Faecal Sludge Treatment Plant (FSTP) - A low cost solution for a sustainable environment

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1. Abstract

In India, sewerage network is available for urban cities only and rural areas are still deprived of under ground drainage network and the sewage treatment plants. Many rural villages still depend on septic tanks for the faecal sludge. As per the sustainable development goal of Untied Nations , under goal no. 6 clean water and sanitation is given the importance and all state and central governments are striving towards achieving the goal. In this context , importance of faecal sludge handling, treatment , disposal and by products has been increased. There are various technologies or equipment available as different options. In view of the importance, various options are highlighted in this paper

Key words : Septic tanks; Faecal sludge; FSTP, Reuse

2. **Introduction**:

In India, rural population of 64% spread over an area of 80% of the land. These areas are generally doesn't have under ground drainage network where the sewage water including faecal sludge generated from human waste (septage). It is generally collected in septic tanks and pit latrines which are not hygienic and lot of health hazards with polluting the ground water to an extent. The need for the septage management at community level and awareness of the faecal sludge management are becoming very important factor in sanitation. It is also called FSSM (Faecal sludge and septage management). Open defecation out side the premises in rural areas has been ended with lot of efforts and awareness in public through the efforts of the Government through Swatch Bharat Abhiyan for construction of infrastructure and creating hygiene education. However, handling the septage management is still in nascent stage in many of the rural areas. In areas where septic tanks are the norm constructed wetlands unplanted drying beds and settling ponds are tanks of example of pre treatment methods for septace Separating solids from liquids eliminate 60 to 80% of the solids additional polishing by wetlands or ponds is required to satisfy discharge regulations sludges from public restrooms are more dense.

3. Basic requirements of FSTP :

Faecal sludge treatment plant is to be established community level / village level to handle the problem. Government is engaging NGOs to clear up the septic tanks using pump mounted trucks to handle and and will be transported to the treatment location. Preliminary activity will be in a receiving chamber and screening of any solids / floating materials as part of the sludge . In this chamber. There will be two receiving chambers which act as a standby during settling

and loading into the other chamber. The overflow of the thickening tank will be treated further with anaerobic baffled reactor. The liquid emanating from the anaerobic baffled reactor will be placed in to the polishing pond for further use for agriculture.

The sludge from the thickener will be applied on to sludge drying beds of which dried sludge will be used as manure for agriculture. This dried sludge consists of nutrients and will be useful for soil conditioning and also as bio fertiliser.

If there are any nearby Sewage treatment plants (STP) or FSTP is part of STP premises, the overflow from the polishing ponds will be further treated to the required standards to drain to lakes / water bodies. Treated STP water can be reused for gardening, flushing and construction activities as per the quality of the treated water.Disinfection of the treated effluent is required if it is in urban areas.

4. Design Basis :

The primary step is determining the treatment capacity of the FSTP, usually measured in Kilo Litres per Day (KLD). It is depending on the population and sludge generation per capita per day. Percentage of population covered under septic tanks / pit latrines are considered as 80% of the rural population. Desludging frequency is one of the main component and is considered as once in 6 months on an average. Including liquid part, it is considered as 1 to 1.5 lit per person per day which depends on the water usage, containment type of septic tank. For solid liquid separation HRT is considered as 1 to 2 days. There will be two tanks with standby. Surface loading rate is generally considered as 40 cum of sludge per sqm per day.

For anaerobic baffled reactor hydraulic retention time (HRT) is considered as 24 hours. Generally 3 to 4 baffles are provided in the reactor. Sludge drying beds is sized based on the organic loading of 6 gm/sqm/day

Quantity and quality of faecal sludge (FS) depends on the excreta production and volume of water used for cleansing and flushing. This also depends on the dietary habits and type of diet consumed. On an average we can consider 500 gm/person/day. FS accumulation depends on the time.

5. Chemical Characteristics :

Volume of solid waste disposed, and their disposal facilities also have an impact on the FSTP. The characteristics of the faecal sludge in terms of BOD, COD are very high compared to sewage. Calculation of faecal sludge quantity is one of the important parameters Faecal sludge is undigested or partially digested are digested slurry or solids containing mostly human excreta and water the physico chemical characteristics of the Faecal Sludge vary depending on factors such as size and type of on site sanitation system and the Geo climatic conditions of the place where tank is located . Faecal sludge characteristics are total solids 25,000 to 40,000 mg/lit , volatile solids 17,000 to 25,000 mg/lit, Total Suspended Solids about 15,000 mg/lit, BOD 2600 to 7500 mg/lit, COD 10000 to 30000 mg/lit, Total Nitorgen (TKN) 700 mg/lit, NH 3N 150 mg/lit, total phosphorus 150 to 450 mg/lit, pH is 5.5 to 9 . Final characteristics after treatment are BOD 30 mg/lit, TSS 50 mg/lit , COD 150 mg/lit , fecal coliform up to 10,000 MPN

6. Treatment Methods :

The main objective of treatment is to ensure that the faecal sludge is safely treated in accordance with standards to prevent pollution of water sources and soils leading to protection of human and environmental health . Treatment stages of faecal sludge are solid liquid separation like screening and settling / sedimentation / thickening. Types of stabilisation are Biological stabilisation which includes aerobic and anaerobic stabilisation , chemical stabilisation (lime stabilisation), Thermal stabilisation

Next stage is Dewatering and drying of sludge . Types of dewatering and drying of sludge is through filtration / evaporation / evapo transpiration. Types of drying beds are planted drying beds and unplanted sludge drying beds. Centrifugation and pressure pressing are also used for dewatering (screw press, filter press and centrifuge are used). In heat drying or solar drying using greenhouse roofing Is adopted . Thermal drying is by pyrolysis and Incineration

The overflow of Thickener ie. liquid or effluent treatment based on the treatment methods adopted above suitable wastewater treatment system based on any of the standard STP technologies may be configured to treat the effluent to achieve required standards covering primary secondary and tertiary treatment. Disinfection of solids is by co-composting lime or ammonia treatment pyrolysis or sludge incineration at 850 degree centigrade . Liquid disinfection is UV or ozonation , chlorination .

Faecal sludge treatment technologies include co composting and Verme composting . It also has nitrogen cycling, chemical mechanism, alkaline stabilisation , coagulation and fluctuation. There will be lot of nutrients in the Faecal sludge in the form of nitrogen, phosphorus and potassium. Thermal drying and pelletizing and solar drying and use of dried sludge as by product are the one of the important Treatments . There are several biological and thermal options for the production of energy from faecal sludge. These technologies have been receiving increased interest due to considerable demand for sustainable biofuels possible technologies include anaerobic digestion which yields biogas , heat and sludge pyrolysis are gasification which yields to biochar, oils and gases Biodiesel can be produced through fermentation / successive chemical reactions and incineration or combustion of dried Faecal sludge. Energy recovery harnesses the energy potential of organic matter in FS but frequently at a trade off of nutrient recovery .

7. Reuse and Implementation:

There are so many pilot projects in implementation of FSTP and citywide inclusive sanitation facilities and strengthen FSM value chain across the country. A commercially viable business model could emerge from sludge derived end products like bio-pellets. depending on the various factors such as participation of private sectors and implementation in PPP model. Faecal sludge is used been used as soil conditioner and Composting traditionally but analysis exhibit that other end products have much demand market value in terms of revenue generation. Comprehensive research works are required to improve quality of liquid part and to promote solid product as It is analysed that low cost options for treating it. In any country in Ammonia level prevents algae development settling tanks offer a certain amount of organic and solids removal but not much nitrogen removal so drying beds without plants remove 30 to 60% of nitrogen and 50 to 60% of nitrogen is removed from construction of wetlands by sludge accumulation in sludge layers Effluent ammonia levels are still too high to receive release

safely stronger sludges from public restrooms provide difficulties in expensive treatment methods excessive ammonia is a common causeway for Pond system failure anaerobic digestion And nitrification denitrification in artificial wetlands are two promising alternatives it is necessary to create sustainable affordable treatment alternatives or substitute onsite sanitation system that collect Urine and vehicle ** in different areas Conclusions Vehicle sledge characteristics and quantities vary based on factors like income levels water access containment size emptying frequency of septic tanks Decentralised options like planting planted drying beds waste stabilisation ponds composting or evaluated with resource recovery of products like soil conditioners animal feed biogas Generation Analysis of treatment plants found mechanical technologies improve efficiency but at a higher cost compared to conventional waste stabilisation points tipping fees Alone are often insufficient for full cost of recovery This paper evaluates the technological options for resource recovery .

8. Conclusion :

Having the proper policy for safe disposal of faecal sludge after treatment and providing community support handling of faecal sludge. It is more evident that the treatment of FSTP by gravity mode will consume no power and the water separated from FSTP shall be combined with STP treatment of suitable technology . The capacities of FSTP are typically small with 1 to 3 MLD and the flow can be combined through STP. A promotional activity shall be raised by Government duly involving local NGOs and self help groups for proper maintenance of FSTP. IEC activities shall be conducted for awareness and upgrading the overall lean water and sanitation as per the United Nations sustainable development goal No. 6 . The standardised technology of low cost FSTP shall be utilised in every habitation for getting the desired results.

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