TECHNICAL NOTE ON

TERRAIN APPROPRIATE TOILET TECHNOLOGY

Author: Anurag Gupta,

Editor: Archana Pandey

Picture Courtesy: DLR Prerana, Darjeeling

Published in 2022

On the cover:
Biba Manger and her husband, an elderly couple from our intervention area who benefitted from the Biodigester toilet constructed in their house in Darjeeling.

About the Project

WaterAid India with support from Twinings implemented a project in two Tea Estates of Darjeeling in the state of West Bengal, India.

With Twinings' support, WaterAid India made a lasting impact in communities, reaching over 5,000 people with improved access to clean water, sanitation and hygiene. Through this project we were able to reach the community with access to clean water, safe sanitation and good hygiene which enabled a better quality of life for the workers and their communities in the identified tea estates. Access to these basic requirements decreased instances of diseases and improved the working conditions of the tea estate workers. As a result, the absenteeism of workers was less due to sickness, thereby adding to their productivity and subsequently increasing their livelihood. their opportunities to work and thus enabling them to earn more. As a result of our intervention in these communities, Community institutions (Samaj) and Tea Estate management, over time the workers and staff became more aware of sanitation and hygiene issues, which enabled them to build strong systems of operation and maintenance within the tea estates.

The project aimed at the overall well-being of the community which includes women, children, Adolescent girls, the elderly and workers whereas it contributed to the business interests of the Corporates with increased return on investment.

The project commenced on 1st July 2019 and reached out to 5,439 people from 21 villages of two Tea Estates (Nagrifarm and Barnesbeg).

Terrain-appropriate toilet technologies

The households in tea estates were using *kuccha* (temporary) toilet pits which are unhygienic and unsafe. These pits have to be dug every seven or ten years depending on the land and weather conditions. Sometimes the pits collapse in monsoons during heavy rains. This makes it unsafe and prone to landslides due to seepage. The pits also let out a foul odour and cause contamination of underground water and springs. WaterAid with the support of Twinings introduced two new toilet technologies in Barnesbeg and Nagrifarm tea estates- Biodigester toilet and Evapotranspiration Faecal Digester (EFD) based toilets. These two types of technologies are environmentally friendly, prevent contamination of soil and water and have a longer life.

Bio-Toilet	66
EFD	9
Total	75

Bio-toilets have three underground chambers. In the chambers, the Microbial inoculum bacteria speed up decomposition and poly-grass mats on the chamber walls help bacteria to multiply. Wastewater from the toilet is gradually cleaned as the water flows from one chamber to the other until the effluent coming out of the third chamber can be filtered further or reused for irrigation.

Evapotranspiration toilets rely on plants absorbing wastewater through their roots and evaporating the water through transpiration; Wastewater from the toilet flows through an underground "tank" built from old tyres, surrounded by layers of stones and sand.

Bio-digester toilet

Bio toilet technology is a new technology designed for toilets which are eco-friendly and best suited for places where there is no facility for following all components of the sanitation value chain viz. emptying, transportation and treatment of faecal sludge. This system requires less maintenance, and can have a lifespan of at least 20 years with proper care and maintenance it is sustainable for all terrains and topography, especially rocky, high-water table and flood-prone areas.

Due to the lack of facilities for treatment of the faecal matter in the Darjeeling Himalaya, the households resort to manually emptying faecal matter whenever the pits or septic tanks are full. This has challenges like faecal matter getting dumped close to the habitation which could affect the soil and sources of water and also the health of families living close-by. Not only this but manually handling faecal waste also proves a risk for diseases to the health of a person involved.

Bio-Digester treats human wastes at the source and decomposes excreta in the digester tank using specific high-graded bacteria that have been adapted to work at temperatures as low as -5°C and as high as 50°C. This bacterial inoculum converts the faecal matter into bio-gas and water.

The faecal matter from the toilet goes to the biodigester tank (constructed underground). The tank has three chambers and the first chamber is filled with bacterial inoculum. The inner layer of all three compartments is covered with poly-grass which acts as a substrate to aid bacteria in creating their colony. From the toilet, the faecal matter goes into the first compartment of the tank. While the inoculum bacteria work on the waste, slowly and gradually excreta flow from one chamber to another.

By the time the waste reaches the last section in the tank, the bacteria have already digested it and biogases (mixture of methane and carbon dioxide) and water remains. The inoculum bacteria used in this biodigester reproduce thereby reintroduction of inoculum isn't required The anaerobic process inactivates the pathogens responsible for water-borne diseases. Since the bacteria digests all the waste, desludging of bio-digester is not required hence, there is less risk for manual scavengers.

Design Considerations

The size of the bio-digester tank depends on the number of household members using it. For a family of 5 to 8 members, the length of the tank is kept at 7.5 feet, depth 5 feet and breadth 4.5 feet. Around 200 litres of inoculum is required for one bio-digester of this size.

BIODIGESTER PITS (PROCESS)

DIGGING A PIT

FILLING UP THE PIT WITH AGGREGATE FOR THE BASE

CREATING THE BASE WITH CEMENT CONCRETE

CONSTRUCTION OF TANK WALL

PARTITIONS FOR CHAMBERS AND PIPE FITTING

FITTING OF THE POLY-GRASS MAT

CONSTRUCTION OF TANK SLAB WITH INSPECTION HOLES

VENT PIPE FITTING

FILLING OF INOCULUM

FUNCTIONAL BIO-DIGESTER

Evapotranspiration faecal digester

Evapotranspiration Faecal Digester (EFD) is an eco-friendly technology for on-site sanitation systems which manage faecal sludge in situ. It is a nature-based zero discharge system. In EFD faecal matter is mainly digested through aerobic digestion and partly through anaerobic digestion. The digested organic matter travels up against gravity through capillary action. The nutrients leave the system by becoming part of plants' biomass through mineralization and absorption by the plant's roots. Evapotranspiration removes the liquid either transpiring through the plants or evaporating at the surface of the soil.

The evapotranspiration toilet has an impermeable, underground substructure (lined with High-Density-Poly-Ethaline- HDPE liner) filled with layers of materials, decreasing in size with each rising, successive layer. Old tyres are used as the main components for the EFD. The digester tank is assembled in an underground trench with tyres arranged in the trench forming a tunnel. The tyre tunnel is surrounded by layers of broken bricks/ stones, sand, and soil. The On the top, broadleaf plants like Bananas and Canna are planted. The toilet is based on the principle that partial anaerobic and aerobic digestion breaks down the solid part of faeces into minerals (mineralisation process). These minerals are absorbed by plants and contribute to plant growth. Water in the system travels up in the filled media through capillary action and reaches the surface wherefrom through the evaporation process it is removed from the system. A large proportion of water is taken up by the plants and lost in the atmosphere through transpiration from the plants' leaves.

The maintenance and use of the Evapotranspiration Faecal Digester system are standard. A superstructure is a conventional porcelain toilet that requires periodic cleaning. No intervention or maintenance is required for the EFD other than to water and protects the plant at the initial stage. EFDs are designed for managing black water therefore grey water from the bathing area and hand wash units etc should not be connected to EFD.

Design considerations

The proposed design for EFD is for 5 to 8 users with a length of 8 feet and 12 numbers of old tyres will be used. The depth of the pit is 4.5 feet and the width is 3 feet.

EVAPOTRANSPIRATION PITS (PROCESS)

A PIT IS DUG WITH A LENGTH OF 8 FEET, DEPTH OF 4.5 FEET AND WIDTH OF 3 FEET

LINING WITH HDPE SHEET

PUTTING BASE OF BRICKS

ARRANGING OLD TYRES TO FORM A TUNNEL

FITTING OF INLET AND VENT PIPES AND FILLING UP OF BIG STONE GRAVELS

FILLING UP WITH SMALL STONE GRAVEL

PUTTING SAND LAYER

SOIL LAYER ON THE TOP FOR BANANA SAPLING PLANTATION

FUNCTIONAL EVAPOTRANSPIRATION FAECAL DIGESTER WITH HEALTHY BANANA PLANTS

WaterAid India

1266, Bhoi Nagar,
Road No-8, Unit-IX
Bhubaneswar-751022
Odisha
www.wateraidindia.in