to be desludged after each feeding /drying cycle. Fresh sludge can be applied directly onto the previous layer; it is the plants and their root systems that maintain the porosity of the filter. The roots of the plants create pathways through the thickening sludge to allow water to escape more easily.

In this technique input is faecal sludge and output is treated sludge and effluent, which can be used in agriculture, arboriculture, pastures(to grow cattle fodder). It can be implemented at neighbourhood level or city level. It is affected by seasonal changes.
The drains must be maintained and the effluent must be properly collected and disposed off. The plants should be periodically thinned and/or harvested. Treated Septage and Leachate may require further treatment based on output quality.

4. **Co-composting**

Co-Composting is the controlled aerobic degradation of organics using more than one feedstock. Faecal sludge has a high moisture and nitrogen content while biodegradable solid waste is high in organic carbon and has good bulking properties. There are two types of Co-Composting designs: open and in-vessel. A Co-Composting facility is only appropriate where there is an available source of well-sorted biodegradable solid waste. Mixed solid waste with plastics and garbage must first be sorted.

In this technique input is faecal sludge and biodegradable organic solid waste and output is compost which can be use in agriculture, arboriculture and pastures. It can be implemented at neighbourhood level or city level. It is affected by seasonal changes and depending on the climate (rainfall, temperature and wind) the Co-Composting facility can be built to accommodate the conditions. At places where there is heavy rainfall covered facilities are especially recommended.
Careful monitoring of the quality of the input materials & keeping track of the inflows, outflows, turning schedules, and maturing times is required to ensure a high quality product. Turning must be done periodically.

5. **Deep row Entrenchment (Trenching)**

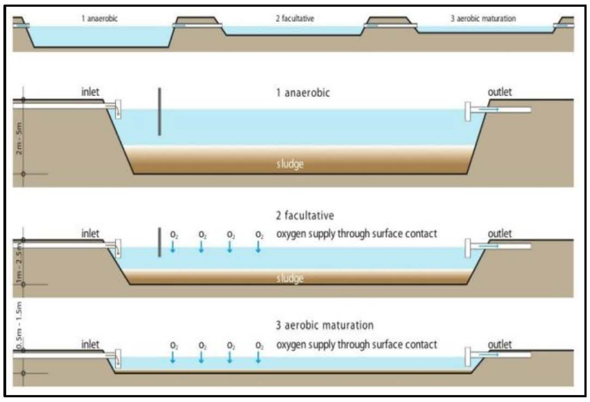
It consists of digging deep trenches, filling them with sludge and covering them with soil. Trees are then planted on top, which benefit from the organic matter and nutrients that are slowly released from the FS. Availability of land & distance to groundwater and surface water bodies are the main constraints. This technology is feasible in areas where the water supply is not directly obtained from the groundwater.

6. **Mechanical Dewatering**

Mechanical dewatering is normally associated with large wastewater treatment plants and is used to separate sludge (residual sludge from wastewater treatment plants or faecal sludge from on-site sanitation) into a liquid and solid parts. These techniques are usually sophisticated and costly for smaller systems to be implemented at community level. The process does not treat the sludge, it only separates solid from liquid parts. Both solid and liquid parts still contain pathogens and pollutants and further treatment is necessary. Mechanical parts need periodical inspection and replacement.

In this technique input is faecal sludge and output is black water, organic solid waste, compost/biosolids which can be use in agriculture, arboriculture and pastures. It requires to be coupled with co-composting or incineration treatment technique. This technology is not affected by seasonal changes as it entirely depends on mechanical process.

7. **Waste Stabilization Pond (Non - aerated)**



WSP comprises pre-treatment units (tanks or ponds) for solid-liquid separation followed by a series of one or more anaerobic ponds and one facultative pond.

A number of problems may arise where waste stabilisation ponds are used to treat municipal wastewater and co-treat FS. In many instances, the problems are linked to the fact that the wastewater ponds were not originally designed and equipped to treat any additional FS load.

In this technique input is faecal sludge and output is sludge & effluent, which can be use in agriculture, arboriculture, pastures, ground water recharge in deep aquifer and in desert areas. It requires to be coupled with co-composting or sludge drying bed. It can be implemented at neighbourhood level or city level. This technique is affected by seasonal changes.

As per sanitation experts and review of various technical documents, it was analysed that waste stabilization pond is good option for treatment of wastewater but not a good option for treatment of Septage.

8. **Advanced nutrient recovery**

Wastewater, municipal sludge or the ash after drying, which is incinerated or disposed of, can be a very rich source for nutrients, in particular phosphorus and nitrogen. There is a wide range of promising technologies emerging which can convert septage to phosphorus and nitrogen. Some of these techniques are still not fully developed. These technologies are expensive and require engineering knowledge to guarantee a sustainable and long-term operation of the facility.

In this technique blackwater, faecal sludge and grey water is converted to fertilizer and treated waste which can be use in agriculture, arboriculture, pastures, ground water recharge in deep aquifer and desert areas. This technique cannot be implemented on neighbourhood or small level. It has to be implemented on city level as it is highly expensive technique.

1.3.1.2 Simplicity in Construction & Operation

Sr No	Technologies / Parameters	Sedimentation ponds /Settling Tank/ Thickening ponds	Sludge drying bed / Unplanted sludge drying bed	Planted sludge drying bed	Co - Composting	Deep row entrenchment	Mechanical Dewatering	Waste stabilization pond (Non - aerated)	Advanced nutrient recovery
1	Expertise for design	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
2	Built with Local materials	Yes	Yes	Yes	Yes	Yes	No	Yes	No
3	Expertise for construction	No	No	No	No	No	Yes	Yes	Yes
4	Expertise for operations	No	No	Yes	No	No	Yes	Yes	Yes

Inferences:

- Expertise is required while designing various options based on site conditions, volume of Septage to be treated, etc.
- Mechanical dewatering & advanced nutrient recovery are hi-tech technologies which require advanced machineries for its construction. Hence these two treatment options cannot be built with local materials. Rest all other options can be built with locally available materials.
- Sedimentation ponds/thickening ponds, unplanted sludge drying bed and Co-Composting technologies do not required expertise for their operations.
- Thus while comparing various options from the considerations of simplicity in construction and operation, Sedimentation tank/settling tank/thickening pond, Unplanted sludge drying bed, Co-Composting & Deep row entrenchment options seems to be more preferable.

1.3.1.3 Financial Parameters

Sr. No	Technologies / Parameters	Sedimentation ponds (SP) /Settling Tank (ST)/ Thickening ponds	Sludge drying bed / Unplanted sludge drying bed	Planted sludge drying bed	Co - composting	Deep row entrenchment	Mechanical Dewatering	Waste stabilization pond (Non - aerated)	Advanced nutrient recovery
1	Capital cost	Low	Moderate	Moderate	Low	Low	High	Variable	Very High
2	Land required	High	Moderate to High	High	High: cold climates, average : warmer climates	High	Low	High	Low
3	O & M cost	Low	Low to Medium	Low	Low	Low	High	Low	Very High
4	Resting period (i.e No. of days / months / years)	SP : 8-12 Months; ST: 2-4 months	10-15 days	2-3 years / 5-6 Years	6-8 weeks	-	-	Anaerobic ponds - 1 to 7 days Facultative ponds - 5 to 30 days	-

Inferences:

- While comparing various financial parameters of all the treatment options, unplanted sludge drying bed and co-composting treatment seems to be most viable options. These options are followed by sedimentation ponds & planted sludge drying bed with moderate land requirement because of high resting period. For the areas where land is not easily available, mechanical dewatering or advanced nutrient recovery treatment options can be adopted but with higher capital and O&M cost.

1.3.1.4 Advantages, Disadvantages & Prevalence

Sr. No.	Description	Advantages	Disadvantages	Prevalence in India/Abroad
1	**Sedimentation ponds /Settling Tank/ thickening ponds**	• Can be built with local available materials • Low capital and operating cost • No energy requirement • Great plus is after sedimentation, sludge is used for agriculture / tree plantation.	• A major minus is the smell, especially if fresh undigested Septage is coming from public toilets. • Large land requirement • Post treatment required for both solid and liquid effluent through SDB or Co-composting	Accra/Ghana & Bangkok, Alcorta (Argentina)
2	**Sludge drying bed / Unplanted sludge drying bed**	• No energy requirement • Can be built with local available materials • Moderate capital cost and low capital cost	• Requires large area • Odour problem • Only applicable during dry seasons or needs a roof during rainy season	Punjab (100 villages) World Bank Project; Accra, Ghana, USA , Dakar, Senegal, Malaysia
3	**Planted sludge drying bed**	• Can handle high loading • Low capital cost; low operating cost • No energy requirement • Widely used by DEWATS for sewage treatment; could as well be used to treat Septage after diluting by mixing with sewage.	• Requires large land area • Long storage time • Requires expert design and operation • Leachate requires secondary treatment • Large de-sludging cycle hence larger area required • More capital and O&M cost as compared to unplanted SDB	Europe, USA, Thailand, Dakar Senegal, Africa
4	**Co - Composting**	• Best combination of cheap bio-technology and agriculture • Good choice for most Indian hot weather cities. • Low capital & operating cost • Easy to set up and maintain and can be built with local materials • No energy requirement	• Requires large land area • Requires segregated organic waste • Long storage times • Operational issues in terms of constant mixing required	Massachusetts, U.S.A; Kalpabriksha Compost Plant in Kathmandu, Bangladesh. Till recently in Dhrangadhra, Gujarat and Barshi, Maharashtra.
5	**Deep row entrenchment (Trenching)**	• No expensive infrastructure or energy required • Odours are eliminated. • Risk of exposure to pathogens is reduced	• Large land requirement • Not feasible where GW is high	China, south-East Asia, Africa
6	**Mechanical Dewatering**	• Reduces volume of sludge • Process can be fully automated	• Constant power supply required • Need expert design • Both dewatered sludge and effluent requires post treatment	
7	**Waste stabilization pond (Non - aerated)**	• No energy requirement • Low O&M cost	• Not a good option for treatment of Septage alone	

Sr. No.	Description	Advantages	Disadvantages	Prevalence in India/Abroad
			• Requires wastewater for process to work • Requires large area • Requires expertise for design and operation	
8	**Advanced nutrient recovery**	• Recovery of nutrients • Effluent requires no further treatment • Production of fertiliser	• Highly expensive technology • Requires expert knowledge • Some processes are still in development stage • Not proven technology • Sludge requires further treatment	In Bangalore (under operation) in 2 extended aeration STPs of BWSSB, septage is received at inlet chamber. DEWATS in their Bangalore campus are running a septage treatment plant of 3 cum capacity In Kerala in 4 cities new STPs being built are designed to receive septage at their inlet chamber.

1.3.2 Septage to Energy

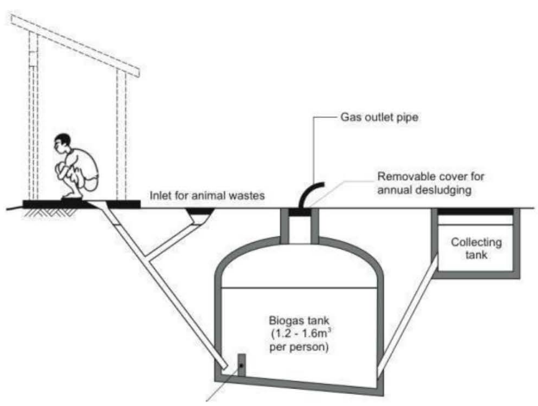
Various considerations taken into account while comparing treatment options for conversion of Septage to Energy are detailed out below.

1.3.2.1 Technical Description

1. Bio-Methanation/Anaerobic biogas reactor

In this treatment technology there is microbes driven anaerobic decomposition of organic components from faecal sludge to biogas. Faecal sludge & organic solid waste is converted to Treated sludge, effluent and Biogas. Pre-treatment of sludge is required but not compulsory. To start the reactor, active sludge (e.g. from a septic tank) should be used as a seed. The tank is essentially self-mixing, but it should be manually stirred once a week to prevent uneven reactions. However once stable state reached, stirring not essential. Gas equipment should be cleaned carefully and regularly so that corrosion and leaks are prevented. Grit and sand that has settled to the bottom should be removed once every year. Bio-Methanation/Anaerobic biogas reactor option is popularised by Sulabh organization in India.

Figure 5: Bio-Methanation/Anaerobic biogas reactor



Advantages:
- Established and mature technology.
- Best suitable for wastes with high moisture content.
- Technology could be optimized for any scale.
- Considerable reduction in the emission of greenhouse gases like methane is possible.

Disadvantages:
- There are concerns with odour and pathogen dissemination from the digestate.
- Issues are there in controlling microbial activity if the digester is beyond a certain size.
- Affected by temperature; less efficient in colder climates

2. Incineration

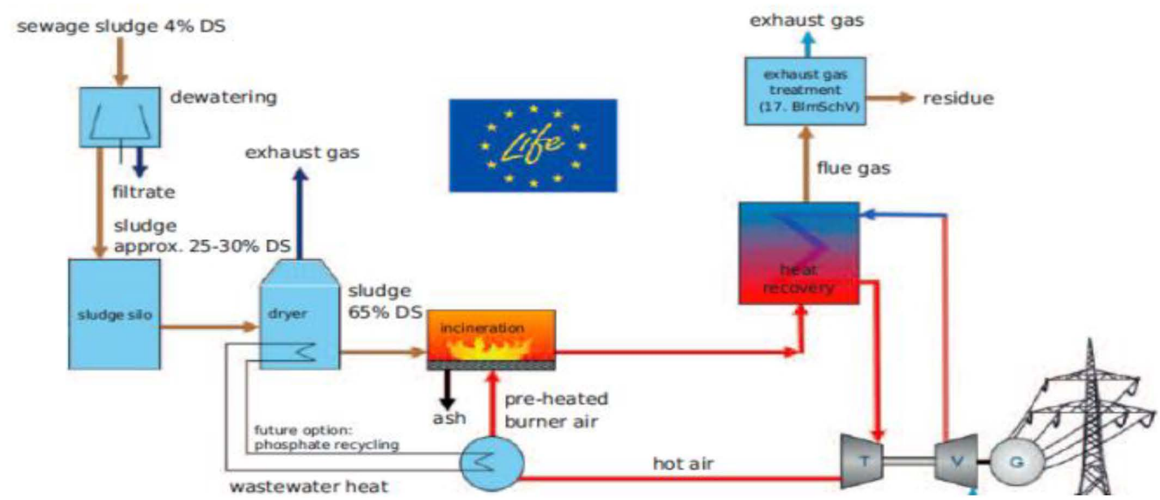
In Incineration treatment option there is oxidation of organics in the sludge under the conditions of complete aeration or oxygenation and requires high temperature. Incinerators are a useful technology to combust household waste, medical waste, slaughter waste, etc. instead of discharging it in a landfill. Furthermore, heat and energy may be recovered and it helps to avoid open burning of municipal waste which creates much more harmful emissions and endanger human health and environment. In this treatment sludge is converted to heat. Drying of sludge is required prior to treatment in incinerators. This technology requires trained operators. There is risk of malfunction if not properly maintained and operated. Requires high quantum of electrical energy.

Advantages: Incineration is relatively effective technology for treating all kinds of wastes.

Disadvantages:

- Liberates considerable amounts of emission
- Sludge incineration costs are not attractive to be used in India
- Sludge incineration is not proven in India

Figure 6: Incineration



3. Gasification

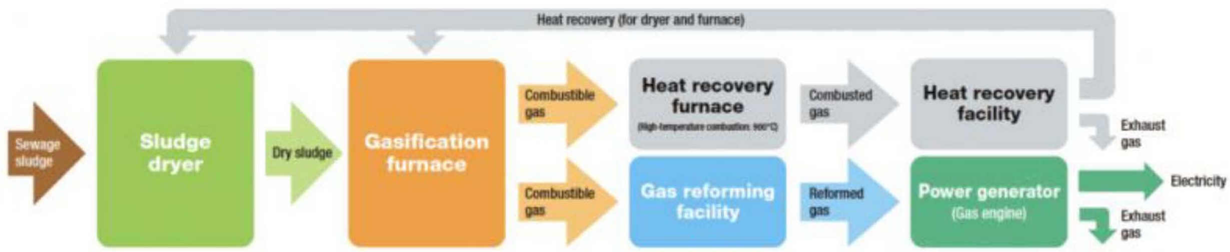
In Gasification treatment technology there is thermal transformation of organic mass under limited supply of air/oxygen to Syngas. In this technology sludge is converted to Syngas & Biochar. Drying of sludge is required prior to treatment in incinerators. This technology also requires trained operators and there is risk of malfunction if not properly maintained and operated.

Advantages: Technology best suitable for dry feedstocks. The produced gas can be converted into any type of fuel by FT synthesis.

Disadvantages:

- Gasification of faecal sludge is a relatively new concept in India.
- Process is very energy intensive, as wet feedstock cannot be used directly in a gasifier.
- The process is economically less viable.

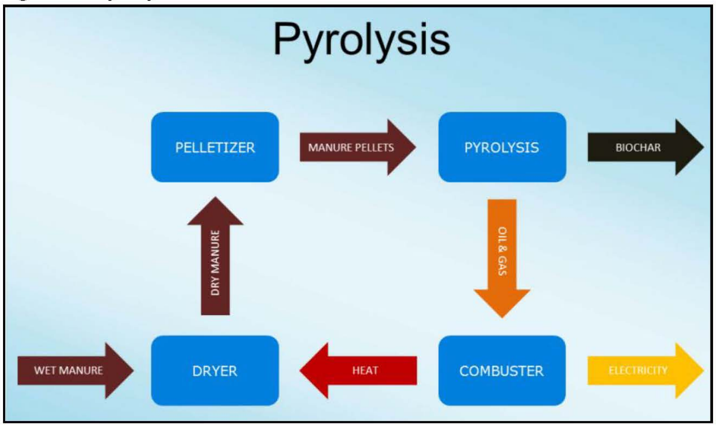
Figure 7: Gasification



4. Pyrolysis

In pyrolysis treatment technology there is thermal conversion of carbonaceous materials in sludge to produce complex oil in the absence of air/oxygen. In this technology sludge is converted to Bio-oil, Pyrolytic Gas and Bio-char. Here also drying of sludge is required prior for treatment in incinerators. This technology requires trained operators and there is risk of malfunction if not properly maintained and operated.

Figure 8: Pyrolysis



Advantages: Energy recovery efficiency is high.

Disadvantages:

- Pyrolysis has been attempted only for the treatment of plastic and related feedstocks so far.
- This process is also energy intensive like gasification, as more energy is needed to dry feedstock.
- High capital and operational costs make the process economically less viable.

1.3.2.2 Energy Requirement and Recovery

Sr. No	Technologies	Bio-Methanation/ Anaerobic biogas reactor	Incineration	Gasification	Pyrolysis
1	**Operational Energy Demand**	Limited (Except for advanced sludge pre-processing methods)	High	Very High	High
2	**Energy Recovery Efficiency**	50-70%	50-60%	70-80%	70-80%
3	**Energy Product and its applications**	Methane as a fuel for heat, electricity and transport Compost-Soil fertilizer	Electricity or heat from hot steam/air	Syngas - As fuel for heat and electricity	Pyrolytic oil as industrial fuel in boilers. Char as solid fuel for heat production in furnaces and medium for soil amendment

Inferences:

- From the above table, it can be observed that energy requirement for operation is least in Bio-Methanation process and maximum in gasification process.
- Efficiency of energy recovery is comaratively low in incineration and bio-Methanation process and high in Gasification and pyrolysis process.
- However, in India only proven technology for sludge to energy is bio-Methanation. Incineration technique is mostly used for treatment of bio-medical wastes and not for sludge treatment.
- Gasification and pyrolysis are new techniques and still not proven for treatment of sludge & energy recovery in India.

1.3.2.3 Financial Parameters

Sr.No	Technologies	Bio-Methanation/ Anaerobic biogas reactor	Incineration	Gasification	Pyrolysis
1	**Capital cost**	Medium-High	Medium-High	High	High
2	**O&M Cost**	Medium-High	Medium-High	High	High
3	**Land Requirement**	Low (Underground Construction)	Less	Less	Less

Inferences:

- From the financial analysis of all the treatment options, it can be analysed that Gasification and pyrolysis are most expensive technologies because of high capital and O&M cost.
- Bio-Methanation and Incineration options are less costly compared to other options.
- In terms of land requirement, all the treatment options require less area.
- From the point of economic/commercial viability, Bio-Methanation is most viable option in India whereas viability of Gasification and pyrolysis is still not proven in India.

1.3.2.4 Environmental Parameters

Waste disposal from Bio-Methanation/ Anaerobic biogas reactor is complete but environmental concerns like odour and pathogens dissemination from stabilized sludge are present. Treatment options through incineration have critical issues like ash disposal and regulated emissions of toxic organics and flue gases. Gasification faces limitations because of ash discharge and emission of toxics, heavy metals etc. In pyrolysis there is a minor constraint with handling of char and ash.

1.4 WAY FORWARD

Thus looking at various options and comparing them from various perspectives, one can select proper treatment technologies according to the prevailing local site conditions. However, looking at various parameters considered above and considering ideal site conditions, treatment technologies such as Unplanted sludge drying bed, Co-composting and Bio-Methanation seem to be most viable options.

1.5 CASE STUDIES

Septage Treatment Plant, Faridpur, Bangladesh

Location

Faridpur town is located in Faridpur Sadar subdivision of Faridpur District in the Division of Dhaka, Bangladesh. The town is located near the banks of the Padma River at 23.6°N latitude and 89.8°E longitude.

Demography	
Population	0.15 Million
Population Dependent on onsite sanitation systems	100%

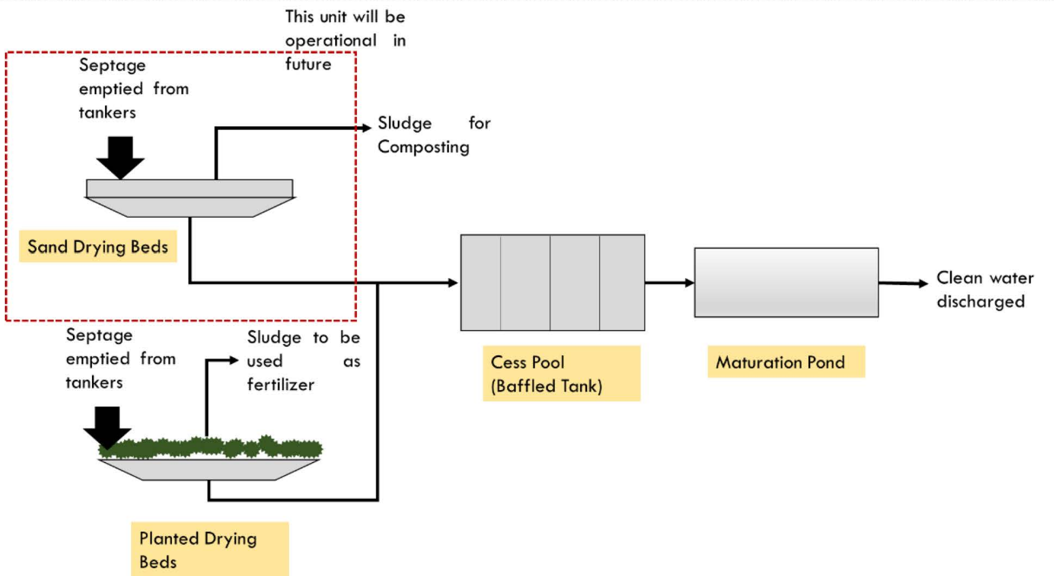
Plant details	
Treatment Capacity	24 m3/day
Year of Commissioning	October 2016
Operating capacity	10 m3/day
Area	6070 sqm

Climate	
Average Temperature	25 C
Average Annual Rainfall	1,127 mm
Average ground water level	3 m bgl

Influent/ Effluent Characteristics

Parameter	**Inflow**	**Outflow**
pH	*7.31*	*not tested*
TSS (As percentage)	*not tested*	*not tested*
BOD (mg/L)	*1860*	*not tested*
COD (mg/L)	*9061*	*not tested*

Treatment process description



Dimensions of Units		
Name of unit	**Number of unit**	**Size of unit**
Planted drying bed	12	8m X 8m
Unplanted drying bed	16	10.75m X 3.75m
Cesspool	6	7m X 6m
Maturation pond	1	12.20m X 10.28m

Process Description

In the present process, septage is emptied through tankers in planted drying beds. The collected sludge in the planted drying bed would be used as fertilizer. The permeate from the planted filter goes to the cesspool. Cesspool is a baffled tank which provides sufficient time to the wastewater for further treatment. The discharge from the cesspool is sent to the maturation pond for further polishing treatment. The water from the maturation pond is discharged in the nearby water body.

Finance, Operation and Maintenance

Name of the Agency operating the faecal sludge treatment plant	Society development committee	**Operations and Maintenance expenditure**	7500 USD for Stuff salary and shed changing of unplanted drying bed/ annum
Cost of Construction (Year of construction)	USD 3,75,000 (2016)	**Source of O & M expenditure**	By public private partnership model (Faridpur municipality and society development committee)
The source of funds for capital costs	UK Aid	**Persons required or employed**	One (Agriculturist) permanent and four stuff day basis

Sources

1. Google maps
2. Faridpur Sadar website
3. Practical Action, Bangladesh

FSTP Devanhalli, Karnataka

Location

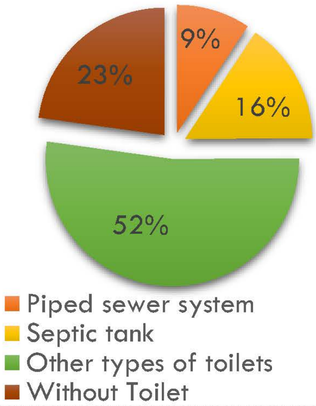
The Town Municipal Council (TMC) Devanahalli was constituted in 1938. It is situated along Bangalore - Hyderabad National Highway No.7 at a distance of 34 Kms from Bangalore. The town is located at 13 15’ 0.6” N and 77 42’ 25.7” E.

Demography (Census 2011)

Parameter	Value
Population	28,051
Households	6,400
Area	15.94 sq km
Density (persons/ sq km)	1,760
Sex Ratio	961
Literacy Rate	71.3 %

Sanitation Infrastructure in Devanahalli

As per the Census of India 2011, only 9 % of the households have access to piped sewer network. 68% of the Households depend on onsite sanitation systems. 16% of them have toilets connected to septic tanks while 47% have VIP type toilets. Hence management of fecal sludge becomes a critical issue for the Town Municipal Council.

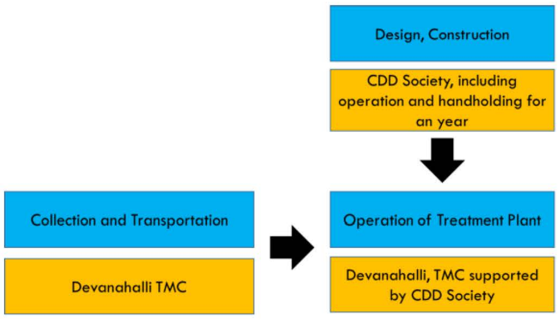


Project Background

Devanahalli is part of the greater Bangalore urban agglomeration. Bangalore and the vicinity has a large dependence on onsite sanitation. Devanahalli in particular has a large proportion of onsite treatment systems. With the support of active municipal council and the Bill and Melinda Gates foundation, it was decided to develop and demonstrate India’s first faecal sludge management plant. The CDD society and the municipal council conceptualized the project. The municipal council provided the land for the faecal sludge treatment plant (FSTP), the CDD society designed and commissioned the plant while the Bill and Melinda Gates foundation funded the project.

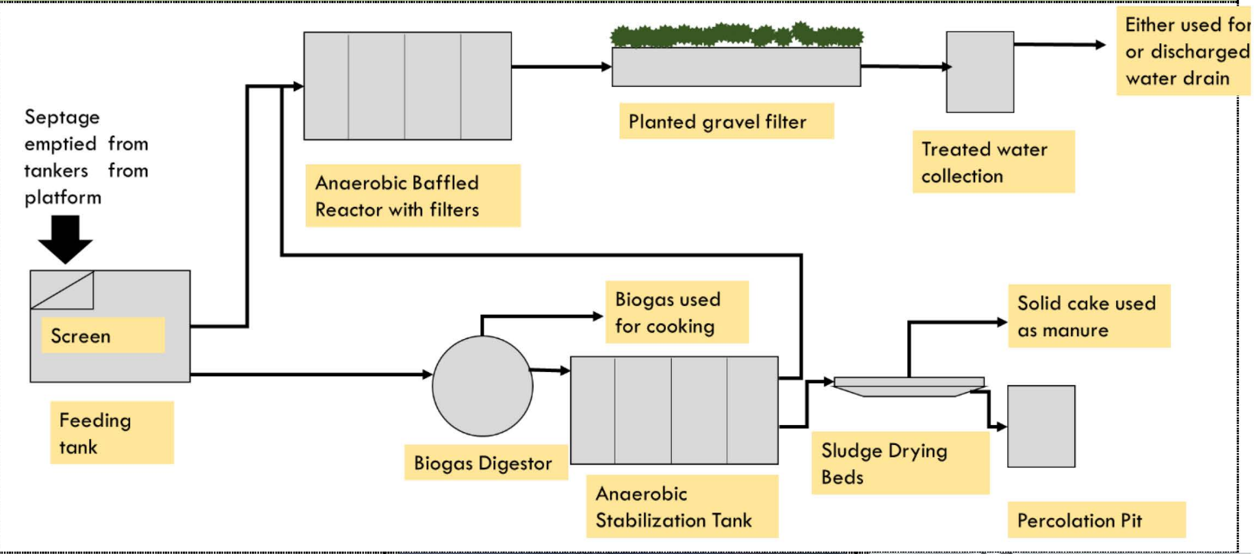
Stakeholder and Responsibilities

At present the FSTP is being maintained by the CDD society. They have a contract to design, construct and train the operator for an year. The fecal sludge is transported through trucks owned bty the TMC Devanahalli.



		Description of Technology
Plant Capacity	6 m3/day	The FSTP at Devanahalli incorporates the unit processes of DEWATS. The treatment technology mainly focuses on anaerobic digestion of the organic components in the faecal sludge. For the treatment of the supernatant liquid, after settling, a combination of anaerobic baffled reactor and anaerobic filter is used followed by the planted gravel filter. For the treatment of solids, biogas digester is primarily used followed by stabilization tank. The liquid portion from the stabilization tank flows into the anaerobic baffled reactor and the solids are sent to the sludge drying bed.
Current volume handled	3-4 m3/day	
Year of Commissioning	November 2015	

Process flow Diagram



Fecal sludge being discharged

Screen inside feed tank

Feed Tank

Sludge drying beds

Stabilization tank

Overview of plant

Process Description

The honey sucker trucks discharge the solids, collected from pits and septic tanks, through a screen into the feed tank. The operator of the FSTP ensures the screen is clean. The screenings are stored in a plastic container and disposed with municipal solid waste once the container is full. The faecal sludge is stored in the feeding tank for 3-4 hours which causes separation of liquid and solid layers.

The liquid part of the faecal sludge is discharged first into the anaerobic baffled reactor. The anaerobic baffled reactor in FSTP is combination of settler, anaerobic baffled reactor and anaerobic filter with two compartments for settler, four compartments of baffled reactor and two compartments of anaerobic filter. The treated liquid from the anaerobic baffled reactor is then polished through the planted gravel filter and stored in collection tank. The water from the collection tank is used for gardening, or discharged in storm water drains.

The solids from the feed tank are discharged in biogas digester. The gas generated by the digester is used for cooking by the operator of the plant. The digested solids are sent to the stabilization tank. The purpose of the tank is to hold and stabilize the effluent. The stabilized solids are then sent to the sludge drying beds. The dried sludge is sold to the farmers at Rs.1/ Kg.

Waste water Characteristics				Specific Requirements	
#	**Parameter**	**Influent**	**Discharge**	**Operating Conditions**	Daily parameters of input and oputput are checked. The level of stabilization tank is also checked to ensure proper functioning of the plant.
1	Chemical Oxygen Demand (COD) (mg/L)	60,000	<100	**Operational and Maintenance**	The plant requires regular testing of the influent and effluent. Also for proper functioning it is essential to desludge the ABR and Biogas Digester.
2	Biological Oxygen Demand (BOD) (mg/L)	28,941	<30	**Area**	625 sq m
3	pH	7.44	7.7	**Operation Cost (Rs.)**	3-4 lakh per year. The cost consists of labour charges for temporary jobs. This excludes the salary of the permanent operator.
				Capital Cost (Rs.)	70 lakhs er tank as per 2015 prices

Advantages

- The plant runs on gravity and hence does not use any electrical/ moving equipment like pumps.
- Reuse of biogas and resuse of sludge 1Rs./Kg

Limitations	Risks
• It is essential to ensure the continuous daily feed for the plant since it is a biological operation.	• Technical staff for operation of the plant.

References
• CDD Society. (2016, July 7). *Articles: CDD India*. Retrieved from CDD India website: http://www.cddindia.org/O&Mproject/articles.html • S, A. (2016, July 7). FSTP Plant. (T. Bose, Interviewer)

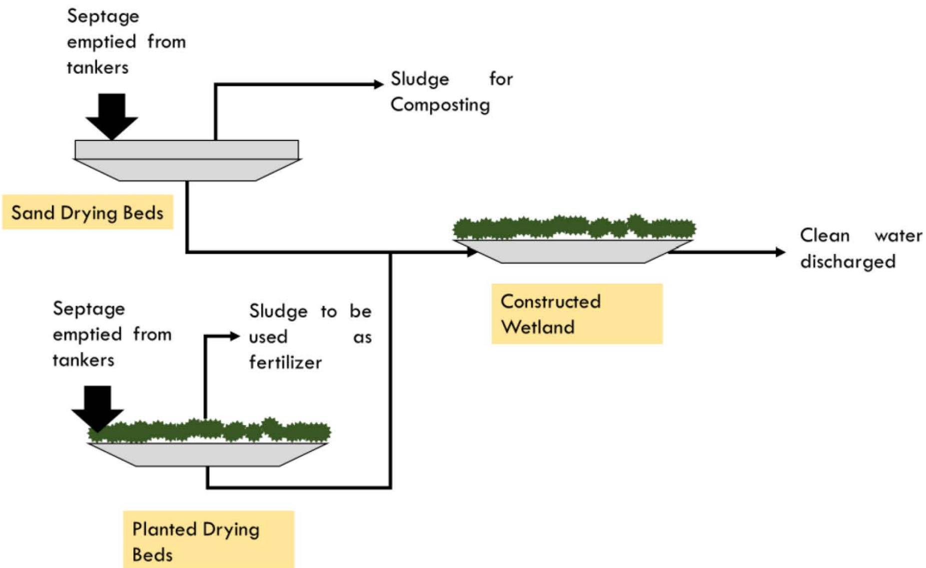
Septage Treatement Plant, Jhenaidah, Bangladesh

Location	
Jhenaidah town is located in Jhenaidah District in Khulna division. It is located at 23.5 N and 89.1 E. The area of the town is 39.63 sq km.	

Demography		Plant details	
Population	0.15 Million	**Treatment Capacity**	45 m3/day
Population Dependent on onsite sanitation systems	100%	**Year of Commissioning**	Not started
		Area	500 sqm

Climate		Influent/ Effluent Characteristics		
		Parameter	**Inflow**	**Outflow**
		pH	*NA*	*NA*
Average Temperature	30 C	***TSS (As percentage)***	*NA*	*NA*
Average Annual Rainfall	2000 mm	***BOD (mg/L)***	*NA*	*NA*
Average ground water level	1.5 m bgl	***COD (mg/L)***	*NA*	*NA*

Treatment process description



Process Description			
There are two parallel systems employed at Khulna. In the first process the waste is emptied from tankers in sand drying beds. The permeate of the sand drying beds is then sent to the constructed wetland. The sludge from the sand drying beds is sent for composting. From the constructed wetland the clean permeate is discharged. The sludge collected in the constructed wetlands takes considerably long time for accumulation. After the constructed wetland is filled with sludge, the sludge would be removed and sent for composting/further treatment or direct application. In the second process, the tankers are emptied into planted drying beds. The process is similar to the first process wherein the permeate is sent to the same constructed wetlands as the first process. The sludge from the panted drying beds here is used directly as fertilizer.			
Finance, Operation and Maintenance			
Name of the Agency operating the faecal sludge treatment plant	Jhenaidah Municipality	**Operations and Maintenance expenditure**	USD 150/month
Cost of Construction (Year of construction)	USD 1,00,000 (2016)	**Source of O & M expenditure**	Under discussion with municipality
The source of funds for capital costs	Bill & Melinda Gates Foundation	**Persons required or employed**	01 semi-skilled and 01 non skilled staff required.
Sources			
1. Google maps 2. Wikipedia, Jhenaidah-District-Town 3. SNV Netherlands Development Organisation			

Septage Treatment Plant, Khulna, Bangladesh

Location

Khulna is the 3rd largest city in Bangladesh. It is located on the banks of the river Rupsha and Bhairab & at the Southwest of the country. It is situated between 21.38' north latitude and 88.58 east longitude and is 12 ft above mean sea level

Demography

Population	1.5 Million
Population Dependent on onsite sanitation systems	100%

Plant details

Treatment Capacity	180 m3/day
Year of Commissioning	Not started
Area	6000 sqm

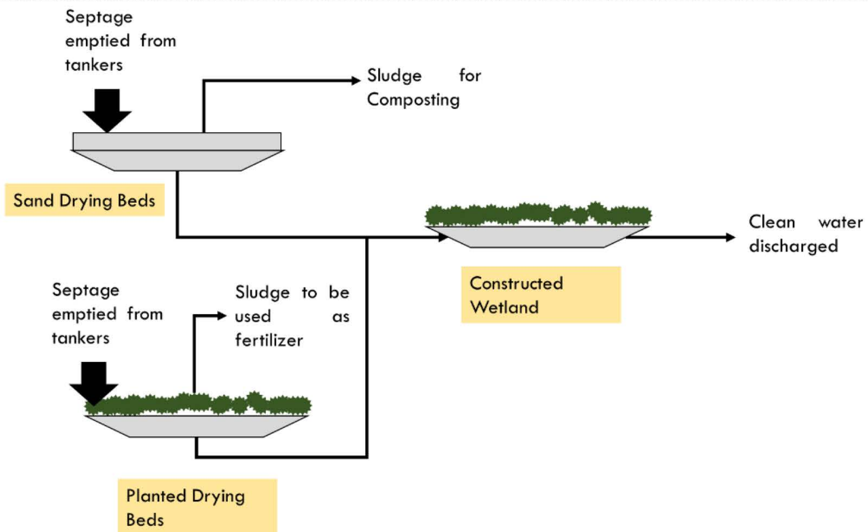
Climate

Average Temperature	30 C
Average Annual Rainfall	2000 mm
Average ground water level	1.5 m bgl

Influent/ Effluent Characteristics

Parameter	**Inflow**	**Outflow**
pH	*NA*	*NA*
TSS (As percentage)	*NA*	*NA*
BOD (mg/L)	*NA*	*NA*
COD (mg/L)	*NA*	*NA*

Treatment process description



Process Description			
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Finance, Operation and Maintenance			
Name of the Agency operating the faecal sludge treatment plant	Khulna City Corporation	**Operations and Maintenance expenditure**	USD250/month
Cost of Construction (Year of construction)	USD 2,00,000 (2016)	**Source of O & M expenditure**	Under discussion with municipality
The source of funds for capital costs	Bill & Melinda Gates Foundation	**Persons required or employed**	01 semi-skilled and 02 non skilled staff required.
Sources			
1. Google maps 2. Kulna City website 3. SNV Netherlands Development Organisation			

C-WAS

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About C-WAS and PAS Programme

Center for Water and Sanitation (C-WAS) at CEPT University carries out various activities – action research, training, advocacy to enable state and local governments to improve delivery of services. In recent years C-WAS has focused our work on urban sanitation. Indicators are developed for measuring on-site sanitation and a framework for citywide sanitation planning. C-WAS also supports cities in implementing city sanitation plans that focus on making cities open defecation free (ODF). In support of these efforts, the team is also working on developing innovative sanitation financing mechanisms.