Training Program on Sustainable Natural and Advance Technologies and Business Partnerships for Water & Wastewater Treatment, Monitoring and Safe Water Reuse in India

Improved MBBR, SAFF and FSSM

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Introduction to the authors

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Learning objectives

At the end of this session, participants will:

- Understand Faecal Sludge, it's characteristics and how it is different from sewage.
- Understand biological treatment of domestic sewage via attached growth processes.
- Have a brief idea about conventional biological treatment processes like MBBR and SAFF, and their current shortcomings.

Agenda of the session

Time	Content
5 min	Introduction to the session
25 min	Introduction to the technology (background overview, principles, performance expected, appropriateness)
60 min	Design of the technology (key considerations, basic calculations, key formulas, etc.)
15 min	Break
15 min	Operation and maintenance
15 min	Construction and/or implementation
30 min	Example: the PAVITR pilot
12 min	Homework: exercise to design/implement the technology for a case study
13 min	Final remarks

Please, adapt

Introduction to the technology

- IMPROVED Moving Bed Biofilm Reactor (MBBR)
- Submerged Aerobic Fixed Film Reactor (SAFF)

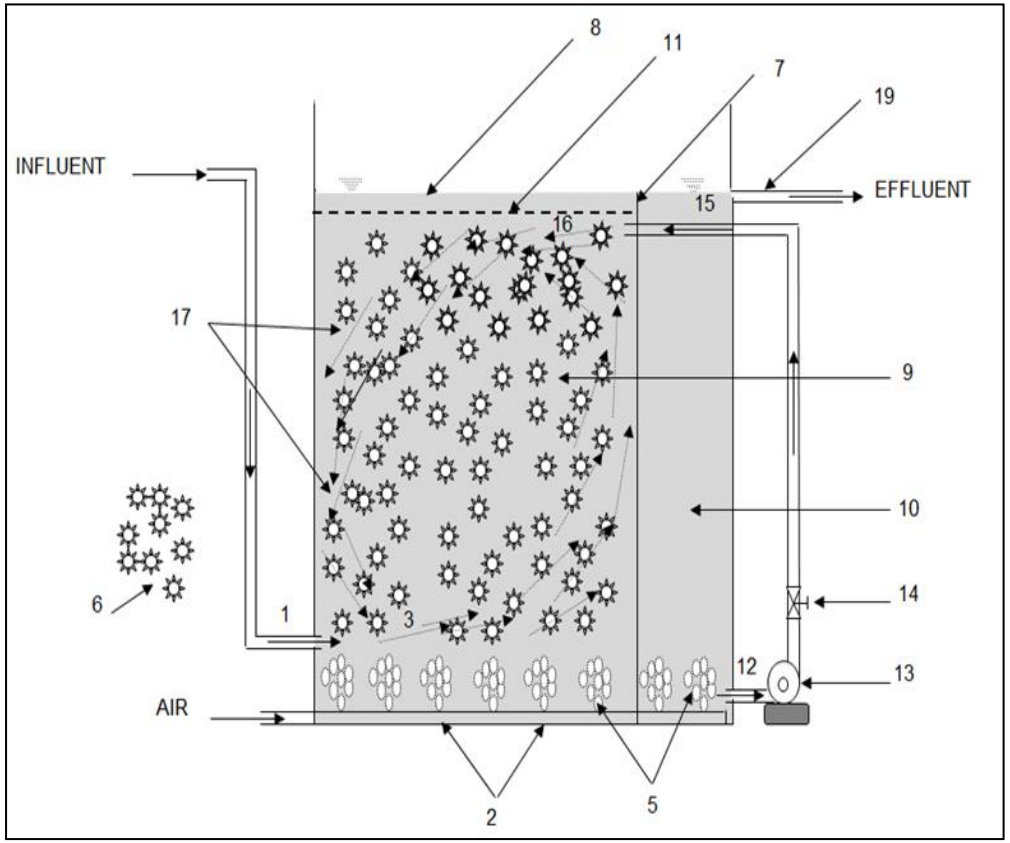
} For Sewage

- Mechanical Dewatering and Drying (MDDS)

} For Faecal Sludge

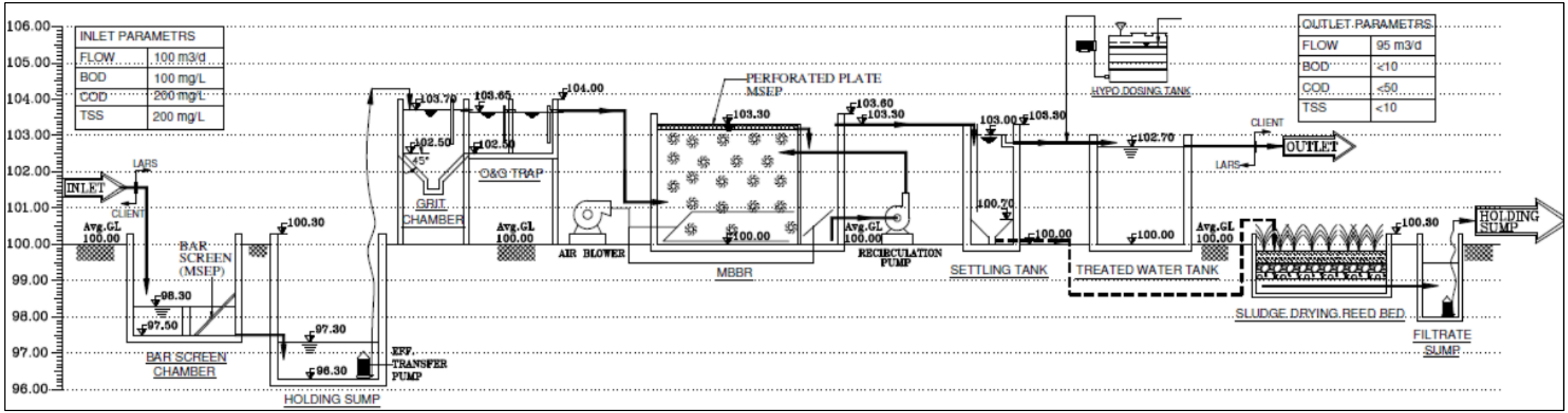
Improved Moving Bed Biofilm Reactor (MBBR)

- The MBBR process utilizes floating plastic carriers (media) within the aeration tank to increase the amount of microorganisms available to treat the wastewater.
- The microorganisms consume organic material. The media provides increased surface area for the biological microorganisms to attach to and grow in the aeration tanks.
- The media is continuously agitated by bubbles from the aeration system that adds oxygen at the bottom. When compared to conventional secondary treatment it provides superior efficiency and value.
- The need for an Improved MBBR arises from the fact that in conventional system, the media remains at the top region and does not utilize the entire volume of reactor. Due to this, stagnation zones are formed inside the reactor and a good biofilm growth is not observed



Schematic diagram of Improved MBBR

Process and Hydraulic Flow Diagram for Improved MBBR System



Submerged Aerobic Fixed Film Reactor (SAFF)

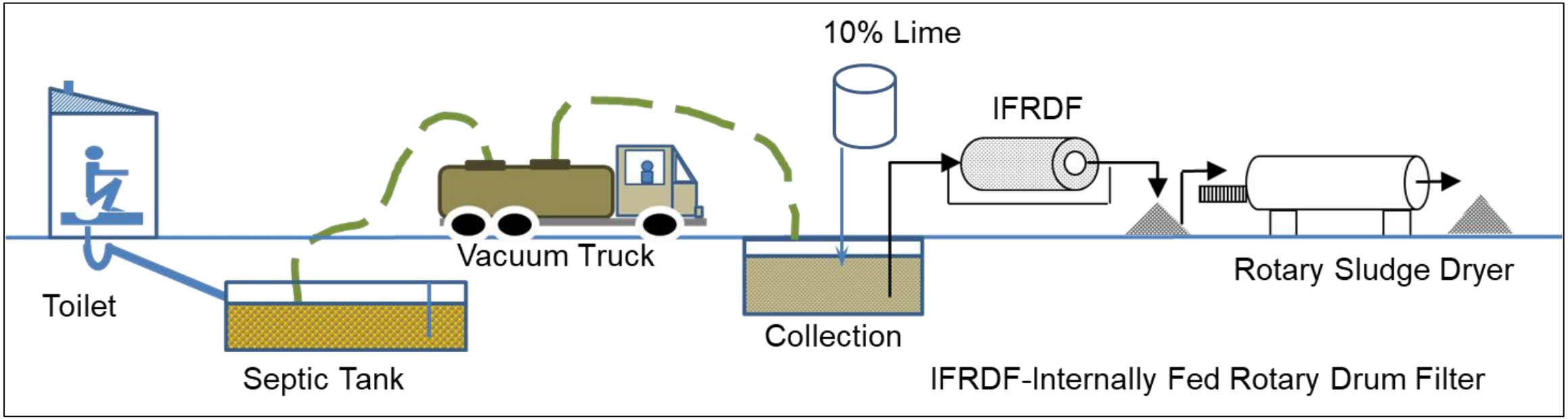
- SAFF process is an attached growth type aerobic biological process which uses corrugated inert UV stabilized PVC media.
- The higher surface area of the Submerged Aerated fixed film technology helps in the rapid digestion of biomass by the attached microbes.
- In this technology, the air is supplied through the diffused aeration system comprising through blower. The SAFF media is rested on bottom support system in which the media is arranged in the fixed reactor.
- Higher loading of BOD on the media enables to reduce the size of the reactor. SAFF requires 25-40% lesser tank volume as compared to activated sludge process.
- Due to the large microbial population inside the reactor, SAFF system can take higher shock loads without reducing the plant performance.

SAFF Reactor

Mechanical Dewatering and Drying (MDDS)

- The Mechanical Dewatering and Drying system is an option for treating feacal sludge originating from septic tanks.
- The unit consists of a sump for homogenization of sludge by agitator mixing and treatment with 10% lime solution. Also, it has a dewatering assembly comprising of a rotary drum filter and a screw compactor, and a LPG-based Rotary dryer.
- Ultimate objective of using this technology is to reduce pathogen and moisture content of the treated sludge to an extent it can be used as an organic fertilizer or soil stabilizing material that has commercial value.
- This technology is compact and can be installed and commissioned in a small area. The plant which we are implementing in Chandrapur (Capacity – 25m3/d) is easily accommodated in the area of 45m2.

Schematic representation of MDDS to treat Faecal sludge



Design of **the technology**

Moving Bed Biofilm Reactor (MBBR)

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Design Data:

Name of Units	Dimensions in mm (L*B*H)
Screen Chamber	1000 x 1100 x 800 SWD*
Oil and Grease Trap	2400 × 1000 × 1150 SWD
MBBR Tank	3500 × 3250 × 3000 SWD
Sludge drying reed bed (3 no.'s)	1700 × 1100 × 1750 SWD

*SWD = Side Water Depth

Submerged Aerobic Fixed Film Reactor (SAFF)

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Design Data:

Name of Units	Dimensions in mm (L*B*H)
Screen Chamber	1000 x 1100 x 800 SWD*
Oil and Grease Trap	2400 × 1000 × 1150 SWD
SAFF Reactor	3500 × 2500 × 3000 SWD
Filter water tank	2750 × 2750 × 2400 SWD
Sludge drying reed bed (3 no.'s)	1700 × 1100 × 1750 SWD

*SWD = Side Water Depth

Mechanical Dewatering and Drying system

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Design Data:

Name of Units	Dimensions in m
Collection Sump	2 dia x 1.5 SWD*
Rotary drum filter	0.6 dia x 2.8 length
Screw compactor	1.2 x 0.3 x 0.3
Rotary dryer	0.65 dia x 4 length

*SWD = Side Water Depth

Let’s have a break

We will be back in 15 min

Construction and implementation

Progress; MBBR & SAFF

Major Activities & Milestones……

- Identification, Consent and Agreement with the stakeholder for implementation of SAFF, MBBR (MIDC Butibori Nagpur)
- Site selection, field survey, Geotechnical Investigations, Sampling and analysis of influent wastewater
- Laboratory scale studies for improvements in MBBR hydro-dynamics and scale-up (G, Fro, Plume length, HRT)
- Laboratory scale treatability studies for improvements in SAFF and determination of kinetic coefficients for full-scale design
- Design and development of process flow schemes for improved MBBR and SAFF (OLR and HRT)
- Detailed designing and finalization of treatment scheme for MBBR
- Detailed engineering design for MBBR & SAFF including – Basic layout, hydraulic flow diagram and P&ID drawings, Structural Design
- Tendering including evaluation of technical & financial bids and work award
- Implementation is completed)

Raw Sewage Sump; Grit Chamber; O & G Trap and MCC cum Operator Room

Multi-grade Filter and Sludge Drying Reed Beds (SDRBs) system

Progress; Improved FSSM system

- Identification and Signing of Agreement for implementation of FSSM (Chandrapur Municipal Corporation, Chandrapur)
- Site selection, field survey, Geotechnical Investigations, Sampling and analysis of Faecal Sludge
- Laboratory scale studies for elimination of Faecal Coliforms (Lime dose, Sieve size for filtration and temperature and time for drying of faecal sludge)
- Design and development of process flow scheme including sludge sump with agitator & pump, dewatering and drying units for 25 m^3/d capacity
- Detailing, Tendering and evaluation of Technical Bids for MDDS.
- Evaluation of Financial Bids and award of work in progress
- Expected timeline for completion of installation: September 2023

Operation and maintenance

Improved MBBR and SAFF

Maintenance includes the following tasks:

- Proper monitoring of the inlets and outlets of STP units for free flow of wastewater.
- Operator should ensure that the sewage is being pumped at the constant designed rate of 5 m3/hr.
- Ensuring adequate DO supply in both MBBR and SAFF reactors.
- Control of chlorine dosing at the final outlet.
- Regular de-sludging and/or recycle of the sludge. In case of feeding in SDRB, each cell should have one week feeding and two weeks resting period.
- Regular monitoring of biofilm growth and sludge should be recycled, in case of decrease in biofilm in the reactor.
- Routine check-up of electro-mechanical equipment for efficient functioning.

Daily maintenance tasks include:

- Regular cleaning of screens at the inlet sump and ensuring sufficient wastewater at the inlet for pumping.

- Regular draining of grits and back-washing of multi-grade filter and removal of filtrate from the sludge drying reed beds to inlet sump.
- Dissolved oxygen measurement to check the availability of adequate DO.
- Maintaining log-book records of equipment operation, maintenance, repair and chemical consumption and energy consumption.
- Maintaining log-book records of Manpower deployment, Flow data and observations on functioning of plant.
- Maintaining overall hygiene and safety at the plant.

Other maintenance tasks include:

- Cleaning of the treatment units.
- Monitoring the structural cracks and leakages.
- Structural examination of RCC material, steel frames etc.
- Pipe connection fitting.
- Look out for the corrosion of the materials used.

Daily maintenance tasks include:

- Lime solution should be readily available at all times for homogenization of sludge.
- Continuous power supply to be ensured for functioning of electromechanical equipment's.
- LPG Cylinders to be available as per the requirement.

Homework

Some important questions…

- Why conventional MBBR needs improvement ?
- Despite improvement of MBBR, why do we need further treatment for the effluent ?
- What is the complete treatment scheme of MBBR and SAFF which is being implemented ?
- What are the advantages of MBBR and SAFF over conventional sewage treatment processes like ASP ?
- What is Faecal sludge and why to treat it separately ?
- What are the benefits of MDDS over other treatment processes to treat faecal sludge ?
- What is the difference between attached growth and suspended growth processes ?

Credits

This training has been created in the framework of the EU-Indian Joint Project “PAVIRT-Potential and Validation of Sustainable Natural & Advance Technologies for Water & Wastewater Treatment, Monitoring and Safe Water Reuse in India”. This project has received funding from the European Union’s Horizon 2020 research and innovation program under grant agreement No821410 and the Department of Sciences and Technology of India under the Grant DST/IMRCD/India-EU/Water Call2/PAVITR/2018 (G).

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