OPERATION & MAINTENANCE OF FSTP

10 KLD Fecal Sludge Treatment Plant

Kalpetta, Wayanad District

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OPERATION AND MAINTENENACE MANUAL

10 KLD Faecal Sludge Treatment Plant at Kalpetta, Wayanad District

This Manual is needed for the technical persons to be trained as Operators and helpers at the FSTP site at Wayanad. It contains Technical Guidelines for carrying out the works.

ACKNOWLEDGEMENTS

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ABBREVIATIONS

ACF	Activated Carbon Filter
BDT	Anaerobic Bio Digester Tank
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CCT	Chlorine Contact Tank
FSM	Faecal Sludge Management
FSTP	Faecal Sludge Treatment Plant
FRP	Fibre reinforced Plastic
HDPE	High density Polyethylene
HP	Horsepower
KMC	Kalpetta Municipality Council
KLD	Kilo Litre per Day
KPCB	Kerala Pollution Control Board
MOC	Material of Construction
MS	Mild Steel
O&M	Operations and Maintenance
Ppm	Parts per million
PVC	Polyvinyl chloride
PSF	Pressure Sand Filter
SOP	Standard operating Procedure
SS	Stainless Steel
TBF	Tiger Bio Filter
TDS	Total dissolved solids
TSS	Total suspended solids
UPVC	Unplastisized polyvinyl chloride

1. KALPETTA TOWN

Keywords: Kalpetta town, faecal sludge disposal, UNICEF, PriMove IDP

Kalpetta is a town and a municipality in the Wayanad district, state of Kerala, India. Kalpetta is the headquarters of Wayanad district as well as the headquarters of Vyathiri taluk. It is a bustling town surrounded by dense coffee and tea plantations and mountains. It lies on the Kozhikode-Mysore National Highway NH 766 (Formerly NH 212) at an altitude of about 780 m above sea level. Kalpetta is 72 km from Kozhikode and 140 km from Mysore.

Apart from being the administrative capital of the district, Kalpetta is also the centre of tourism activities in Wayanad due to its central location within the district and its proximity to most visited tourist sites.

As of 2011 India census Kalpetta had a population of 31,580 and 7,519 Households. Males constitute 49% of the population and females 51%. In Kalpetta, 11% of the population is under the age of 6 [1].

Country	India
State	Kerala
District	Wayanad
Area	40.74 km^2 (15.73 sqm mi)
Elevation	780 m (2,560 ft.)
Population (2011)	31,580
Density	780/km^2 (2,000/sqm mi)
Official Languages	Malayalam, English
Time zone	UTC+5:30 (IST)
PIN	673121 (Kalpetta Head PO), 673122 (Kalpetta North)
Telephone code	+91-4936
Vehicle registration	KL-12

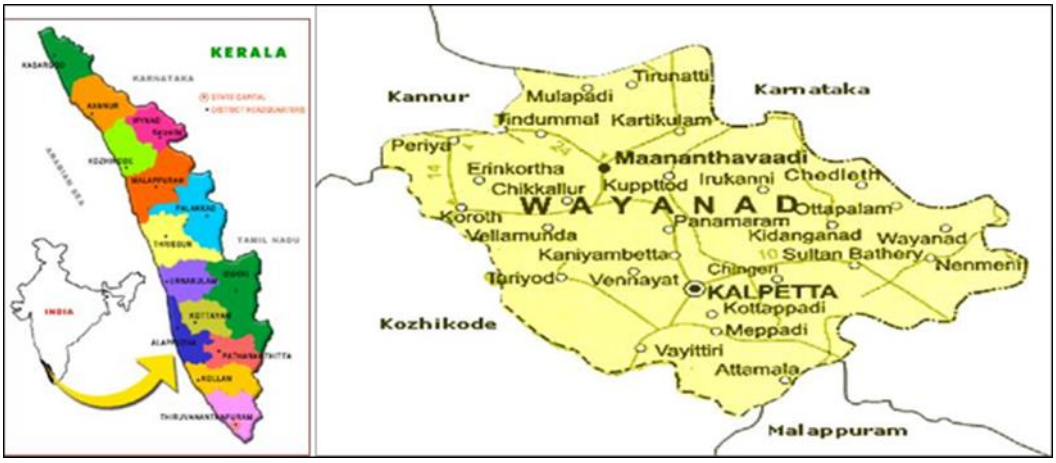


Figure 1- Waynad District Map

[1] https://www.census2011.co.in/data/town/803264-kalpetta-kerala.html

2. FAECAL SLUDGE MANAGEMENT

Faecal sludge management (FSM) is the collection, transport, and treatment of Faecal sludge from pit latrines, septic tanks or other onsite sanitation systems. Faecal sludge is a mixture of human excreta, water and solid wastes (e.g. toilet paper or other anal cleansing materials, menstrual hygiene materials) that are disposed in pits, tanks or vaults of onsite sanitation systems. Faecal sludge that is removed from septic tanks is called septage.

FSM is necessary in densely populated areas where a proportion of population is not connected to a sewerage network, and the covering and rebuilding pit latrines is not possible. This is the case in most urban areas of developing countries, but such services are also used in developed countries where sewerage systems are unavailable. FSM services are usually provided by formal and informal private sector services providers, local governments, water authorities and utilities. However, in many developing countries FSM services are often unavailable or if they are available are often informal, unregulated, unhygienic, and unsafe. This can lead to surface water and groundwater pollution, spreading of pathogens into the environment and adverse public health impacts. It can also result in unreliable services with relatively high costs to the households which need them.

Faecal sludge collection services can be made available on a scheduled basis or on a call-for-service basis (also known as on-demand, on-request, or non-scheduled services). The collected faecal sludge may be transported to treatment plants by using a vacuum truck; a tank and pump mounted on a flatbed truck; a small tank pulled by a motorcycle; or in containers on a hand cart. Mobile or permanent transfer stations can be used to improve the efficiency of faecal sludge transportation by transferring the waste to larger tankers for haulage to treatment. The wider use of multiple decentralized sludge treatment facilities within the city (to avoid long haulage distances) is currently being researched and piloted.

The Faecal sludge is collected by septic suction tanker or honeysucker and brought to treatment site. This “high strength” (relatively high organic content) Faecal sludge is treated with a Tiger Bio Filter system. The treated water may be provided optional tertiary treatment for polishing and disinfecting the effluent and utilized for gardening or irrigation activities. Another possibility is to use the treated faecal sludge after composting as a soil conditioner. Historically, the term night soil was used for faecal sludge.

This unique project is undertaken by Kalpetta Municipality and is perhaps one of its kinds for Faecal Sludge Treatment and reuse undertaken by a local body in India.

3. NEED OF PROJECT

In August 2018 Kerala received worst flood after July 1924. Several NGO, GO's and Private sector assist Kerala Government for Flood rescue and rehabilitation majors. One of the agencies UNICEF is actively engaged in rehabilitation measures. As part of their program, UNICEF selected PriMove Infrastructure Development Consultants Pvt. Ltd as a Contractor by e Tendering system with Purchase Order No. 81066913, Dt. 20th Dec 2018.

4. PROJECT DESCRIPTION

Supply and Installation of Sludge Treatment Unit - Design Construction, Supply, Installation Testing & Commissioning of 10 KLD Capacity Faecal Sludge Treatment Plant based on Tiger Bio Filter Technology

Annual Maintenance of Sludge Treatment Unit – One-year Operation and Maintenance of Faecal Sludge Treatment Plant

1	Site Location	Dumping ground area, Vellaram Kunnu Road, Kalpetta
2	Coordinates	(11°35'26.30"N, 76° 3'19.56"E)
3	Owner of the FSTP	Hon. Secretary, Kalpetta Municipality
4	Contractor of the FSTP	PriMove Infrastructure Development Consultant's Pvt Ltd
5	Required Area	700 Sqm including beautification and garden
6	Technology	**Tiger Biofilter Technology**

5. TECHNOLOGY OF THE TIGER FSTP - VERMIFILTRATION

Keywords: Vermifiltration, earthworms, sludge conversion, vermicompost

5.1. General

Vermifiltration is a more efficient method of sanitation relative to septic tanks and pit latrines[1]. Earthworms are well known agents that promote digestion of organic waste, producing vermicompost. In vermifilters, worm-based sludge treatment is combined with water filtration to digest organic matter present in septage. The worms need only air, water, and sludge (food) to operate efficiently as a part of the vermifiltration system.

The Tiger Biofilter technique is based on vermifiltration. The technology uses a filtration arrangement consisting of Bio media to trap and treat impurities from faecal sludge / wastewater. The filtration medium is arranged in stacked manner with bio media on top. The top layer serves as active zone habitat for Bacteria and earth worms specifically bred for the purpose, while bottom layers provides structural support and free drainage for clear water. The trapped impurities (Organic matter) are then consumed by bacteria and earth worms as an energy source for metabolism and reproduction resulting in reduction in organic matter (measured as Biochemical Oxygen Demand).

The system is designed with sufficient surface area and worm quantity. The worm consumes the BOD (Organic matter) load in 24 to 72 Hrs. making bed available for next loading. As the Natural oxygen transfer takes place no need of artificial air supply in form of blower resulting in less consumption of power and consumables and is therefore cost effective and environmentally friendly. The tiger bio filter uses far less energy and space compared to similar technologies.

Tertiary treatment in form of Pressure Sand Filter, Activated Carbon Filter and PurAll Chlorination can be used as an option for polishing the effluent.

[1] The technology is adequately studied and researched having references in **Manual on sewerage and sewage treatment (Second Edition)** by CPHEEO and MINISTRY OF URBAN DEVELOPMENT 1993 under chapter 26 EMERGING TECHNOLOGIES FOR SEWAGE TREATMENT point no. 26.3 VERMICULTURE TECHNOLOGY.

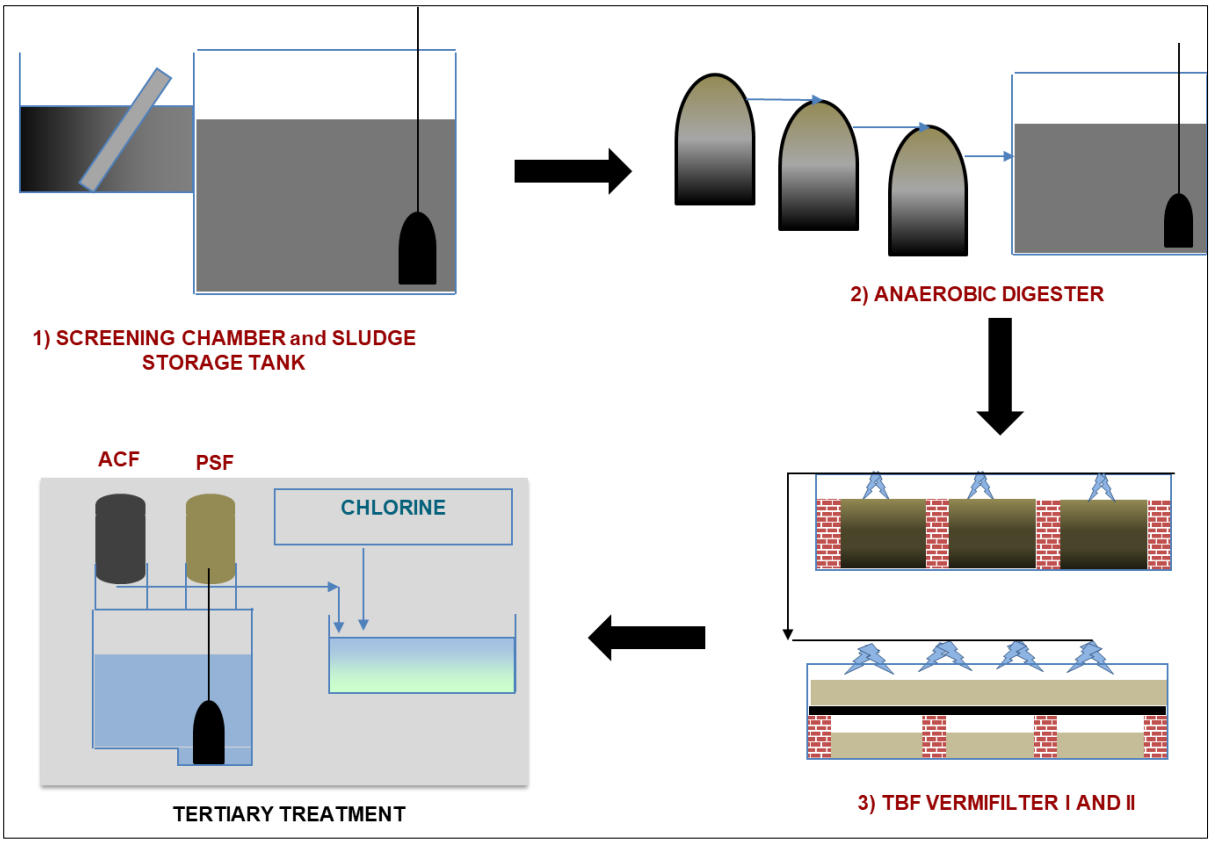


Figure 2 Treatment schematic ACF – Activated Carbon Filter, PSF- Pressure Sand filter

5.2. Component of Technology

Major components of the Faecal Sludge treatment comprise of primary and secondary treatment. Primary treatment removes inorganic solids, and comprises of screening, solid-liquid separation, and grit removal. Secondary treatment includes anaerobic digestion, Vermifiltration, and Polishing and disinfection. The technology units are explained are as follows.

5.3. Primary Treatment

5.3.1. Screen Chamber cum Solid Liquid Separator Tank with Grit Removal Arrangement

Primary treatment is done by filtering inorganic grit from the faecal sludge. This is achieved by passing the sludge through a collection of filters of varying size, which retain this grit and allow the sludge to be treated more efficiently.

- The grit tank, made of frp, consists of 2 chambers a) screen chamber b) solid-liquid separation tank. The screen chamber is fitted with a bar filter to remove unwanted large objects from Faecal sludge.
- The screened faecal sludge then enters solid-liquid separation tank. The sludge stagnates, settling the inert solids (grit). These settled solids are removed periodically and treated through vermifiltration separately.
- The Faecal sludge is removed and taken to next tank of anaerobic digester.

5.4. Secondary Treatment

5.4.1. Anaerobic Biodigester Tank (BDT)

The primary filtered sludge is passed through an anaerobic digestion tank, where a collection of processes breaks down biodegradable material in the absence of oxygen.

- The digestion process begins with bacterial hydrolysis of the input materials: Insoluble organic polymers, such as carbohydrates, are broken down to soluble derivatives that become available for other bacteria.
- Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. These bacteria convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide.
- Finally, methanogens convert these products to methane and carbon dioxide. The methanogenic archaea populations play an indispensable role in anaerobic wastewater treatments.

5.4.2. TBF Vermifiltration I and II

The separated sludge is passed to the TBF Vermifiltration beds, where organic faecal waste is neutralized. These beds are set up comprised of earth worms, bacterial culture, and a material suitable to provide a habitat and respiration zone for earthworm growth and reproduction.

- The special Tiger worms used in the vermicomposting filter unit are capable of compositing faecal waste. Organic matter is consumed by earth worms as an energy source for metabolism and reproduction.
- The system is designed accordingly with sufficient surface area and worm quantity. The worms consume the septage organic load and convert it to vermicompost. The system's layered media design encourages efficient treatment activity by the worms.
- Passing the treated filtrate through a secondary vermifiltration set up ensures complete neutralization of solid waste components.
- Lastly, the generated vermicast can be sold as safe, fertile vermicompost, contributing to the circular economy.

5.5. Tertiary Treatment

5.5.1. Polishing and Disinfection

The treated liquid output from TBF Vermifiltration is polished and disinfected for safe human handling. This is a polishing unit, provided to remove any colour or odour remaining from secondary treatment. The disinfection by Chlorination is provided to make treated effluent safe for human handling and disposal.

5.6. Schematic Diagrams of the Plant

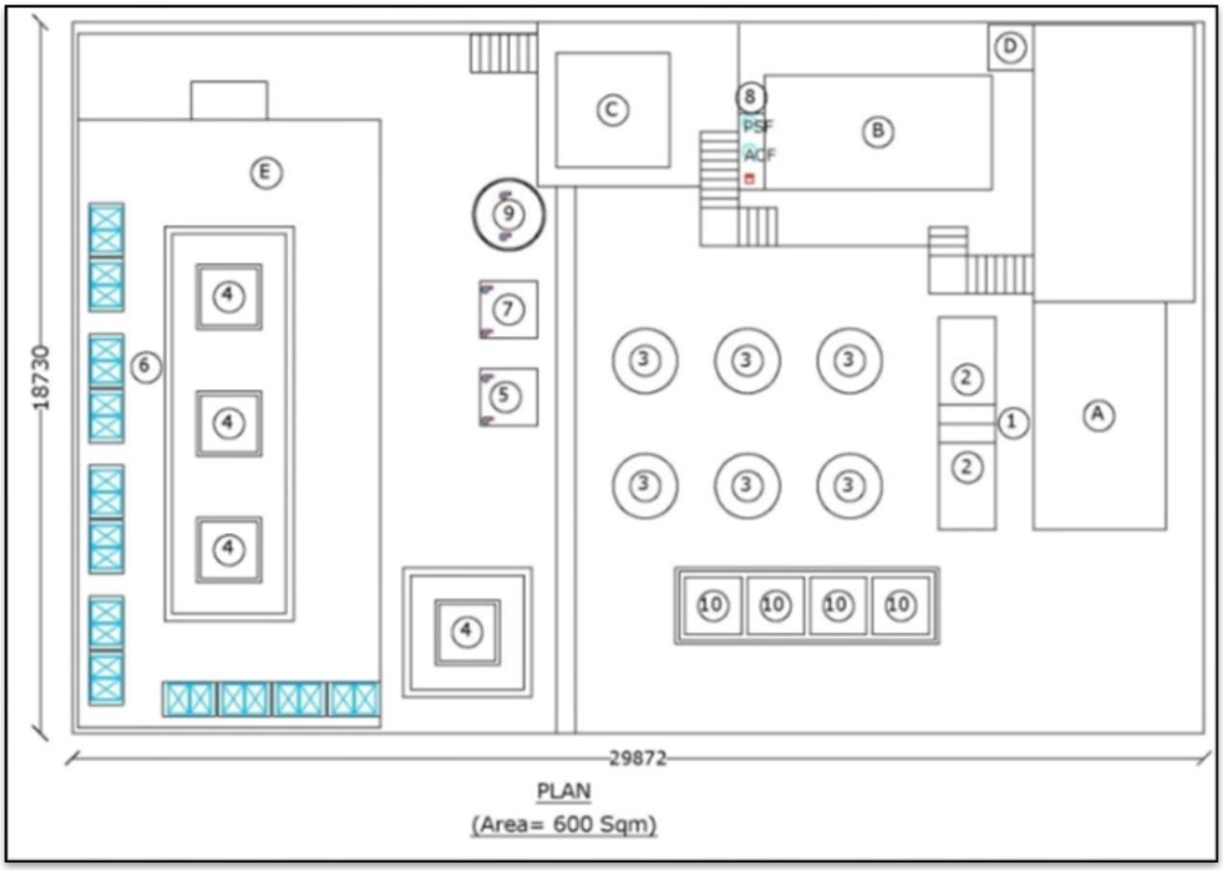


Figure 3 FSTP Schematic diagram - Layout of FSTP kalpetta

Sr. No.	Description	Sr. No.	Description
1	Screen Chamber	**A**	Unloading Platform
2	Solid Liquid Separation Tank	**B**	Cabin
3	Anaerobic Digester(BDT)	**C**	Store room space
4	Tiger Bio Filter- I	**D**	Toilet block
5	Intermediate Storage Tank	**E**	TBF Shed
6	Tiger Bio Filter- II		
7	Filter Feed Tank		
8	Filter Platform		
9	Treatment Water Tank		

Flow Direction Diagram of FSTP kalpetta

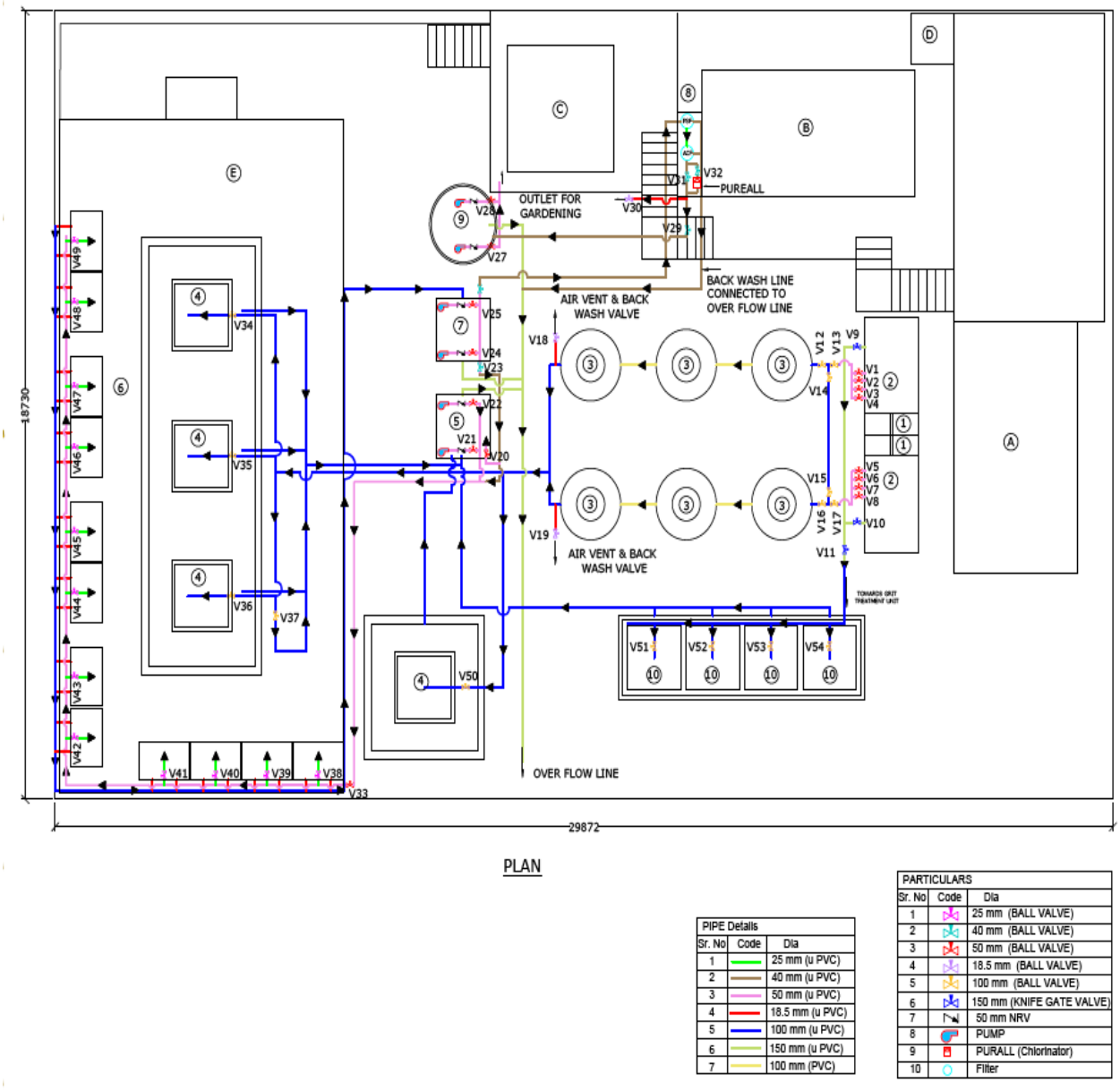


Figure 4 Flow diagrams with flow direction fstp kalpetta

Hydraulic Flow Diagram of FSTP kalpetta

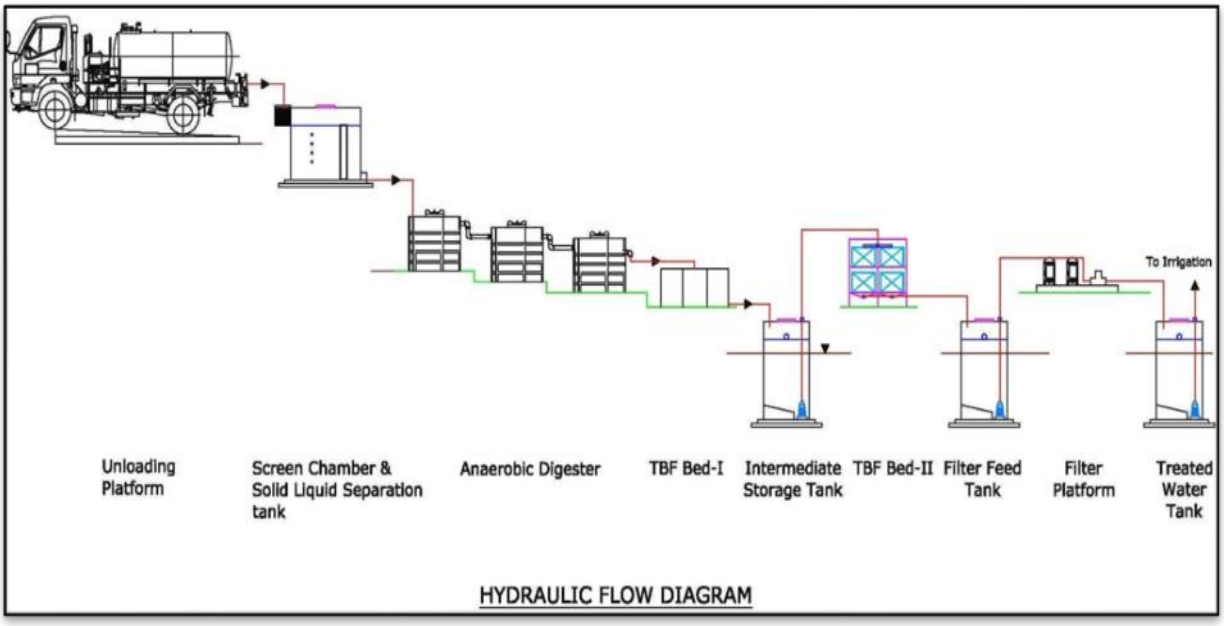


Figure 5 Hydraulic flow diagrams

6. OPERATION AND MAINTENANCE

This operation and maintenance (O&M) manual is the reference for the operation and maintenance of the equipment and processes that comprise the tiger bio filter (TBF) based faecal sludge treatment plant at kalpetta.

Plant in-charge, operators, and maintenance personnel shall use this manual and associated company and equipment manufacturer's procedures to operate the fstp in faecal sludge Collection system.

6.1. Collection of septage

6.1.1. Honey Sucker Vehicle

Honeysucker with pumping arrangement and piping for septage collection The Faecal sludge collection system includes, green hose pipe, valves, hose nipples, vessel for storing Faecal sludge like 2000 litres to 10000 litres capacity and 3 to 5 Generally, the job of carrying out suction from septic tanks and transporting the sludge to the treatment facility is done by a two-member team comprising of the suction truck driver and one helper. Commonly about 3000 to 6000 litres tanks are available. Vacuum pumping arrangement is available on the suction tanker to suck the septage from septic tank to suction tanker vessel.

The primary function of the collection system is to collect septage waste from the houses in the town while maintaining safe conditions by using honeysucker or septic tanker. The collected septage will be deposited at the FSTP.

6.1.2. Daily Preparation for the Emptying and Transport Service

- Receive work orders for the day Check the functioning of vacuum evacuator and equipment
- Check personal protective equipment – All employees shall be responsible for maintaining their own personal protective equipment (such as gloves, boots, hat, face mask, Davy's lamp) in good condition
- Check disinfecting and spill control equipment – Operators should be trained on identifying spills and proper methods of disinfecting. Sprinkle lime over spilled area, wait for 15 minutes, and then wash with water
- Check Hoses – inspect hoses for cracks and wear – and discard or repair worn and broken hoses. Connecting the Hose in the correct manner using the clamp style fitting ensures a tight and leak proof connection. Use of twine and plastic for making connections causes leaks and requires clean-up.

6.1.3. Operating the Vacuum Evacuator

Operators should be familiarized with the proper operation of the equipment in use for each operation. This includes the physical operation of the truck, and all valves, piping, power take-offs and ancillary equipment for the vacuum evacuator (including

the tank, valves, hoses, and fittings). The following steps can be followed for operating the vacuum evacuator.

- Reach the first site and meet the building owner
- Collect basic information about the septic tank, age of septic tank, family size and use of cleaning material.
- Before pumping, check the tank to look for perceptible damage to the structure and to verify proper piping is in place.
- Check the water level to get clues for tank condition: high levels (above outlet level) indicate a clogged outlet; low levels (below outlet level) indicate a leaking tank (or tank not in use).
- Check for back flow into tank during pumping and when pumping is complete. Flow back may indicate a problem with plumbing in the house or clogged disposal.
- Open the access covers, inspect the interior and exterior of the tank. If more than one, locate and remove lids (for at least 2 hours) from all compartments.
- Each compartment will require pumping after ventilating. Probe the tank with the last length of hose. This will provide an indication on the volume of sludge to pump.
- Start the pump or vacuum equipment. The operator should make sure there is suction and that the pump is operating.

6.1.4. Other Precautions

- Volume in the tank should start decreasing rapidly. Use hose to break up sludge and scum to the extent possible.
- After pumping is complete, check the tank for remaining sludge. If there are accumulated solids remaining, initiate the pump-back procedure, which is to send the pumped Faecal sludge under pressure back into the tank and direct this flow toward the sludge mass. This will break up the mass, making it possible to pump out. When the pump-back is complete, pump out the tank again (suction). When pumping is complete, wash the hoses and replace the tank lids. Clean up any spills and disinfect with lime or bleach solution.

6.1.5. Safely Transport Faecal Sludge to Sludge Treatment site

- Plan the trip so as to arrive at the disposal site within the specified disposal site operating hours.
- Report equipment malfunctions or required repairs immediately to supervisors.
- At the Disposal Facility position the truck so that the faecal sludge may be directed to the receiving chamber with only one length of hose.
- Open the valve and allow the sludge to flow via gravity into the receiving chamber
- When the tank is empty, disconnect hose and clean tank and hose with water

- Use all safety precautions with all safety equipment's during and after Septage receiving and disposal at site and keep site clean

6.1.6. Manifest forms or simple receipts to be filled that specify

- Location or address of the pumped septic tank.
- Septage characteristics (residential or commercial)
- Name and address of the property owner or occupier.
- Volume of septage pumped
- Any notes regarding tank deficiencies, missing pipes or fittings, improper manholes or access ports, cracks or damage observed

6.1.7. Ensure Safe Practices

- Always keep first aid kit, gas detection lamp and fire extinguisher in the septage evacuator vehicle.
- Provide training to workers handling septage on safety and hygiene practices and how to use safety equipment
- Provide fencing or compound around septage treatment facility premises
- Train staff and insist to wear helmets, gum boots, gloves, and all safety equipment while on work.
- Ventilate covered tanks/pits by keeping them open for sufficient period before entering
- Paste list of emergency numbers on septage evacuator and at a prominent place in septage treatment / disposal unit

6.1.8. Operations (Septage receiving)

- Start the pump for sucking waste from septic tank without spilling the septage.
- Close valve and vessel outlet properly with proper precautions while handling the valves.
- Empty the suction tanker at FSTP Screen Chamber and Septage Storage Tank
- Septage delivery must be made in the presence of FSTP operators, and as per delivery schedule
- Make sure schedule for various suppliers' delivery at FSTP septage with proper calendar and quantity of septage evacuated.
- Daily septage holding and treatment is 10,000 litres only. The plant cannot store excess septage, so it must be ensured that no excess septage comes to the FSTP
- Ensure there is no spillage of septage while it is being emptied at the FSTP
- Do not allow septage unloading at site without any pre-information about delivery at FSTP site.

- Only septage will be accepted for treatment. Kitchen waste from hotels and unknown sources waste is not allowed for treatment at FSTP
- Septage will be accepted only during operating hours which are 8.00 am to 6.00 pm
- Filling the data sheet or form before unloading septage properly is the responsibility of the Plant In-Charge

6.1.9. Preventive Measures

- Before septage unloading, ensure the waste comes from septic tank. If waste comes from unknown sources do not allow the unloading the waste at FSTP.

6.1.10. Corrective Measures

- If prohibited debris, plastic, sanitary pads, shampoo rappers, rubber, paper etc. material is present in the septic tank then if possible skip that waste during sucking or separate out at source.
- If valves of honeysucker are choked; remove and clean properly and reinstall
- If waste spilling is detected at site or near septic tank while sucking the waste or unloading the waste, it must be cleaned immediately with safe handling by using a cleaning agent.

6.1.11. Troubleshooting- Treatment at site

PROBLEM	CAUSE	REMEDIAL MEASURE
• Faecal sludge will not transfer to screen chamber	• Choking the valve • Valves are not properly operated by helper • Plastic waste, pads etc. blocked in the outlet pipe • Suction pump not working properly	• Check and clean suction pump regularly • Check and clean valves regularly • Check and clean vessel regularly • Follow SOP for collection of septage from septic tanks and operates the valves • Replacement of damaged parts
• Smelling Issue	• Due to excess gas generation in the vessel • Spoiling issue	• Unloading septage immediately after sucking from septic tanks • Release gas during transportation to air regularly • Clean contaminated area immediate by using cleaning agent

6.1.12. Photos of septage receiving

1	2	3
		
Septic Tanker	**During unloading septage**	**Septage receiving**

6.2. Screen Chamber

6.2.1. Components

- Fibre Reinforced Plastic (FRP) Screen Chamber or Channel
- SS 304 bar screen with 6 mm spacing between bars

Two FRP screen chamber units are provided and dimensions 1.5m x 0.5m x 0.5m. The bars on the screen racks are typically fabricated out of 25 mm x 3 mm bars of stainless steel 304. A specified opening gap is kept between the bars. The screen frame is fixed in the bar screen chamber at an angle of 60º to the horizontal, leaning away from the incoming side. It must be ensured that there are no gaps left between the screen frame and the floor and the sides of the chamber. The upper end of the screen must rest against an operating platform, on which the FSTP operator stands to rake the debris collected at the grill.

6.2.2. Function

The function of the bar screen is to prevent entry of solid particles/ articles above a certain size, such as plastic cups, paper dishes, polythene bags, condoms, and sanitary napkins into the FSTP. (If these items are allowed to enter the FSTP, they will clog and damage the FSTP pumps as well as choke the plumbing, and cause stoppage of the plant.)

6.2.3. Operation of Screen Chamber

- Septic tanker outlet pipe will connect to screen chamber inlet pipe coupler and open the valves properly and allow flowing septage from septic tanker to screen chamber
- Observe and clean the bar screen during emptying of faecal sludge from septic tanker using the hand rake
- Check and clean the bar screen after complete draining of Faecal sludge after every feeding

- Do not allow solids to overflow/ escape from the screen
- After unloading of Faecal waste, clean the screen chamber immediately using water
- After screening we are collecting all waste and washing with fresh water and sun drying for few days. After sun drying spreading chlorine solution for disinfection, and with proper packing hand over to the solid waste dumping site for further treatment.
- With proper packing waste handing over to the solid waste dumping treatment site for disposal.

6.2.4. Preventive Measures

- Ensure no large gaps are formed due to corrosion or bending of the screen bars
- Clean the screen chamber properly after receiving septage by using fresh water to control the odour problem

6.2.5. Corrective Measures

- Replace corroded/ unserviceable bar screen immediately if gap between screen bars has increased.

6.2.6. Lab Testing and Reporting

- Data sheet should be filled properly during the operations at FSTP site

6.2.7. Troubleshooting- Treatment at site

PROBLEM	CAUSE	REMEDIAL MEASURE
• Large solids particles pass through, and choke the plumbing • Overflow of septage from over the screen	• Ignorance by helper • Screen damaged • Large solids passed though the bar screen due to high velocity during Faecal sludge unloading activity	• Helper must check septage level heading up upstream side of screen and rake the screen during feeding, continuously if required • Check frequently that the gaps between bars are appropriate, and if required, the screen should be repaired or replaced immediately • Drain the suction tanker without pumping, also make sure Faecal sludge coming from suction tanker pipe will not directly impact on bar screen

• Excessive collection of trash on screen	• Inadequate operation by helper	• Helper must monitor the screen during emptying and clean as required
• Excessive odour	• Spill over of septage during emptying • Screened objects dumped near screen chamber	• Helper must monitor and remove solids particles during feeding continuously(refer pic 3) • Screenings to be removed immediately from site and dumped at designated location in waste dumping yard. • Clean screen chamber by water after unloading of Faecal sludge immediately

6.2.8. Photos of Screen Chamber

1	2	3
		
Screening of floating material	**After screening septage passing into tank**	**Screening removal**

6.3. Solid Liquid Separator Tank

6.3.1. Components

- FRP solid liquid storage tank - 2 Nos.
- Plumbing and fittings

Solid liquid separator tank is made of FRP, with MS ribs to sustain exerted by the septage on the inside of the tanks after it is filled. A slope is provided at the bottom to settle and easily remove grit particles. Two Solid Liquid Separator Tanks are provided, and each of dimensions 2.3 m x 1.5 m x 2.0 m, each with approximately 5000 litres storage capacity.

6.3.2. Function

The Faecal sludge from the bar screen chamber is collected in the solid liquid separator tank. This tank is the first storage tank in the FSTP. Its main function is to act as a buffer: To collect the incoming faecal sludge from suction tanker that comes at widely fluctuating rates and pass it on to the rest of the anaerobic digester at a steady (average) flow rate. Further, due to retention time, solids and liquid are separated and grit particles will settle at the bottom of the tank.

6.3.3. Operation

- Wait for at least 2 hours after the septage is received in the tank to allow for settlement.
- Regularly check the settled grit at the bottom of the tank. There is a marking provided on the tank to denote maximum allowable grit level. Once the grit accumulation reaches this mark, it should be removed by opening the valve.
- There are four 50 mm valves provided on each tank.
- The septage is to be released into the BDT by opening the top valve.
- The septage is to be released every 20 min interval and for each time a maximum of 200 litres is to be released from each tank. Approximate time for draining 200 litres should be 2 Min and 20 Sec.
- Thus, in each cycle, a total of 400 litres is to be drained. With a 20-minute cycle, the total release per hour should not exceed 1200 litre.
- Clean top of the tank or cover regularly
- Check and clean clogged valves, unions, and vent pipe regularly
- Check leakages from the tanks, plumbing fittings and piping etc. regularly
- Keep the observation window clean. This can be done by flushing the window from inside with a jet of water when the tank is empty

6.3.4. Preventive Measures

- Observe the Faecal sludge level in the tank during unloading and make sure that the tank does not overflow.
- Tank cover must close properly each time.
- After every three months, the tank should be clean to remove settled muck/ sediments

6.3.5. Corrective Measures

- Remove grit regularly after grit level increases at the bottom of the tank to prevent choking problem in the BDT.
- During septage unloading work, septage may spill out on the tanks. In this case, immediately clean the tank for safety purposes.

6.3.6. Lab Testing and Reporting

- Data sheet should be filled properly during the operations at FSTP site. See annexure A-2
- Inlet sample will collect at this point for lab testing (raw sample).

6.3.7. Troubleshooting - Treatment at site

PROBLEM	CAUSE	REMEDIAL MEASURE
• Faecal sludge will not transfer to BDT	• Due to thick septage; choking the valve • Air Trapping • Valves are not properly operated by helper • Plastic waste, pads etc. blocked in the outlet pipe	• Check and clean valves regularly • Follow SOP for operates the valves and schedule for septage addition in BDT • Replacement of damaged plumbing • Dilute the thick sludge • Check screening process regularly
• Odour	• Due to storing septage for many days in the tank	• Draining the tank regularly as per schedule • Washing and cleaning tank frequently

6.3.8. Photos of Solid Liquid Separation tank

1	2	3
		
Solid Liquid Separation Tank	**Plumbing Arrangement**	**Grit valve**

4	5	6
		
Four valves for flow operating	**Scale for water level**	**Valve operation**

6.4. Grit Removal Arrangement and Treatment Tank

6.4.1. Components

- Grit Chamber in brickwork – 4 Nos.
- Plumbing and fitting

The grit treatment tank is made of brickwork with four compartments, each sized at 1.5 m x 1.5 m x 1 m. This tank is filled by graded filter media at bottom to pass excess water from grit and retain solids particles on top of the filter media layer, called bio-media layer. Worms and bacterial culture are present in the Biomedia layer and these are treating grit and organic and converted into vermicompost.

6.4.2. Function

Separated grit will be removed from the solid liquid separator tanks for further treatment on grit drying and treatment unit, using worms.

6.4.3. Operation

- Open the gate valve of solid liquid separator tank to remove grit particles.
- Spread grit particles on the grit treatment bed.
- Every week, grit should be removed. Use a different bed each time to treat the grit, as per schedule.
- Properly drain excess water and add this water to the TBF-II feed tank for further treatment.
- Check every bed's activity about waste converting into vermicompost.

6.4.4. Preventive Measures

- Regularly check the grit level in the solid liquid separator tank
- If the grit level increases, then immediately remove grit
- Check valves regularly

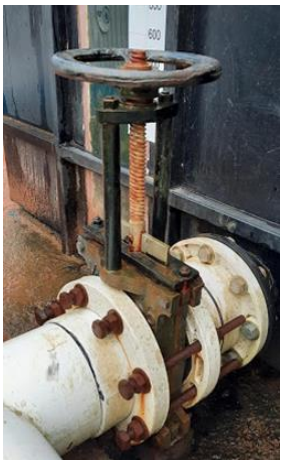
6.4.5. Corrective Measures

- If grit is accumulated in a large quantity, then remove the excess grit and dispose safely at dumping ground.

6.4.6. Troubleshooting - Treatment at site

PROBLEM	CAUSE	REMEDIAL MEASURE
• No grit coming on the grit beds	• Valves are choked • Grit compaction in the tank	• Check and clean valves before opening • If required, clean manually
• Excess grit deposition in solid liquid separator tank	• Valves are choked • Septage storage minimize	• Remove excess grit immediately • Check plumbing and fittings

6.4.7. Photos of Grit chamber

1	2	3
		
Grit chambers	**Flow control valve**	**Main Gate valve for grit chamber operation**

6.5. Anaerobic Bio Digester Tank (BDT)

6.5.1. Components

- Bio Digester Tank in HDPE- 6 Nos.
- Plumbing and fittings

Readymade HDPE Circular Biodigester tank is used for anaerobic digestion of the faecal sludge. 6 total BDTs are provided each with a capacity of 3000. The diameter of each BDT is 1.6 M and height is 1.6 M. Meshed baffles provided inside the BDT for attached growth process of microorganism. The BDTs are assembled in 2 series of 3 tanks each, and the outlet of the BDT is transferred to the Tiger Vermifiltration-I by gravity.

6.5.2. Function

Anaerobic digestion is a collection of processes by which micro-organisms break down the biodegradable material in the absence of oxygen.

Inoculum composes of bacteria capable of anaerobically degrading organic fraction. There are two types' acidogenic and methanogenic; this is a proprieties item of the technology.

These tanks are used to reduce organic load from Faecal Sludge. This tank contains specially formulated bacterial culture which consumes organics from faecal sludge. This is a three-stage process.

6.5.3. Operation

- Check water level inside the Solid Liquid Separator Tank and out of four valves, as per water level one by one valve will be opened for feeding.
- Open the ball valve fully for a few seconds to remove choked sludge, and then set as per designed flow rate of solid liquid separator tank to transfer the Faecal sludge towards the BDT
- Observe the BDT outlet point for faecal sludge outflow.
- If overflow is observed, then close the valve and wait for settlement.
- Always keep closed the air vent valve of the BDT.
- After finalisation of valve opening, start a stopwatch.
- Open selected valve fully and stop the feeding after 2 Min 20 Sec
- Simultaneously check the level marking as well within 2 Min 20 Sec we are adding 200 litres of septage one time into one series of BDT tank
- After addition of 200 litres, wait for a 20 min cycle completion for BDT-Series-I as we propose that 15-17 min is a resting period between two feedings for BDT-Series-I. The same holds for BDT-Series-II.
- After 20 min cycle, restart and operate the subsequent valve and repeat.
- Maximum 600 litres per hour septage passing through each BDT Series and total 1200 Litres per hour from both BDT.
- Observe the solid accumulation into BDT tanks on a weekly basis
- If possible, shoot videos and photos during opening of the BDT
- Keep the visual observations like flies, gas bubbles etc.
- Maintain and provide data for daily and weekly updates

6.5.4. Preventive Measures

- Check all valves and plumbing fittings regularly.
- Check acrylic sheet and lid of the BDT regularly for breakage.
- Always maintain anaerobic conditions in BDT.

- Do not open lid or acrylic sheet without instructions from the Plant In-Charge.
- Check the air vent pipe regularly.

6.5.5. Corrective Measures

- If anaerobic condition is not maintained, then check lid and acrylic sheet. If required, repair or replace immediate.
- If leakages from plumbing are observed, then repair or replace immediately.

6.5.6. Lab Testing and Reporting

- Data sheet should be filled properly during the operations at FSTP site. See annexure A-2
- Sample from BDT will collect at the TBF-I bed point for lab testing.

6.5.7. Troubleshooting - Treatment at site

PROBLEM	CAUSE	REMEDIAL MEASURE
• Overflow/ Short circuiting	• Trapping air • Plumbing breaking • Did not proper closing of Air vent pipe • Solid accumulation	• Check plumbing arrangement and air vent pipe. if choked remove or replace • Always keep close air vent pipe • Remove excess solids every three months to TBF-I bed
• Leakage	• improper plumbing work • breakage of plumbing	• Repair or replace plumbing and fitting immediately
• Presence of Inorganic waste	• Improper screening operation by operator	• Check screening operation properly
• No bubbling	• No anaerobic condition maintaining	• Make sure lid and vent pipe keep close every time

6.5.8. Photos of BDT

1	2	3
		
BDT Tanks	**BDT Series**	**Flow Control valve**

4	5	6
		
Air vent valve	**Piping arrangement**	**Valve arrangement**

6.6. TBF Vermifiltration-I (TBF-I)

6.6.1. Components

- TBF bays in brickwork- 4 No's
- Plumbing and fittings

This tank is constructed with Bricks and Plastering. Total three bays provided with tank in tank design. Size of each bay is 3.3 M X 3.3 M X 0.8 M and inner tank size is 1.5 M X 1.5 M X 0.8 M. The partition walls are made as per honey combing type brick wall.

6.6.2. Function

The thickened sludge coming from the Anaerobic Bio Digester Tank is then spread on Tiger Vermifiltration-I beds comprising earth worms and bacterial culture situated into a suitable habitat.

This tank is used to separate the residual solids and liquid stream coming from anaerobic digesters. The offensive odours are completely removed in this stage. The trapped solids are consumed by earthworms and converted to Vermicompost, reducing the organic load. The liquid stream leaves the tank from the bottom and is stored into a tank.

Biomedia composed of worm's culture, bacterial culture and cocopeat it is a proprietary items of the technology.

6.6.3. Operation

- Check all beds before beginning feeding from the BDT. Decide which valve is to be opened, as per schedule.
- Check the top of each respective bed layer if previous waste is converted, and if so, check the quality of vermicompost and worm availability.
- Open only one valve before starting BDT feeding and confirm return valve is closed properly.

- Ensure before starting the addition of thickened septage from BDT tank that the TBF bay's first valve is open as per requirement (whether its chamber 1, 2, 3 or 4).
- Observe the beds during flow starting and ending for the worm's response towards the incoming solids from the BDT tanks
- Water logging activity needs to be monitored - verify time required for water draining
- Solid accumulation if seen thick incoming solids are coming from BDT tanks
- Vermicompost conversion observations - Check vermicompost formation through photos and monitoring on daily basis
- Before feeding, check worm quantity and worms health
- Check vermicompost conversion rate after feeding regularly.
- Keep observational records of baby worms and cocoon
- Change the feeding chamber for every one-hour cycle.
- Feed alternate to the all three chambers to prevent the TBF beds from heavy loading and water logging load

6.6.4. Preventive Measures

- Ensure all valves are closed after feeding is completed.
- Do not open all valves at a time. Only open one valve, as per schedule.
- Check TBF beds regularly as well as check worm quality and quantity.

6.6.5. Corrective Measures

- If solid excess accumulation is observed, then change the coir mats.
- If thickened wastewater comes from BDT, then as per site conditions, decide the use of alternate bays.
- Vermicompost will be removed after every three months if required.

6.6.6. Lab Testing and Reporting

- Data sheet should be filled properly during the operations at FSTP site. See annexure A-3
- Sample will collect at the outlet of the TBF Vermifiltration-I at intermediate tank point for lab testing.

6.6.7. Troubleshooting - Treatment at site

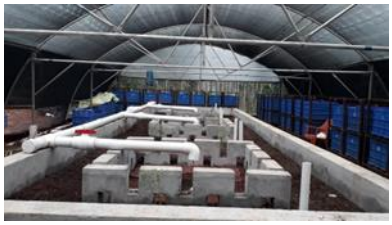
PROBLEM	CAUSE	REMEDIAL MEASURE
• Water logging	• Excess solid accumulation on the TBF bed surface	• Remove excess solids as well as on mat or replace mat • Stop the feeding

• Excess solid accumulation or flow	• Variation in septage from BDT	• Check BDT tank, if excess solids accumulation in the BDT, need to remove
• Thickened wastewater	• Excess solids accumulation in the BDT	• excess solids accumulation in the BDT, need to remove
• Inorganic waste present	• Improper screening operation by operator	• Check screening operation properly
• Lack of flow	• Choking of plumbing • Solid deposition in the pipe	• Check and clean piping and fittings by using freshwater jet

6.6.8. Vermicompost Removal

- Removal of Vermicompost from TBF first beds and TBF second crates
- Frequency of VC removal is once every three months if required
- First, observe the VC accumulation into TBF three chambers, as well as TBF crates
- As per VC generation rates from each chamber and TBF crates, collect all generated VC into one corner of each chamber and crates
- Use heap method for VC collection into each chamber and TBF crate
- Keep all heaps rest for one day
- On the next day remove the heaps carefully, avoid the worms and cocoon from VC during collection.
- Heaps help to remove worms from collected VC
- Scoop the collected VC. Use safety gloves.
- Keep the VC into sun to dry for at least 15 days for disinfection before packing

6.6.9. Photos of TBF operation

1	2	3
		
TBF first arrangements	**Flow controller**	**Worms under mat**

4	5	6
		
Septage addition through the BDT tank	**Pipes for ventilation**	**Valve opening for TBF first chamber**

6.7. TBF Vermifiltration-II (TBF-II)

6.7.1. Components

- 12 MS fabricated stands
- 48 plastic crates with filter media and bio media
- 24 FRP funnels
- Plumbing and fittings

This tank is made in MS fabricated material with Plastic Crate and FRP funnel. Total 12 MS stands are provided, and size of each stand is 1 M X 1.3 M X 1.5 M with two FRP funnels for treated water collection at the bottom. Two crates at each level provided with filter media including aggregates, filter sand, bio-media including worms and bacterial culture.

6.7.2. Function

The technology uses filtration arrangements consisting of Bio media which contains worm's culture, bacterial culture and cocopeat culture, Biomedia function trap and treat impurities from TBF VERMIFILTRATION-II. The filtration medium is arranged in a stacked manner with bio media on top. The top layer serves as active zone habitat for Bacteria and earth worms specifically bred for the purpose, while bottom layers provides structural support and free drainage for clear water. The trapped Impurities (Organic matter) are then consumed by bacteria and earth worms, resulting in reduction in organic matter (measured as Biochemical Oxygen Demand (BOD).

6.7.3. Operation

- Once started, the automated pumps will pump wastewater the appropriate levels from the TBF-I into a collection tank.
- Feeding pumps will operate alternately.
- Plant can run both mode automation and manual. If plant is on auto mode, there is no need to start pump - it will start itself by level sensors. If plant is on manual mode – check the water level into tanks and if a sufficient level is found in the tank, then start the pump.

- Two operating valves can be adjusted manually for TBF crates flow and return flow as well.
- Adjust the valve as per daily flow limits as designed is 750ml/min on each crate, once the adjustment of valve is complete, adjust the flow inside TBF crates
- Flow checking is done by beaker and stopwatch.
- Take a beaker and put it the below of TBF crates flow start the stopwatch and stop the watch after 1 min check the volume collected after one minutes of flow it should not be more than 750 ml/min
- Regularly check the flow of two to three crates each time.
- Make observations on worms' population, growth, colony formations, baby worms, cocoon as per data sheet
- Fresh vermicompost – observe all TBF second crates daily and note down the vermicompost seen
- Check water logging in the crates regularly
- Further, check side draining from crates
- Check piping arrangements regularly for avoid the leakage problem

6.7.4. Preventive Measures

- Check worm population in each crate regularly to avoid water logging condition
- Check plumbing and fittings regularly to avoid leakages
- Do not change valves arrangement to avoid flow rate variation.

6.7.5. Corrective Measures

- If water logging condition is observed in the crates, check flow rate as per design.
- If water logging condition is observed in the crates, then check worm quantity and add if required.
- If water logging condition is observed in the crates, then check solids accumulation, if excess solids present then remove immediately solids and add in the grit chamber.
- If worms are not present in the crates, then add more worms immediately.
- Vermicompost will be removed after every three months if required.

6.7.6. Lab Testing and Reporting

- Data sheet should be filled properly during the operations at FSTP site. See annexure A-3
- Sample will collect at the outlet of the TBF Vermifiltration-II outlet at filter feed tank point for lab testing.

6.7.7. Troubleshooting - Treatment at site

PROBLEM	CAUSE	REMEDIAL MEASURE
• Water logging condition	• Excess flow rate • Solid accumulation • No worms present • Filter media disturbance	• Adjust flow rate and check • Remove excess solids with safe handling • Addition of worms • Check and replace filter media layers if required
• Smelling issue	• Improper treatment • Dead worms in crate	• Check process of the treatment unit • Remove dead worms immediately by gloves or put some fresh vermicompost
• Varies in the flow rate	• Leakages from plumbing	• Check and repair or replace plumbing

6.7.8. Photos of TBF II operation

1	2	3
		
TBF second one set	**Distribution arrangement through the channels**	**TBF 2 stand arrangement**

4	5	6
		
TBF II arrangement	**TBF arrangement stand inside the shed**	**TBF second stand arrangements**

6.8. Pressure Sand Filter (PSF), Activated Carbon Filter (ACF) and Chlorination

6.8.1. Components

- PSF and ACF FRP Vessel
- Filter Feed Pump
- PurAll Chlorinator
- Plumbing and Fittings

PSF and ACF vessels are made in FRP. Diameter of each vessel is 0.3 M and height is 1.5m. In PSF, 10 mm gravel is used as a bottom support layer, followed by 6 mm chips, and the top of the layer is 500-micron filter sand which is used for filtration. In ACF, 10 mm gravel is used as a bottom support layer, and the top of the layer is anthracite carbon. The PSF and ACF are connected by plumbing. Once in a year we have to wash the PSF And ACF media to remove clogged organics .Inlet water is pumped into the PSF, then the ACF, and then through the PurAll chlorinator. One chlorination cartridge can be useful up to 5 lac litres of treated water.

Chlorination unit has desired set unit is 5 PPM, and it can be treating up to 5 lac litres treated water.

We have provided 6 cartridges and it can treat total 30 lac of treated water.

6.8.2. Function

Tertiary treatment is used as a polishing and disinfection unit, provided to remove any colour or odour remaining from secondary treatment for safe handling of treated wastewater for gardening and irrigation. The disinfection by chlorination is provided to make treated effluent safe for human handling and disposal.

6.8.3. Operation

- Check water level in the Filter feed storage tank.
- Check operating pump I or II before starting pumping.

6.8.4. Preventive Measures

- Check valve arrangement first before starting the feed. Return and backwash valve should be closed during feeding.
- Check all valves are closed after feeding work is completed.
- Do not open FRP vessel or multiport valve without instructions.
- Do not change plumbing without instruction.
- Do not change PurAll valve adjustments.
- Do not open all valves simultaneously. Only open one valve as per schedule.

6.8.5. Corrective Measures

- If output water quality is not good, then a back-wash operation must be conducted immediately improve water quality from PSF and ACF.
- After chlorination, if chlorine is not present in the treated water, first check the cap of the PurAll – If red indicator shown, then open the PurAll cap and replace chlorine cartridge immediately.

6.8.6. Lab Testing and Reporting

- Data sheet should be filled properly during the operations at FSTP site. See annexure A-3
- Sample will collect at the outlet of the Chlorination unit at Final Treated water tank point for lab testing.

6.8.7. Troubleshooting - Treatment at site

PROBLEM	CAUSE	REMEDIAL MEASURE
• Bad water Quality • Dirty Water at outlet	• Irregular backwash taking • Changing valves arrangements due to effect on inlet flow rate	• Take backwash immediately • Adjust flow rate as per design flow
• Smelling issue	• Irregular backwash taking • Lack of Chlorine or chlorine cartridge finished	• Take backwash immediately • Check and Replace immediately with new chlorine cartridge
• Water not coming the PSF and ACF	• Filter Feed Pump is not working • Choking in the pump or plumbing line or fittings	• Check pump and if any particles choked in the pump then remove and check again • Check plumbing line and fittings first if any damages then replace it or if choking, clean it

6.8.8. Photos of Operations

1	2	3
		
PurAll Unit	**PSF – ACF**	**Control valve**

7. RESPONSIBILITIES OF STAKEHOLDERS

Keywords: Plant staff, PriMove, KMC, duties, responsibilities

7.1. General

The Kalpetta Faecal Sludge Treatment Plant will be operated by PriMove for a period of one year, as stated in the contract. After this period, the responsibility of operating the plant is to be borne by KMC. KMC will be involved in the O&M of the plant from an early stage, in order to professionally train the KMC staff in operating the plant. With this in view, the manual has been developed to serve as a guide to the O&M processes. The Plant In-Charge and helpers are the persons responsible for operating the FSTP. Kalpetta Municipality and PriMove are also responsible for supporting the O&M team for running the FSTP.

It is recommended that there should be a team of three persons to operate the plant in two shifts.

- Plant In-Charge for general shift
- Two Helpers working in two shifts rotationally

7.2. Plant In-Charge Role and Responsibility

The Plant In-Charge is responsible for ensuring smooth operation of the plant and to ensure proper functioning in terms of output parameters, equipment maintenance, regularly maintaining data and compilation of report etc. The detailed scope is given below.

Plant In-Charge's responsibilities include, but are not limited to, the following:

- Know all the process related aspects outlined in this manual
- Being familiar with applicable permit, state PCB requirements, monitoring, reporting and record forms that must be completed concerning FSTP operations
- Maintaining complete and accurate operation records
- Know all safety standards and hazards related to the treatment facility
- Know the capabilities and limitations of the complete Faecal sludge treatment system and how to best operate the system with changing loading and climate conditions
- Notify KMC or PriMove of potential problems of a serious nature.

7.3. Helper's Responsibilities

The helper must be present and active daily onsite and on-call presence at the FSTP under guidance of Plant In-Charge.

Helper's responsibilities include, but are not limited to, the following:

- Helper must be familiar with the equipment and processes of the FSTP

- Helpers are onsite to perform continuous routine operations and respond to emergency or upset events at all times of the day, 7 days a week
- They must have the ability and knowledge to operate FSTP equipment, collect, compile, and evaluate operating information, and to plan necessary actions and maintenance procedures to achieve continuous proper operation of the plant under the supervision of the Plant In-Charge
- The helper is able to make sound judgment regarding when and where to obtain additional help
- The helpers must notify the Plant In-Charge, KMC or PriMove of potential problems of a serious nature

7.4. Management Responsibilities – KMC

Municipal support for the FSTP is an essential element of the properly conducted operation and maintenance program.

Responsibilities of Municipal management include, but are not limited to, the following:

- Regular and timely supply of faecal sludge from honey suckers / suction tankers as per schedule.
- Know-how to operate the system and the function and purpose of each major element of the system, including awareness of significant or frequently recurring issues associated with the system and specific elements.
- Ensuring the Plant In-Charge and helper is provided with current and appropriate technical manuals.
- Understanding the elements of periodic reports required by KMC and KPCB; ensuring that required operation and maintenance tasks are properly done, and ensuring the reports are accurate and submitted in a timely manner.
- Supply of electricity and water to operate the FSTP without any disturbance

7.5. Management Responsibilities – PriMove

As the technology for the FSTP is a proprietary technology of PriMove IDC, PriMove shall provide the technological support necessary for the smooth functioning of the Kalpetta FSTP. Responsibilities of management include, but are not limited to, the following:

- Technical support for plant operation and maintenance
- Verifying data sheets and analysis report
- Modification in the plant or process if require
- Coordinate with Municipality about Faecal Sludge inlet and outlet if parameters vary

7.6. Desired Qualification and background of Plant Operation team member

Plant In-Charge

- Diploma or BE in Civil / Mechanical / Environmental, preferably with experience of operating water treatment plant / sewage treatment plant /Faecal Sludge Treatment Plant
- Basic understanding of operation and basic repair/ maintenance knowledge of operating small pumps, valves etc.
- Experience in handling and leading a team
- Must be adept at record keeping and basic computer knowledge about MS office and emails etc.
- Good communication skill in English, Hindi, and Malayalam.

Plant Helper

- Minimum 10th / 12th passed, preferably with experience of operating water treatment plant / sewage treatment plant.
- Experience of composting/ vermicomposting/ solid waste treatment
- Required Communication skill in English, Hindi, and Malayalam.
- Willingness to work with compost/ sludge (with due safety measures)

8. NOTE ON HEALTH AND SAFETY

8.1. General

- Operator will be trained by plant in charge for minimum 10 days to understand the technology, FSTP safety terms and plant operation.
- The deep tanks – for deep tanks, any cleaning procedure or any handling procedure shall be done in the presence of supervisor
- The gas generation risk at any end of the units (BDT) – particularly tanks, any gas generation in case of trouble shooting is expecting in such case the plant operators shall bring it to the notice of super-visor, super-visor, who should check issues, consult the engineer manager of the plants and accordingly make the safe removal of the gas before giving any access to the plant operators.
- Safety from mosquito-, insect- and snakebites – at the fstp the operators and supervisor shall use mosquito repellent while operating the plant. In case of insect bites, use Lacto calamine lotion (kept in the first aid box) as a first response. As a safety precaution from snakes and potentially dangerous creatures, keep torch into first aid box. Pointing work or closing of crevices should be done. Prevent any crevices and possible hiding places. In late evening place should be well lit.

8.2. Safety Procedure for operators

- This Health and Safety Rulebook is presented for the use of all employees of this utility to assist in the administration of our safety program and to provide means and methods that will aid in the performance of our various assignments in a safe and efficient manner.
- Employees working in the FSTP facility must be trained prior to commencement of work so that they are aware of the health and safety risks as well as the operational procedures associated with the FSTP. The following are important safety rules:
- It is the intent of the utility to conduct its operations in a safe and efficient manner with the utmost regard for the health and safety of the employees and the public. Safety is an integral part of everyone's duties and responsibilities.

8.3. Important safety rules

- Working with Faecal sludge requires adequate protection for operators. This includes wearing steel toed shoes, hard hat, rubber aprons, and protective glasses with side shields, protective gloves, and ear plugs.
- All authorized personnel working in the FSTP should have taken Hepatitis A and B vaccine.
- Operator need to keep his working area clean to minimize the risk of accidents.
- Regular personnel hygiene (like washing hands) is important to prevent illness.
- Always follows the Lock-out, tag-out procedures when servicing equipment.

- No person shall drink the water in the plant or the water that is discharged from the FSTP.
- Safety showers and eyewash are located within proximity of chemical systems in the FSTP plant.

8.4. Handling of Septage

- Any person handling or operating the plant or handling any waste matter, whether treated or non-treated shall essentially use a mask and gloves and provide a mask and gloves to the honey sucker personnel who discharge the Septage from Septage vehicle.
- First aid box - Always place a first aid box at FSTP location that includes, Band-Aid and bandages, crepe bandage, antiseptic creams, Vicks, cotton, Dettol, Lacto calamine, seizer, diarrhea tablet and ORS packet The first aid box will be checked every week by the supervisor, and any consumption will be replenished within 24 hours.

8.5. Contact Personnel for Health and Safety

- Owner of the plant- Kalpetta Municipality Council
- Operator of the plants - PriMove Infrastructure Development Consultants Pvt. Ltd.
- First respondent for Health and safety issue- Unaise Muhammad- Plant In charge, Phone- 09539491771
- Second respondent – Rohit Patankar - Project Manager –Phone- 09595839521
- Emergency contact number – DIAL 102
- Ambulance services - 09847393712
- Civil hospital, Kalpetta – FATIMA HOSPITAL 04936204018

9. LIST OF ASSETS

A detailed listing of every part used in the plant

Sr. No.	Description	Quantity
A.	**Screen Chamber and Solid Liquid Separator Tank**	
1	Screen Chamber MOC- Fiber Reinforced Plastic (FRP) with MS Brackets SIZE- 2.3M X 0.5 M X 0.5 M	2 Nos.
2	Bar Screen MOC- Stainless Steel SIZE- 6 mm opening	2 Nos.
3	Solid Liquid Separator Tank MOC- fiber Reinforced Plastic (FRP) SIZE- 2.3 M X 1.5 M X 2 M CAPACITY-5000 Liters	2 Nos.
4	Plumbing MOC- UPVC Distribution System	-
B.	**Anaerobic Bio Digester Tank**	
1	Anaerobic Bio Digester tank (BDT) MOC-HDPE SIZE-1.6 M Dia X 1.6 M CAPACITY- 3000 Liters each BDT	6 Nos.
2	Plumbing MOC- PVC and UPVC Distribution System	
C.	**TBF Vermifiltration – I**	
1	TBF VERMIFILTRATION–II- Outer Tank MOC-BRICK MASONRY SIZE-3.3 M X 3.3 M X 0.8 M	4 beds
2	TBF VERMIFILTRATION–II- Inner Tank MOC-BRICK MASONRY SIZE-1.5 M X 1.5 M X 0.8 M	4 beds
3	Filter Media 20 MM Aggregates 500 Micron Filter Sand	In each crate
4	Biomedia Vermicompost + Coco pit Tiger Worms and bacterial Culture	In each crate

5	Plumbing MOC- UPVC Distribution System Collection system	
D.	**TBF Vermifiltration – II**	
1	TBF VERMIFILTRATION–II TBF Stand-MS with FRP funnel Size- 1.4 M X 1.05 M X 1.5 M	12 Stand 24 Funnel
2	Crate MOC-Virgin Plastic- Nilkamal Size- 0.82 M X 0.58 M X 0.42 M	48 Crate
3	Filter Media 20 MM Aggregates 500 Micron Filter Sand	
4	Biomedia Vermicompost + Coco pit Tiger Worms and bacterial Culture	
5	Plumbing MOC- UPVC Distribution System Collection system	
E.	**Intermediate Storage Tank**	
1	Intermediate Storage tank with Lid MOC- fiber Reinforced Plastic (FRP) SIZE- 1.5 M X 1.5 M X 2.5 M CAPACITY-5000 Liters	2 Nos.
2	Pump for Distribution to TBF Vermifiltration- II Make- Kirloskar, 1 HP	1W + 1S
3	Plumbing MOC- UPVC Distribution System Collection system	
F.	**Filter Feed Tank**	
1	Filter Feed Tank with Lid MOC- fiber Reinforced Plastic (FRP) SIZE- 1.5 M X 1.5 M X 2.5 M CAPACITY-5000 Liters	2 Nos.
2	Pump for feeding to Polishing Make- Wilo, 0.5 HP	1W + 1S
3	Plumbing	

	MOC- UPVC Distribution System Collection system	
G.	**Treated Water Tank**	
1	Treated Water tank with Lid MOC- Precast Reinforced Cement Concrete (RCC) MOC- MS fabricated Lid SIZE- 1.75 M Dia X 2.5 M CAPACITY-5000 Liters	1 No.
2	Pump for treated water distribution Make- Wilo, 0.5 HP	1W + 1S
3	Plumbing MOC- UPVC Distribution System Collection system	
H.	**Polishing Unit**	
1	Rapid Sand Filter MOC- FRP Vessel 0.3 M Dia X 1.5 M Height Multiport Valve Interconnecting Pipe and fittings 6 mm Aggregates 500 Micron Filter Sand	1 No.
2	Activated Carbon Filter MOC- FRP Vessel 0.3 M Dia X 1.5 M Height Multiport Valve Interconnecting Pipe and fittings 6 mm Aggregates Activated Carbon Chips	1 No.
3	PurAll Chlorinator MOC- UPVC and FRP Interconnecting Pipe and fittings	1 No.
I.	**Admin cum Control Room**	
1	Portable Cabin MOC- MS fabricated Size- 20 Ft X 10 Ft X 8.5 Ft	1 No.
2	LED Tube Light	3 Nos.
3	Fan	2 Nos.
4	Bulkhead Door Light	1 No.

5	Switch and Socket Board	6 Nos.
6	AC provision point	1 Nos.
7	Office Table- MS fabricated with wooden Top	1 Nos.
8	Chair- Plastic -Deccan	4 Nos.
9	Stool- Plastic –Deccan	4 Nos.
J.	**Others**	
1	Shed for TBF System MOC- GI fabricated with poly film and shed net Size- 32 Ft X 16 Ft X 10 Ft with one door for opening	1 No.
2	Toilet Block with overhead water tank and basin MOC- FRCS panel with Orissa pan and HDPE water tank Size- 3 FT X 3 FT X 6 FT	1 No.
3	Tiger Toilet Biodigester MOC- FRP Circular ring type digester Size- 1 M Dia X 1.5 M depth	1 No.
4	Platform for tanker unloading MOC- Reinforced Cement Concrete Size- 6 M X 3.5 M X 0.2 M	1 No.
5	Electrical Pole with LED Light	6 No.
K.	**Tiger Biofilter-III**	
1	Grit Chamber MOC-BRICK MASONRY SIZE-1.50 M X 1.50 M X 0.9 M	4 No.

Conclusion:-

It is hoped that this manual will guide and instruct in the operation and maintenance of the FSTP. Primove has given one year of assistance of operation and maintenance and has already trained staff. In case of any major issues that is not being solved and in case of doubts please feel free to contact Primove.

10. ANNEXURE

Annexure 1

Data sheet for data collection during septage collection

Sr. No.	Description	Details
1	Date of Septage Collected	
2	Family Name	
i.		
ii.		
iii.		
3	Contact Number	
4	Vehicle Number	
5	Vehicle Driver Contact Number	
6	Locality	
7	Taluka/Block	
8	District	
9	No's of members are permanently residing in the HH	
10	Type of storage facility for septage	
		Septic Tank
		Single Pit
		Two Pit
11	Capacity of storage facility	
12	Date/Year of septic tank construction	
13	MOC of Tank	
		Brick tanks
		Readymade plastic tanks
		RCC tank
		RCC Pipe tanks
		Ferro cement
14	Dimension of the tank	

Annexure 2

Data sheet for data collection during septage unloading at FSTP site (A-D)

Sr. No.	Description	Details
A.	Screen Chamber	
1	Type of septage	Liquid / Semi Liquid / Thick Liquid / Solid
2	Odour during unloading	Yes / No
3	Type of inorganic waste present	Plastic / Pads / Rubber/ Paper / Others
4	Overflow during unloading	Yes / No

Sr. No.	Description	Details
B.	Solid Liquid Separator Tank	
1	Grit settlement level	_____MM
2	Odour during unloading	Yes / No
3	Overflow or Spillage	Yes / No

Sr. No.	Description	Details
C.	Grit Chamber	
1	Type of Grit	Liquid / Semi Liquid / Thick Liquid / Solid
2	Odour during unloading	Yes / No
3	Tentative Quantity	_____Litre
4	Type of inorganic waste present	Sand / Plastic / Pads / Rubber/ Paper / Others

Sr. No.	Description	Details
D.	Anaerobic Bio Digester (BDT)	
1	Type of septage	Liquid / Semi Liquid / Thick Liquid / Solid
2	Odour during unloading	Yes / No
3	Type of inorganic waste present	Plastic / Pads / Rubber/ Paper / Others
4	Overflow during unloading	Yes / No
5	Chocking in the plumbing	Yes / No

Annexure 3

Data sheet for FSTP unit observations (A-C)

Sr. No.	Description	Details
A.	**TBF VERMIFILTRATION-I**	
1	Type of septage/wastewater	Liquid / Semi Liquid / Thick Liquid / Solid
2	Odour during unloading	Yes / No
3	Type of inorganic waste present	Plastic / Pads / Rubber/ Paper / Others
4	Overflow during unloading	Yes / No
5	Chocking in the plumbing	Yes / No
6	Presence of worms	Yes / No
7	Presence of cocoons	Yes / No
8	Presence of vermicompost	Yes / No
9	Water logging condition	Yes / No

Sr. No.	Description	Details
B.	**TBF VERMIFILTRATION-II**	
1	Type of septage/wastewater	Liquid / Semi Liquid / Thick Liquid / Solid
2	Odour during unloading	Yes / No
3	Type of inorganic waste present	Plastic / Pads / Rubber/ Paper / Others
4	Water logging condition	Yes / No
5	Side draining from crate	Yes / No
6	Chocking in the plumbing	Yes / No
7	Presence of worms	Yes / No
8	Presence of vermicompost	Yes / No

Sr. No.	Description	Details
C.	**Polishing**	
1	Type of water	Liquid / Semi Liquid / Thick Liquid / Solid
2	Solids are present	Yes / No
3	Odour during unloading	Yes / No
4	Chocking in the plumbing	Yes / No
5	Quality of treated water	Best / Good / Poor
6	Chlorine Smell	Yes / No

Annexure 4

Basic Information and Technical Information

Date		**Time**		**am/pm**

1. Basic Information (Must be completed by the septage emptier (person)

Complete Name			
No's of members are permanently residing in the HH			
Phone Number			
Complete Address			
Taluka/Block		District	

2. Technical Information (Must be completed by the septage emptier (person)

Volume of septage emptied (litres)					
Type of storage facility for septage			Source		
Holding Tank			Residential		
Septic Tank			Restaurant		
Single Soak Pit			Office/commercial		
Two Soak Pit			Industrial		
Other (specify)			Other (specify)		
Date/Year of septic tank construction					
MOC of Tank					
Brick tanks			RCC tank		
Plastic tanks			RCC Pipe tanks		
Dimension of the tank					
Length		Width		Height	

The undersigned being duly authorized hereby certifies to the accuracy of the source and type of collected septage identified above and subject to this manifest.

Date	Signature

Annexure 5

Information about the Honey Sucker Supplier:

(Must be completed by the Plant In-Charge)

Company Name	
Vehicle Driver Name	
Vehicle Driver Contact Number	
Type of Vehicle	
Vehicle Number	
Trip Code	

The above evacuator delivered the described septage to this FSTP and it was accepted.

Date	Signature of authorized Plant In-Charge

Annexure 6

Daily / Weekly Activity Schedule

Sr. No	Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	8.00 to 6.00	Works to be carried out every hour Open valve and allow passing faecal sludge from solid liquid storage tank to BDT						
		Removal of Screening waste from Screen every time when unloading work is started Washing of the screen chamber and screen after unloading of faecal sludge Back wash						
		Observation of gas generation or short-circuiting in the BDT regularly						
		Daily updates all data into the Dropbox files						
		Feeding to TBF I - BED 1	Feeding to TBF I - BED 2	Feeding to TBF I - BED 3	Feeding to TBF I - BED1	Feeding to TBF I - BED 2	Feeding to TBF I - BED 3	
		Cleaning of TBF I - BED3	Cleaning of TBF I - BED1	Cleaning of TBF I - BED2	Cleaning of TBF I - BED3	Cleaning of TBF I- BED1	Cleaning of TBF I - BED 2	
		Cleaning plant area, water spreading in the garden, etc.						
		Checking water level in the TBF-I feed pump and operation for TBF beds						
		Once in a week meeting with municipality about plants operations update or any trouble shooting about plant operations						

Annexure 7

Monthly Activity Schedule

Sr. No	Time	Monthly Routine Activity	
	As per schedule	Once in a month all pumps need to be check by authorised person to ensure all pumps are in a good condition	
		Once in a month All electrical panels and electrical fitting checking and repairing if any found	
		Once in a month BDT accumulation checking from all the BDT tanks as per procedure	
		DC meeting for update of the plant operations	
		Once in a month meeting with Honey suckers about the updates about Septage order and any other issues if any	
		Monthly progress report of the FSTP plant operations submission to the UNICEF as well as Municipality	
		Once in a month collect all stages sample for analysis and analyse through the CSE lab and update all data into sheet as well as monthly reports	

Annexure 8

Periodic Activity Schedule

Sr. No	Time	Periodic Activity	
	As per schedule	Vermicompost removal from TBF first beds and packing for sell	
		Vermicompost removal from the TBF II beds and packing for sell	
		Grit chamber – vermicompost checking and removal	
		FSTP site visit by Project manager to ensure that the plant perform as expected, and conduct troubleshooting if required	

Annexure 9

Technical Credentials

Peer Reviewed Publications

- Dr. Michael Templeton, Imperial College, London published a paper on Tiger Toilets at International Water Association Conference S@SMALL for Sustainable Solutions for Small Water & Wastewater Systems, Nantes, France, Oct. 2017
- Furlong et al. (2016) Technical and user evaluation of a novel worm-based, on-site sanitation system in rural India. Waterlines Vol. 35. No.2
- Furlong et al. (2015) the development of an onsite sanitation system based on Vermifiltration: the 'Tiger Toilet'. Journal of Water, Sanitation and Hygiene for Development, 5, 608-613
- Furlong et al. (2014b) Processing of human faeces by wet Vermifiltration for improved on-site sanitation. Journal of Water, Sanitation and Hygiene for Development, 4, 231-239
- Furlong, C. et al. (2014a) Paper presented to the IWA-AIT 1st Specialist Conference on Municipal Water Management and Sanitation in Developing Countries, Asian Institute of Technology, December 2014.

Annexure 10

Intellectual Property

1. **Tiger Toilet**

"TOILET SYSTEM OFFERING SAFE AND COMPLETE WASTE TREATMENT IN DIFFICULT TERRAIN"

PATENT NO. WO 2018/225082 A8

2. **Tiger Toilet**

"SYSTEM OF TREATMENT OF SEWAGE WASTE FOR ON-SITE SANITATION"

PATENT NO. WO 2017/29682 A1

3. **Tiger Toilet**

"TOILET SYSTEM OFFERING SAFE AND COMPLETE WASTE TREATMENT IN DIFFICULT TERRAIN"

PATENT NO. 201721018207 A

4. **Tiger Bio-Filter**

"SYSTEM FOR TREATMENT OF SEWAGE BY VERMIFILTRATION"

PATENT NO. 201721031518 A
