2018

Faecal Sludge Treatment Technologies in India - Compendium

National Institute of Urban Affairs

Sanitation Capacity Building Platform

Why a Compendium?

Faecal Sludge Treatment Technologies in India - Compendium is an attempt to provide knowledge on a wide range of Faecal treatment technologies without bias and/or agenda, and helped to increase the recognition that a fully functioning sanitation value chain must link toilets to a treatment facility. With the increased coverage of toilets across the country under the Swachh Bharat Mission, it's imperative for the technological interventions for the management of Faecal waste – septage and sludge. It also presented resource recovery and reuse options as a necessary objective for the sustainable management of excreta.

The compendium is a collation of the information on the different Faecal sludge treatment technological options available in India and assessment of their performance considering the operational treatment plants in India. This compendium is a live document with updation as more FSTPs get operational. The Compendium presents technological options for treatment of Faecal sludge in India relating to its working principle, features, applicability, performance, strengths and challenges. It also focuses on the details of the installed locations covering the area requirement and costs incurred.

This Compendium plays the role of a reference tool for decision-makers, technologies and relevant stake-holders. Further, this Compendium is primarily focused on the non-sewered urban centres with Faecal sludge treatment being imperative and does not relate to the requirements for sewage treatment. Thereby, the technology information and costing of the technologies cannot be compared with the sewer based systems. Sewer based systems in total comprise of sewer connections and treatment unit. The cost comparison can only be made to the end to end system and not solely on the treatment unit.

Current Status

There are 6 Faecal sludge treatment plants operating in India[1], adopting different treatment approaches and technologies. For ease of understanding, the treatment technologies in use are broadly categorized based on the process principles: biological and non-biological systems. The technologies based on the treatment mechanism are grouped under the categories listed below

A. Biological treatment

1. Decentralized wastewater treatment System (DEWATS)
2. Sludge Drying Beds, also with Co-composting (mostly in combination with sludge drying bed)
3. Planted Drying Beds
4. Upflow Anaerobic Sludge Blanket (UASB)
5. Co-treatment with Sewage

B. Non-biological treatment

6. Pyrolysis (thermal process)

- Sludge settling and MBBR: Jabalpur FSTP
- Upcoming FSTPs in India

[1] As in December 2017; listed by MOHUA, Govt. of India (KPMG Updates)

FAECAL SLUDGE TREATMENT TECHNOLOGY 01	
Technology	**DEWATS** – *Biological*
Working Principle	DEWATS is natural aerobic and anaerobic stabilization of the waste with increased contact time with the active biomass followed by treatment of both remaining sludge and effluent.
Key features	• The treatment is biomethanation based treatment with pre-and post-treatment for solid and liquid handling • The solid handling is generally through Stabilization, Sludge Drying Bed and for liquid treatment Anaerobic Baffled Reactor with filter chambers followed by Planted Gravel Filter. • The dried sludge is further co-composted with municipal solid waste. • The entire system is a biological based treatment system with no chemicals used • This is a gravity-based system with low electromechanical equipment depending the layout • The products from the process are treated liquid & compost and biogas as ecofriendly fuel
Performance	The compost from the process is biosafe only it is co-composted as composting attains higher temperature capable to destruct bacteria & viruses. However, the helminths destruction elevated temperatures > 85 degree C.
Applicability	• Suitable for wastewater streams with fluctuating inflows • Applicable for organic wastewater streams • Co-composting with other organic solid waste enhances the compostability of the other wastes.
Operations & Maintenance	• Cleaning of pretreatment unit • Regular desludging of biomethanation digester • Removal of sludge from drying bed • Harvesting of plants in gravel filter
Strengths	• Low operation and maintenance cost • No skilled labour required • No direct contact with faecal sludge, allows for safe operations
Challenges	• The filtration of liquid can only reduce the pathogens count and would not make completely biosafe • Sludge handling requires space

Technology Installed Location Details		
Location (s)	**Status**	**Technology Provider**
Devanahalli, Karnataka	Operational. Commissioned in 2015	Consortium for DEWATS Dissemination Society and Bremen Overseas Research and Development Association (BORDA)
Capacity	**Area Requirement**	**Manpower**
6 KLD	108 sq.m./KLD	
Capital cost and Operational cost	Capital cost: Rs. 11.2 Lacs/KLD Annual Operating Cost: Rs. 1 Lacs / KLD	
Set-up time	Primarily civil works – ranges from 90 days to 150 days	
Snapshots		

FAECAL SLUDGE TREATMENT TECHNOLOGY 02	
Technology	**Sludge Drying Beds with Co-composting –** *Biological*
Working Principle	This is a simple gravity solid liquid separation using a drying bed followed by co-composting of solids with other organic wastes in a sequential process over a period. The liquid is further required to be treated. This is a process of drying the waste and co-composting with other organic wastes in a sequential process. The Faecal sludge spread is semi dried on the bed and is mixed with other organic waste sequentially over a period.
Key features	• This is a simple system of drying and composting adopting sequential process of drying and mixing the different organic wastes over a period • The other organic wastes could possibly include MSW, cow-dung, kitchen waste, etc. • After composting the compost is recovered by the process of sieving • The complete process takes longer duration for the final product bio compost • The liquid from the process is required to be further treated
Performance	• The compost is biosafe considering the composting temperature. However, the helminths destruction happens only at elevated temperature > 85 degree C. • When co-composted with different organic wastes, the compost obtained is nutrient rich and has high saleable value.
Applicability	Suitable for all types of organic wastes/ sludges including kitchen, market, house wastes, etc.
Operations & Maintenance	• Manual application of other organic wastes on to the drying beds • Removal of compost from the drying beds • Mixing of Faecal sludge compost and kitchen waste (other organic waste) compost • Sieving the compost • Bio compost packaging
Strengths	• Nutrient rich bio compost with high saleable value • Co-composting with other organic solid waste enhances the compostability of the other wastes
Challenges	• Labor intensive process requiring manual handling at each stage • Suitable at location where there is land availability • It is location specific customized process where there are easy availability different types of waste • The helminths destruction need to be ascertained

Technology Installed Location Details		
Location (s)	**Status**	**Technology Provider**
Bansberia, West Bengal	Operational. Operational since 2006	Greenery bio-compost and animal study Pvt. Ltd. (Plant operator)
Capacity	**Area Requirement**	**Manpower**
Total capacity of Plant - 1500 metric tons/year Faecal Sludge - 12KLD	2.7 Hectares	Not available
Capital cost and Operational cost	Capital cost: Not available Annual Operating Cost: 13.5 Lacs	
Snapshots	 	
Set-up time	• Primarily civil; 60 days to 90 days; need the SWM infrastructure, which could take about a year's time	
Additional features	• The plant incorporates sequential addition of poultry waste, slaughter house waste and parallelly, vermi composting of kitchen and cow dung. The composts from the processes are mixed together. • The system also incorporates lime addition for pathogens removal. • The plant does not have liquid treatment facility considering that the liquid is completely evaporated. The studies report that the seepage of liquid coming out from the sludge drying beds find its way into the Hooghly River passing just behind the plant.	

FAECAL SLUDGE TREATMENT TECHNOLOGY 03	
Technology	**Planted Drying Beds** – *Biological*
Working Principle	This is a biological system with combination of sludge treatment and liquid treatment by the natural process. Planted drying bed is an extension of unplanted drying bed (FAECAL SLUDGE TREATMENT TECHNOLOGY 02), but has the added benefit of transpiration and enhanced sludge treatment due to the plants. Filters do not need to be desludged after each feeding/drying cycle. The liquid is further treated in plated gravel filter.
Key features	• The end to end system comprises planted drying beds for solids and liquid separation, planted gravel filter and polishing pond for liquids treatment • Gravity based system, based on natural treatment with no use of chemicals or electricity • Minimal and simple operations with no skilled operator required • A nursery within the facility would facilitate in reusing the treated wastewater and sludge • Minimal odor
Performance	The system capable to meet the prescribed norms for sewage in terms of physical and chemical parameters. The process outputs need to be ascertained for biosafety The pathogens removal in the sludge requires inactivation through chemicals or destruction using heat. The gravel filtration of liquid can only reduce the count and would not remove completely.
Applicability	Suitable for all organic wastewater
Operations & Maintenance	• Removal of screenings from screen chamber • Trimming plants • Harvesting plants in drying bed and filter • Sludge removal from the drying beds
Strengths	• Low operation and maintenance cost • No skilled labour required • No human contact with waste
Challenges	The rate of biological degradation during extreme cold weather takes longer for treatment duration. The biosafe character of the process outputs need to be ascertained.

Technology Installed Location Details		
Location (s)	**Status**	**Technology Provider**
Leh, Jammu & Kashmir	Operational	Consortium for DEWATS Dissemination Society and Bremen Overseas Research and Development Association
Capacity	**Area Requirement**	**Manpower**
12KLD	60 sq.m./KLD	Not available
Capital cost and Operational cost	Capital cost: Rs 4.5 lacs/KLD Annual Operating Cost: Rs. 83000/ KLD	
Set-up time	Primarily civil works; ranges from 60 days to 120 days	
Snapshots	 	

FAECAL SLUDGE TREATMENT TECHNOLOGY 04	
Technology	**Upflow Anaerobic Sludge Blanket (UASB)** – *Biological*
Working Principle	This is anaerobic digestion process where Faecal sludge is pumped from the bottom into the reactor, influent suspended solids and bacterial growth lead to the formation of sludge blanket. Bacteria in the sludge blanket break down organic matter by anaerobic digestion, transforming it into biogas. After high volume-reduction, the digested sludge is further dried for reuse.
Key features	• The sludge blanket is kept in suspension by the flow regime and formed gas bubbles • A separator at the top of the reactor allows to recover biogas for energy production, nutrient effluent for agriculture and to retain the sludge in the reactor • Sludge accumulation is low and the desludged sludge from the reactor is dewatered and can be dried in drying beds (FAECAL SLUDGE TREATMENT TECHNOLOGY 02)
Performance	• Capable to meet the prescribed norms for sewage for physical and chemical parameters. The biosafety of the process outputs need to be ascertained.
Applicability	Suitable for high organic load waste
Operations & Maintenance	Excess sludge is required to be removed from the reactor Feeder pump and control of organic loads requires skilled staff for operation and maintenance
Strengths	• High removal of organics and solids and the possibility to recover biogas
Challenges	• Requires skilled staff and is sensitive to variable flows. • Biosafe nature of the process outputs need to be ascertained

Technology Installed Location Details		
Location (s)	**Status**	**Technology Provider**
Brahmapuram, Cochin	Operational. Commissioned in 2015	Consortium of ABG Group (Kerala) and Ionex (Mumbai)
Capacity	**Area Requirement**	**Manpower**
100KLD	12 sq.m./KLD	Not available
Capital cost and Operational cost	Capital cost: Rs. 42.5 lacs/KLD to build & operate for 5 years Annual Operating Cost: Rs. 24000-30000 / KLD	
Features	The UASB is followed by sludge drying beds for handling desludged sludge. The liquid is recycled back into the system	
Set-up time	Combination of civil and mechanical; ranges from 180 to 300 days	
Snapshots	 	

FAECAL SLUDGE TREATMENT TECHNOLOGY 05	
Technology	**Co-treatment in STP** – *Biological*
Working Principle	This is a treatment of Faecal sludge and septage in Sewage Treatment Plant (STP) with pre-treatment facilities for Faecal sludge.
Key features	• Due to the similarity of the characteristics of the sewage and Faecal sludge co- treatment is considered option • The two options for treating Faecal sludge in STP. It could be treated either as part of liquid stream or sludge handling stream • Addition to either of the stream pretreatment infrastructure in the STP and distribute the sludge into appropriated treatment unit in STP • For addition to liquid stream in STP, Faecal sludge be added at multiple treatment points viz., screening, before primary treatment (primary clarifier) or before secondary treatment (ASP) • Faecal sludge addition to sludge stream may be made either at before sludge stabilization or dewatering stage. • For co-treatment STP need to be equipped with Faecal receiving station, pre-treatment facilities and redistribution facilities in STP • The influent quality requirements for the STP at both liquid and solids addition points must be met during the additions
Performance	With pretreatment facilities and STP capability to handle Faecal sludge, prescribed sewage treatment norms be met. The sludge handling system should have pathogens inactivation/ destruction stage.
Applicability	Faecal sludge and sewage
Operations & Maintenance	• Regular cleaning of pretreatment facilities • Monitoring the pretreated Faecal sludge to match to the STP requirements
Strengths	• Faecal sludge and sewage be treated at single location minimizing the maintenance requirements • No separate infrastructure required for Faecal sludge treatment with reduced capital cost
Challenges	• The Regulated flow to the STP needs to be engineered and changes to this can effect the entire performance of the STP • STP capability to handle Faecal sludge is governed by (i) quantity of Faecal sludge and (ii) aeration capacity and solids handling capacity of the plant • The ability of the STP to co-treat Faecal sludge depend on STP type, design capacity and Faecal sludge pretreatment facilities as Faecal sludge is 50 times higher strength than sewage

Technology Installed Location Details		
Location (s)	**Status**	**Technology Provider**
Puri, Orissa	Operational. Commissioned in 2017	--
Capacity	**Area Requirement**	**Manpower**
50KLD	20 sq.m./KLD	Not available
Set-up time	Primarily adopting to existing STP; civil works ranges from 45 days to 60 days	
Capital cost and Operational cost	Capital cost: Rs 3.5 lacs/KLD Annual Operating Cost: Rs. 35000/KLD	

FAECAL SLUDGE TREATMENT TECHNOLOGY 06	
Technology	**Pyrolysis** – *Non-Biological*
Working Principle	The working principle of pyrolysis is thermochemical decomposition of organic material at elevated temperatures in the presence of controlled oxygen (pyrolysis) to efficiently convert sludge to biochar without external power.
Key features	• The system comprises of grit removal, pasteurization, solid-liquid separation, dryer, pyrolizer, heat exchanger and dewatered effluent treatment system. These different subsystems integrated together form a complete plant that can process Faecal sludge to biochar. • The counter flow heat exchanger recuperates the heat generated from pyrolysis and is reused back within the system. No external heat source is required enabling sustained operations • The system is equipped with online temperature monitoring systems optimizing the energy consumption and ensuring the pasteurization. • The biochar and pasteurized liquid are the products from the process.
Performance	• The process outputs meet the prescribed Indian norms for sewage and international norms for Faecal sludge. • The process outputs are completely biosafe for use
Applicability	• Applicable for treatment of Faecal sludge, STP sludge or sludges with organic content
Operations & Maintenance	• Cleaning of screening and grit units • Regular removal of Biochar
Strengths	• Automated system with no direct contact with faecal sludge • Suitable for all weather conditions • The products from the process including dewatered effluent are biosafe for reuse including food nursery • Modular System which can be easily scalable • Suitable for installation within the city having unique physical appearance • Fast deployment, with very low footprint
Challenges	• Varied septage characteristics pose depend for external thermal energy needs

Technology Installed Location Details		
Installed Location (s)	**Status**	**Technology Provider**
Warangal (TS), Wai (MH), Narasapur (AP)	Operational	TIDE Technocrats, Bengaluru, Karnataka
Capacity	**Area Requirement**	**Manpower**
15 KLD	10,000 sft	3 members/ shift (Two shift operation) (Operator, Helper & Security)
Capital cost and Operational cost	Capital Cost- Rs 8 lacs/KLD Annual Operational Cost- Rs. 65,000 to 1,00,000/KLD	
Additional Features	• Sanitation Resource Centre and green house of food and non-food nursery plants for reusing the treated liquid has been planned at all the installed plant locations	
Set-up time	Primarily mechanical; ranges from 90 days to 120 days	
Snapshots		

FAECAL SLUDGE TREATMENT TECHNOLOGY – **Sludge settling and MBBR**: Jabalpur, M.P.

- Number of installation: 3 Nos
- CAPEX and 5 years OPEX for 1 treatment plant: 68.99 Lakhs (Cost same for other 2 plants)
- Installation locations: Adhar tall, Poly pathar, Garha – Jabalpur municipal corporation
- Client: Jabalpur municipal corporation (JMC)
- Fund: AMRUT
- Tender and bid document preparation: JMC Installed by: Meco Technologies, Bilaspur
- Installation year: 2017
- Installed capacity of each treatment plant: 50 KLD (same for others) Area (footprint): 400 sq.feet (per treatment plant)
- The input to the system: Raw faecal sludge collected and transported in trucks owned by JMC and private operators.
- Output: Treated water and Thickened sludge

Treatment Process and Design Parameters

Faecal Sludge Receiving: Faecal Sludge collected by trucks from in and around Jabalpur city is disposed of in 1 of the 3 FSTPs installed. The trucks usually arrive during daytime and directly disposed into the Sludge thickening tank through a perforated pipe arrangement provided to retain trash and bigger size particles. The operator removes the pipe after every discharge and cleans the accumulated trash, disposing it of nearby, which is often collected by the municipality. However, interaction with the operator revealed that removal of trash from such pipes is difficult and hence during FS receiving, the pipe is removed and contents from the truck are directly discharged into the tank.

Sludge Thickening tank: This is an underground tank which receives the sludge from the truck. The sludge here is mixed with flocculants (typically those used in STPs) for aiding gravity settling. Usually, 3-5 litres of flocculants are added (manually) for a truckload of septage (5 cum). The mixing is done by means of aerating the volume using a coarse bubble diffuser. The aeration process is typically run for around 10-15 minutes, just after the addition of flocculants. After this, the mixture is let to settle for a period of 2-3 hours. During this time, the heavy particles settle at the bottom, while the supernatant remains at the top. As and when a new load arrives into the tank, the supernatant is displaced into a supernatant holding tank. Once in a day (or more if required), a desludging truck empties the settled solids from this tank and taken to an undisclosed location for dumping.

Supernatant holding tank: The supernatant from the sludge holding tank, flows into this by gravity. This tank acts as a holding tank from where the supernatant is pumped into the MBBR tank for treatment.

MBBR and supernatant treatment: Treatment of supernatant happens through MBBR process, where the liquid is aerated and allowed to pass into a tube settler for the settling of solid particles. The secondarily treated supernatant is then made to pass through a vertical rapid carbon and sand filter for tertiary treatment. This treated liquid is then dosed with liquid chlorine and discharged for collection in the clear water holding tank. The treated water is also used for backflushing the rapid carbon and sand filter. It was initially envisaged that the water flowing through drains nearby would be mixed along with supernatant from FS thickening to dilute it and make it effective for treatment in MBBR. However, in operation, this is not being exercised currently.

Upcoming FSTP's in India			
Sl.no	**Location**	**Technology**	**Expected date of commissioning**
1	Wai, Maharashtra	Pyrolysis	Mar'18
2	Kohima, Nagaland	Upflow Anaerobic Sludge Blanket Digestor (UASB)	Aug'18
3	Periyanaickenpalayam, Tamil Nadu	Sludge Drying Beds	Feb'18
4	Trichy, Tamil Nadu	DEWATS	Apr'18
5	Bhubaneswar, Orissa	DEWATS	Feb'18
6	Cuttack, Orissa	Co treatment with STP	Sep'18
7	Brahmapur, Orissa	DEWATS	Sep'18
8	Baripada, Orissa	DEWATS	Sep'18
9	Bhadrak, Orissa	DEWATS	Sep'18
10	Baleswar, Orissa	DEWATS	Sep'18
11	Sambalpur, Orissa	DEWATS	Feb'18
12	Rourkela, Orissa	DEWATS	Feb'18

Way forward

The compendium is prepared based on the secondary data available on the technologies in India. As stated earlier, this is a living document, and as we visit more FSTPs, interact with the key stakeholders, the data provided will be more refined. At present, only limited technologies are available for treatment of Faecal sludge. There are about 6 technologies currently in use. 12 new FSTPs are under construction all of which are employing either of the technologies listed in the compendium as per the secondary research.

The costing and area requirements of the technology vary distinctively from location to location. Various factors influence the costing, which are being analyzed to establish common bench-marks to help rapid adoption across the country.

PROJECT
Sanitation Capacity Building Platform

DEVELOPED BY
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DISCLAIMER
While every effort has been made to ensure the correctness of data/information used in this compendium, neither the authors nor NIUA accept any legal liability for the accuracy or inferences drawn from the material contained therein or for any consequences arising from the use of this material.

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CASE STUDIES: DECENTRALISED SANITATION IN INDIA

S. NO	1	2	3	4		5	6	7	8	9
	Case Study Name	Scale and Implementing agency	Description of Treatment	Important Features		Tank size or Area	Tentative cost in Rs.	O & M cost	Salient features	Safe reuse or Disposal of human wastes/ water
1	(Centre for Science and Environment, New Delhi) Operational since : 2005	**Institutional** Centre for Science and Environment CSE, Delhi	The treatment modules include a settler, an anaerobic baffled reactor and a planted filter bed.	The treated wastewater is stored in an underground sump. The water is retained in ABR for 24 hours for secondary treatment.		2m x 2m x 2m dimension for primary treatment, The ABR has a dimension of 10m x 2m x 1.5 m and consists of a series of chambers. tertiary treatment the bed size is 22m x 2m x 0.6m and filled with different sized filter materials.	Rs. 2,25,000, Designed Capacity: 8 KLD	Rs.25,000-30,000 per year (approx.)	About 8KL of wastewater is treated and reused. The entire water requirement for horticulture and gardening is met by the treated wastewater. The result showed that the efficiency of the system is 82% in terms of BOD removal.	This treated wastewater is pumped out through 1HP automatic pump to meet the horticulture requirements of the building.
2	Aravind Eye Hospital, Pondicherry,	**Institutional** Consortium for DEWATS Dissemination (CDD) Society, Bangalore	Anaerobic treatment through baffled reactors and final treatment is done through polishing ponds.	The treatment facility receives 2.7- 3KLD from hospital building that includes only sewage. DEWATS was adopted to meet the demand of huge water requirement for horticulture and maintaining the lush green area of 15 acres within the hospital premises.		Area : 2690 sq. m	1.12 crore Designed Capacity: 320KLD	2.5-3 lakhs per year	BOD reduction: 98% COD reduction: 96% TDS reduction: 96%	Water reused in horticulture and maintaining the lush green area of 15 acres within the hospital premises.
3	Decentralised Wastewater Treatment System at Kachpura village in Agra, Operational since : 2010	**Community** Centre for Urban and Regional Excellence (CURE), Agra Nagar Nigam (ANN) and USAID	The wastewater then enters into three chambered septic tank. After primary treatment, it goes to nine chambered baffled anaerobic reactor which is filled with gravels,	The aim of the programme was to improve the sanitation conditions in the slum areas. The system treats approximately 50 KLD of the total wastewater which it receives from 5 clusters of slums through a common drain.		Not given	50KLD Rs 10-11 lakhs, Designed Capacity: 50 KLD	Rs 70,000-80,000 per year	BOD reduction: 61% COD reduction: 94% TDS reduction: 94%	The treated wastewater is reused for horticulture and irrigation.
4	Decentralised wastewater treatment system at Bankers Colony, Bhuj Operational since : 2006	**Community** Hunnarshala Foundation, Municipality of Bhuj and Kutch Navnirman Abhiyan, funded by American India Foundation and Care today group	Anaerobic Baffled Reactor which is a nine chambered system with the anaerobic filter in the last two chambers. Then, planted filter and finally to the polishing pond.	From the polishing pond the treated wastewater is reused. This treatment system is maintained in such a way so that the area can be utilised as a public space also.		Area : 300 sq. m	Rs 14-15 lakhs, Designed Capacity: 30KLD	Rs 1-1.5 lakhs/year	BOD reduction: 91% COD reduction: 81% TDS reduction: 98%	The treated wastewater is reused for horticulture purpose in order to develop the green belt in the region. The excess of treated wastewater goes to the storm water drain which passes through the city and meets Hamirsar Lake.
5	Decentralised wastewater treatment system at Adarsh College, Distt Thane Operational since : 2008	**Institutional** Kualgaon Badlapur Municipal Council, GTZ (now GIZ), Ecosan Services Foundation	Anaerobic treatment, horizontal planted filter, polishing pond.	A toilet complex with two independent toilet blocks for male and female has been constructed in the school premises,The treatment plant receives 2-3 KLD of wastewater. Black water and grey water is collected in the collection tank from where it goes to the biogas settler.		Area : 57 sq. m	Rs 4 lakhs, Designed Capacity: 7 KLD	Rs 60000-80000 per year	NA	Reused for horticulture purpose. The biogas collected is used to provide energy to gas stoves and lamps present in the Ecosan exhibition hall.
6	Decentralised wastewater treatment system at Friends of Camphill, Bangalore Operational since : 2003	**Individual/ Residential** Consortium for DEWATS Dissemination (CDD) Society, Bangalore	Biogas produced as a result of anaerobic digestion enters into the extension chamber where it is stored for further use. From the settler, wastewater enters into 16 chambered baffled reactors, horizontal planted gravel filter, polishing pond.	Biogas production through anaerobic digestion.		Area : 110 sq. m	Rs 5.5 lakhs, Designed Capacity: 9KLD	Rs.5000-8000 per year	BOD reduction: 92% COD reduction: 91% TDS reduction: 94%	Treated wastewater is used for horticulture requirement. Biogas generated is used for cooking for 3-5 hrs daily.
7	Decentralised Wastewater Treatment System for Beedi Workers colony at neighborhood level, Operational since : 2005	**Community** Consortium for DEWATS Dissemination (CDD) Society, Bangalore	Anaerobic Baffled Reactor, planted gravel bed, treated water is finally collected in the collection tank.	Biogas produced is used by the colony residents for cooking.		Area : 542 sq. m	Cost is not given, Designed Capacity: 36 KLD for 600 users		BOD reduction: 96% COD reduction: 96%	Achieve improved sanitation situation in the community. The treated wastewater is reused for landscaping and safe disposal of wastewater helps in reduction of Environmental pollution.
8	Anoxic Bioremediation in Hauz Khaz Lake, New Delhi, Operational since: 2007-2011	**City (Water body/lake)** JM Enviro technologies Pvt. Ltd and Delhi Development Authority	Anaerobic live bacterial strains in liquid form. These bacteria decompose the accumulated sludge flocs and large organic molecules into simpler ones that can be consumed by the bacteria itself.	Consortium is effective in controlling odour, reducing TSS, BOD, oil/ grease accumulation in sewage/ polluted water and solids. Some of the strains of Persnickety® 713 also helps in increasing the DO level in wastewater.		Area: 15 acres	Capital cost: Rs. 5,72,500, Designed Capacity: 128ML	Rs. 2.8 lakhs/ acre / year	BOD reduction: 70 % pH also reduced from 9 to 8	Reused in lake. It is simple discharge.
9	Anoxic Bioremediation in Kushak Drain, New Delhi, Operational period: 2009-2010	**City (Water body/lake)** JM Enviro technologies Pvt. Ltd , New Delhi Municipal Corporation (NDMC)	In the beginning, whole of the drain was inoculated with Persnickety@713. One dosing station was established at the starting point of the drain and bacteria medium was dosed at high concentrations initially. Half of the dosing solution was introduced at the dosing station and remaining half was used to inoculate the bacterial product throughout the drain. Once the bacterial strain entered the regeneration phase dosing quantity was reduced and maintained till the end of the project.			Length of the drain: 2.8 km in length	Rs. 60,000, Designed Capacity: 3 MLD	Rs. 1.9 lakhs / MLD / year	Increase in DO: 72% approximately BOD reduction: 77% approximately TSS reduction: 80% approximately	Reused in lake. It is simple discharge.

Source: http://www.cseindia.org/node/3769
http://www.cseindia.org/userfiles/list_technologies_jan10.pdf
http://cseindia.org/content/constructed-wetlands-%E2%80%93-wastewater-treatment-systems