Patora FSTP – the first in rural Chhattisgarh

Safe and effective faecal sludge management is the need of the hour as it can improve the quality of life whether in urban or rural areas by contributing to good health and a cleaner environment. It is particularly important in the rural areas, given that many villages do not have underground drainage systems.

After trial runs and testing in August 2021, the FSTP Plant in Patora Gram Panchayat of Durg District in Chhattisgarh has been operational since September 2021, leaving no room for manual scavenging.

The FSTP in Patora GP of Chhattisgarh caters to a population of 13,877 individuals and 2803 households in 5 GPs namely, Patora, Chunkatta, Selud, Godpendri and Fekari.

Each week about 3 truckloads each with 2500 litres of faecal sludge is treated at the plant. Thus far, the plant has received 43 trucks loads and treated 1,07,500 litres.

Earlier, an intensive IEC campaign was carried out across the panchayats, covering the importance of FSM and why it was needed. The residents who have the contact numbers of the Panchayat have become accustomed to calling for the honey sucking truck.

A recent development is that the State has approved of CSR funds to be used for purchasing a desludging truck. This will accelerate the programme, ensuring smooth implementation of the project.

Background: Patora and surrounding gram panchayats are largely agricultural areas with about 65 per cent pucca houses. About 57 per cent of the workforce constitute agricultural and other labourers and 60 per cent of families are engaged in farming as primary or secondary source and own livestock, providing good market opportunity for co-composting along with processed sludge. Further, Patora GP has one of the best revenue collections

records as compared to other GPs of the state during the last five years. The GP also has an active women's SHG that works dedicatedly on hygiene and sanitation issues. In light of such reasons, Patora was the best choice for providing a treatment plant with limited external fund reliance.

Sanitation coverage: With 100 per cent toilet coverage, the GP was declared Open Defecation Free (ODF) in 2017. Most of existing toilets have lined tanks which are completely waterproof structures with little chance of leakage. However, 43 per cent of toilets have unlined tanks which are loose structures which are prone to leakage from the base and walls. The latter are in the process of being converted to lined tanks to improve the containment system.

Rationale for setting up the FSTP in Patora

Survey and Research: A survey conducted earlier by WaterAid shows that 93 per cent of the households were willing to follow scheduled desludging services and more than 70 per cent were willing to pay more than Rs.250 as annual FSM cess. Previously, in the absence of any form of sludge treatment practice, faecal sludge was being dumped on the outskirts/outer drain and sometimes in the farmlands on individual requests. An FSTP was therefore absolutely essential.

Desludging and transportation: Desludging and transportation were completely demand driven and were provided on call requests by private operators and the nearby Utai Nagar panchayat. It was limited to around 7-8 requests per month. Given that the Gram Panchayats in the project area did not own a desludging truck, the operation was served by a remotely located operator, resulting in substantial charges paid on serving every request. Around Rs. 2500 was being charged for desludging per trip. The long commuting distance and limited demands were the main reasons for charging higher tariffs. In order to reduce tariffs, it was recommended in the baseline study report that Patora Gram Panchayat would

need to procure a 3500 litres capacity desludging truck to serve the proposed scheduled desludging operation.

Capacity and Treatment proposed: The low volume and inconsistency of desludging which was less than 4 loads a month, called for more IEC and awareness building efforts to ensure higher loads in future. Considering the current and the future demand of the next 5 years, it was decided to implement a plant which can accommodate and treat 3 truckloads of Faecal sludge per week which is 3 KLD thrice a week or 9 KL per week.

The treatment method proposed was a Planted Drying Bed (PDB) that can tolerate inconsistent loads without much operation on a daily basis. Such a system does not require frequent desludging. It can be desludged once the bed is full which is after 2-3 or more. The dried solids obtained after that period can be directly used for land application. Further, a PDB needs limited manpower and operations on a daily basis thus lowering the operations costs.

Adoption of a Planted Drying Bed (PDB) System:

This consists of a **screening chamber** that screens large solid waste fragments like plastic, cloth, sanitary napkins etc; a **Planted Drying Bed** where solids dewatering, drying and stablisation takes place; **Integrated Settler and Anaerobic Filter** for treatment of PDB percolate/effluent; a **Constructed Wetland** for further treatment and oxygenation of percolate/effluent; and a **Polishing Pond** for disinfection and storage of treated effluent.

Process Description: The faecal sludge is first discharged into a screening chamber where it passes through a screen to physically separate solid waste and inorganic solids such as plastic, cloth, sand, silt, etc., that were present in the faecal sludge. This prevents clogging of the Planted Drying Bed (PDB). From the screening chamber the sludge moves into the planted drying bed which are constructed wetlands that are loaded with layers of sludge which is subsequently dewatered and stabilized through multiple physical and biological mechanisms. Once the output is stabilized, the mineralized sludge can be used as a soil amendment and organic fertilizer. Solids obtained from the drying beds can also be co-composted with municipal organic waste, further dried and stored, or solar dried for additional pathogen reduction. The liquid portion separated from sludge is treated in the anaerobic treatment modules.

Description of the various module components:

Screening Chamber: It is a physical method of separation of solid waste and inorganic solids such as plastic, cloth, sand, silt, etc. from septage to prevent the clogging of subsequent treatment modules. This is accomplished by a set of inclined parallel bars having openings at 25mm distance. The sludge from the screening chamber is further conveyed into the Planted Drying Beds.

Planted Drying Bed (PDB): A Planted Drying Bed is a simple, permeable bed (comprising of media like sand and graded gravel) that is planted with species of plants found in wetlands, marshes and swamps. PDB, when loaded with sludge in layers, dewaters and stabilizes the sludge through physical and biological processes. The liquid component in the sludge is dried naturally by a combination of evaporation (though for transpiration by plants) and percolation through the filter media. Through moisture loss and degradation, the sludge volume continuously reduces, and the plants and their root systems help in maintaining porosity in the sludge layer.

The dried sludge does not need to be desludged after each feeding/ drying cycle and fresh sludge can be applied directly onto the previous layer. The beds are filled with sand and gravel which act as filter media and support the vegetation. Sludge is applied to the surface and the filtrate flows down through the subsurface to collect in perforated pipes. The percolate from the planted drying bed is collected and conveyed to the liquid wastewater treatment system for further treatment. The dried sludge from the drying beds has to be removed after accumulation up to 1m height (appositely in 3 years in this case) and disposed-off in the landfill area or transferred to the co-composting unit in case the dried sludge is used as compost.

The number and area of PDBs required is designed based on total volume of sludge to be discharged every day, thickness of sludge layer for each loading, characteristics of sludge especially Total Solids and adequate resting period. In order to ensure regular sludge feeding to the PDB as well as to ensure adequate resting period after each loading of bed, it is necessary to plan more than one bed. Under this design 3 PDBs (with required surface area) for $9m^3$ of septage per week were provided. To ensure proper feeding and distribution of sludge across the surface area of the bed, splash plates are provided at the end of the pipes carrying the septage from the screening chamber on to the PDB.

The bed has different layers of filter material with thickness of each layer as per the design requirement - bottom layer coarse gravel (20-40mm size), middle layer coarse gravel (10-20mm size), second fine gravel layer (5-7mm size) and top layer is sand. The plants in the planted drying bed are Canna indica. The density of plantation is in the range of 4 to 12 plants/m2.

PDBs are technically simple, but biologically complex and must therefore be carefully operated during start-up to ensure that the plants have a chance to acclimatize to growing under conditions of high-strength FS. During the start-up phase, the beds should be irrigated with fresh water or untreated wastewater or diluted FS. Planting during the rainy or wet season is also recommended to help the plants endure the commissioning phase.

Depending on climatic conditions and operational conditions, the PDB may take 3- 6 months for start-up.

Once the sludge has reached the maximum accumulation level in the PDB (i.e. 1m from the filter top) it needs to be desludged. Considering the climate of Patora, a resting period of two months needs to be provided before desludging and after the sludge has reached the maximum accumulation level in the PDB to ensure greater pathogen and moisture reduction. It is recommended to carry out the desludging during the summer season to avoid handling of dried sludge with high moisture content.

Integrated Settler and Anaerobic Filter (ISAF): The percolate from the Planted Drying Bed is further subjected to treatment in the Integrated Settler and Anaerobic Filter (AF). Septage by its own characteristics has very high quantity of solids. Although most of the solids will be retained on the top of the planted drying bed, a small percentage of some of the solids may infiltrate the percolate. Therefore, it is proposed to provide a Settler for sedimentation before it enters the Anaerobic Filters. A settler is a primary treatment technology for wastewater; it is designed to remove suspended solids by sedimentation. The AF consists of two chambers in series in which the wastewater flows up-stream. Here, the suspended and dissolved solids available in the wastewater undergo anaerobic degradation. The activated sludge settles down at the bottom of each chamber and the influent wastewater is forced to flow through this sludge blanket where anaerobic bacteria make use of the pollutants for their metabolism. As wastewater flows through the filter, particles are trapped, and organic matter is degraded by the biomass that is attached to the filter material.

Constructed Wetland: Organic load coming out of the ISAF is already within the required effluent (BOD < 30mg/L) requirement. However, in order to remove the odour and colour and to enrich the wastewater with oxygen it is necessary to allow the wastewater to pass through aerobic treatment. Constructed wetland is made of planted filter materials consisting of graded gravel. The main plants used in this filter bed are Canna Indica, Reed juncus, Papyrus and Phragmites. The plant selection is mainly based on their ability to grow in wastewater and have their roots spread wide. This module also aids in reducing the nutrients such as Nitrogen, Phosphorous and potassium present in effluent.

Polishing Pond: A Polishing Pond is a shallow pond constructed with a maximum depth of one meter to allow for oxygenation through surface exchange and hygienisation through ultraviolet radiation from sunlight. Some sedimentation might also take place in the pond. It helps in reduction of organic matter, removal of odour and colour and hygienisation. For the proposed unit, the maturation pond has been provided a retention time of seven days in the design (pond diameter is 3m).

Other Infrastructure: In addition to the main treatment modules infrastructure provided within the FSTP premises are: two rooms for operator accommodation or office purpose; gate for security and entry/exit of desludging vehicles; pump with sensor for pumping of effluent to constructed wetland; landscaping for enhancing the aesthetic value of the facility; and solar pump for using Polishing Pond water for landscaping.

A toilet has not been proposed as the adjacent segregation yard already has a toilet. Since this is a combined waste management facility it was decided the toilet of segregation yard be considered common for both units.