TN US SP

TAMIL NADU URBAN SANITATION SUPPORT PROGRAMME

iihs™
INDIAN INSTITUTE FOR HUMAN SETTLEMENTS

In Association With:

Keystone

Consortium for DEWATS Dissemination Society

Training programme on Fecal Sludge Management for Engineers in Trichy Corporation

Faecal Sludge Treatment Technologies

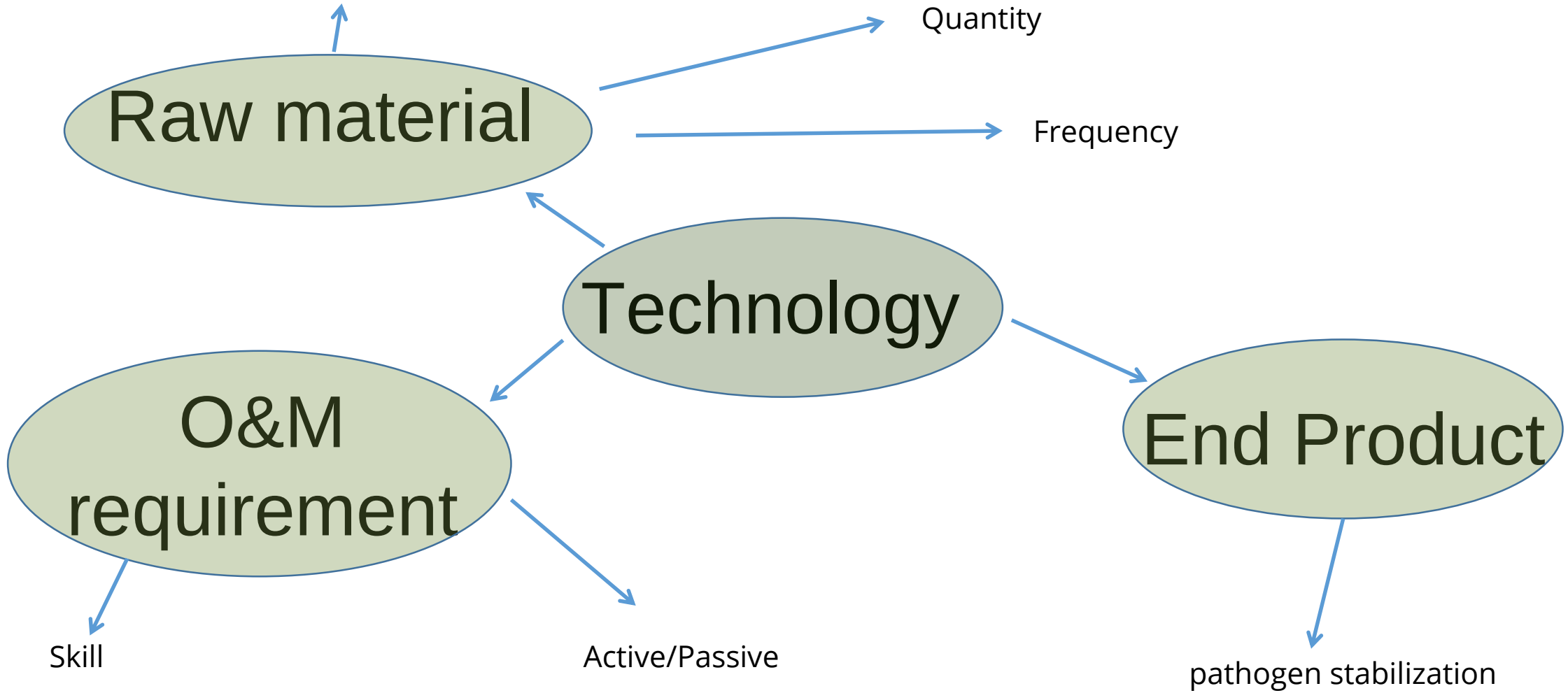
Treatment

- **What can treatment do….?**

- Reduce Smell and visually displeasing outputs
- Stabilising the sludge to reduce health and environmental risks
- Dedicated place for disposal – easy to regulate
- Revenue generating end products

Factors influencing selection of right technology

Quality: Type of containment



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RECAP - Treatment Approach

1. Separation of solids
2. Sludge stabilization
3. Dewatering / Drying
4. Sludge percolate treatment
5. Disinfection
6. Safe disposal / Reuse

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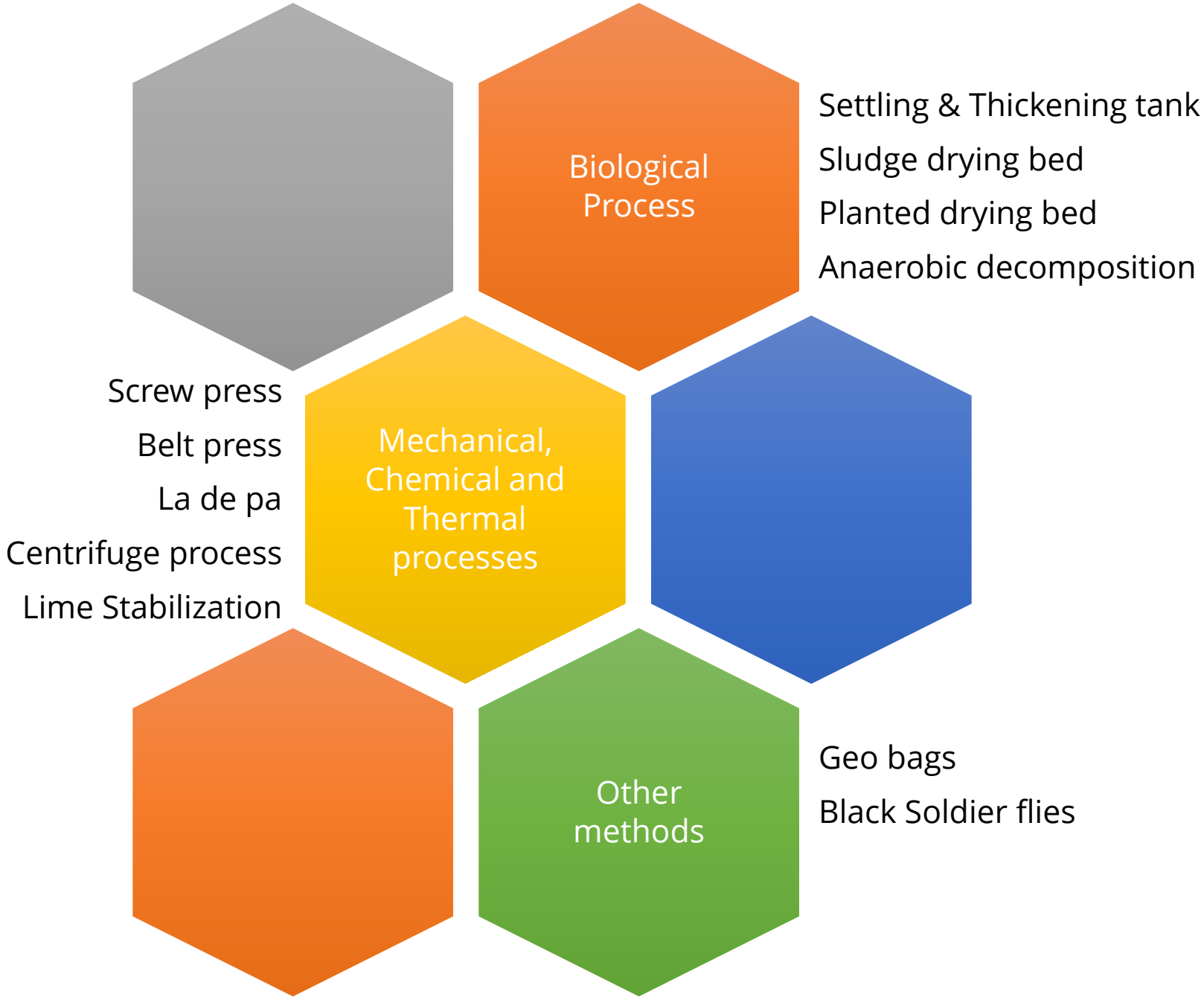
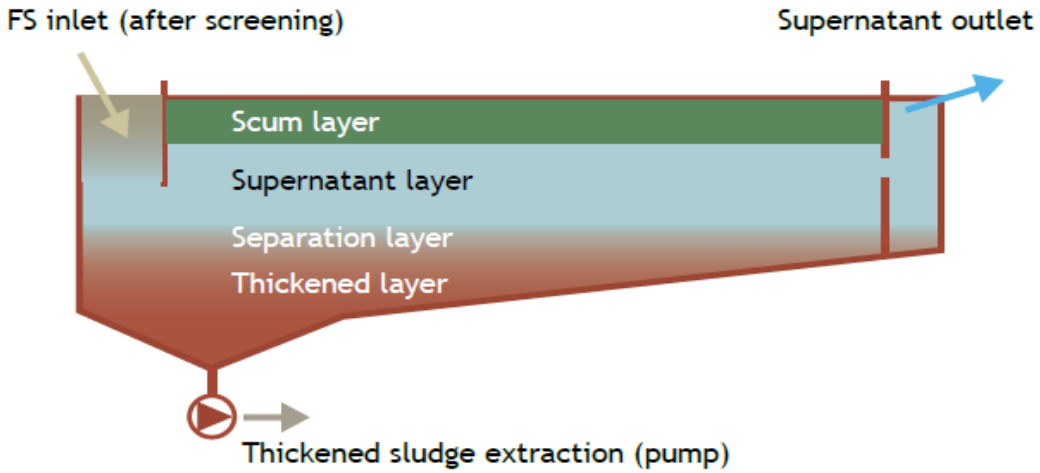
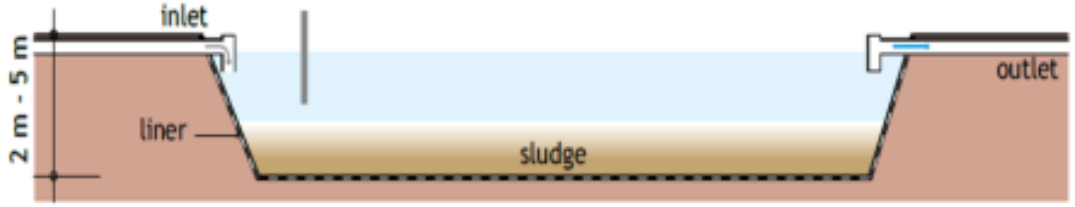
Treatment technologies



Settling Tanks and Sedimentation Ponds

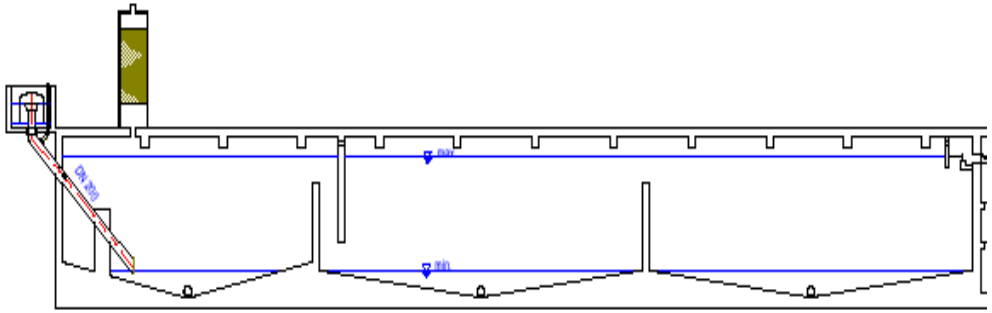
- Sedimentation of the heavy particles occur without any external forces under gravity
- Settling tanks provide a liquid retention time of a few hours (to ensure settling of Settleable solids)
- Sedimentation ponds provide a liquid retention of few days or several weeks
- designed on
    - Desired depth
    - Quantity of accumulating solids
- The accumulating solids have to be removed and treated further





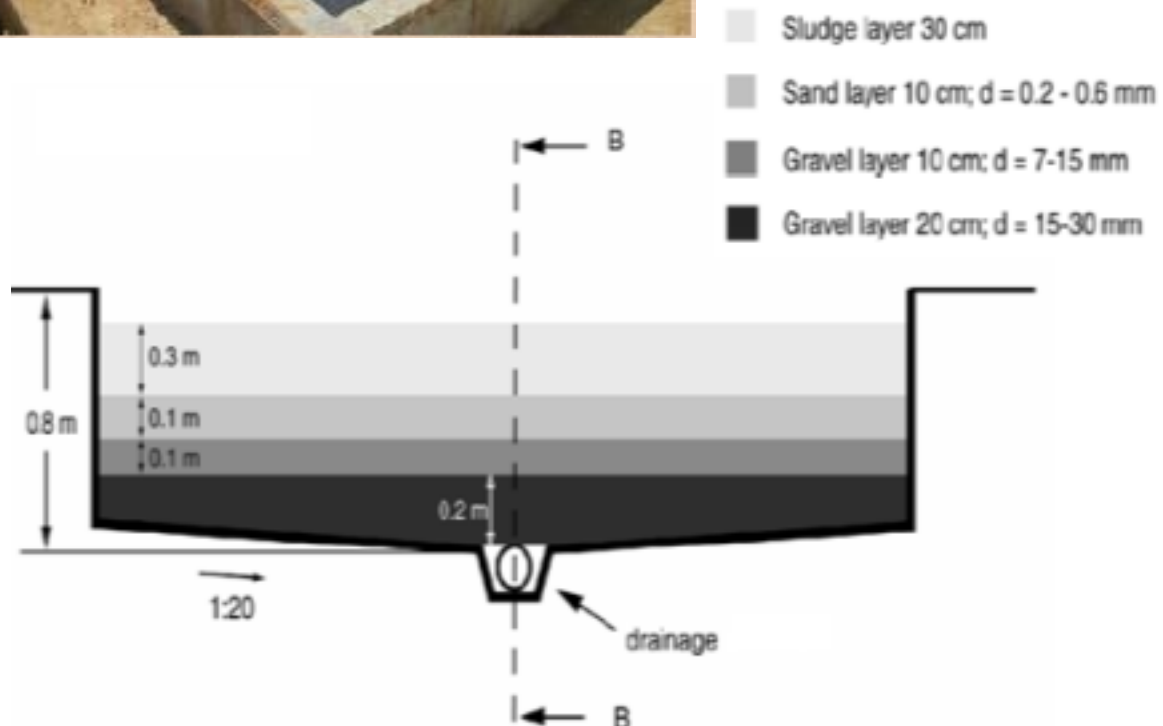
Anaerobic Digestion

- This process ensure effective sludge digestion and stabilization
- During digestion:
  1. Organic matter is converted to biogas
  2. The stabilized sludge (digestate) utilized as soil conditioner
- The SRT is maintained for 10-15 days
- Removal of accumulated solids from the digester remain a challenge



Sludge Drying Beds

- Key process involved – Filtration and evaporation
- Graded filter media of different diameter
- Approximately 50-80% of the liquid drains of as filtrate an 20-50% due to evaporation
- Sludge drying period range of 10-20 days depending on the temperature



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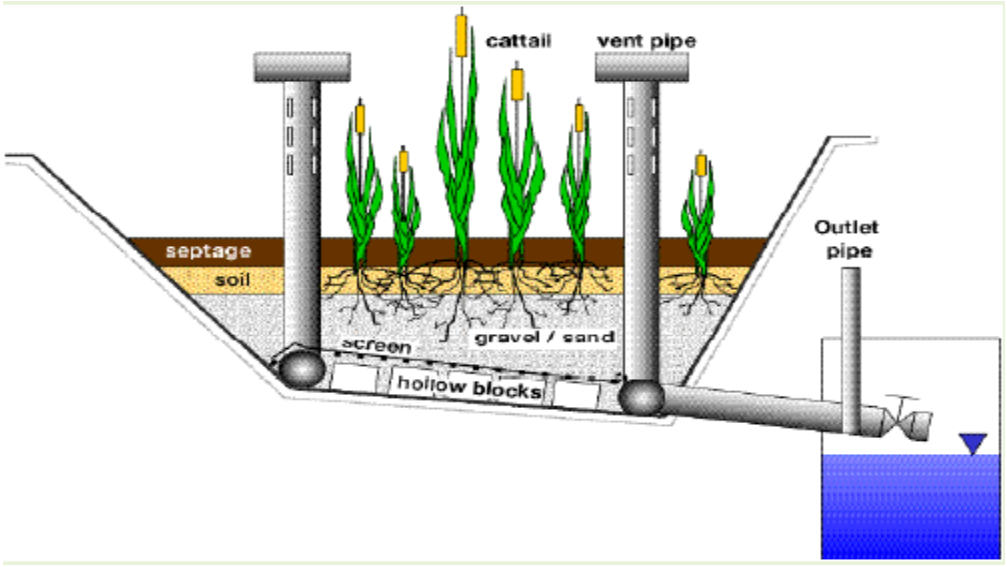
Planted Sludge Drying Beds

- FS is loaded with layers of sludge
- multiple physical (dewatering) and biological mechanisms (volatisation)
- The beds consist of gravel/sand/soil filter planted with plants such as reeds, cattails, bulrushes
- Sludge retention time is 2-3 years depending on sludge loading rate TS



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Mechanical Treatment Options

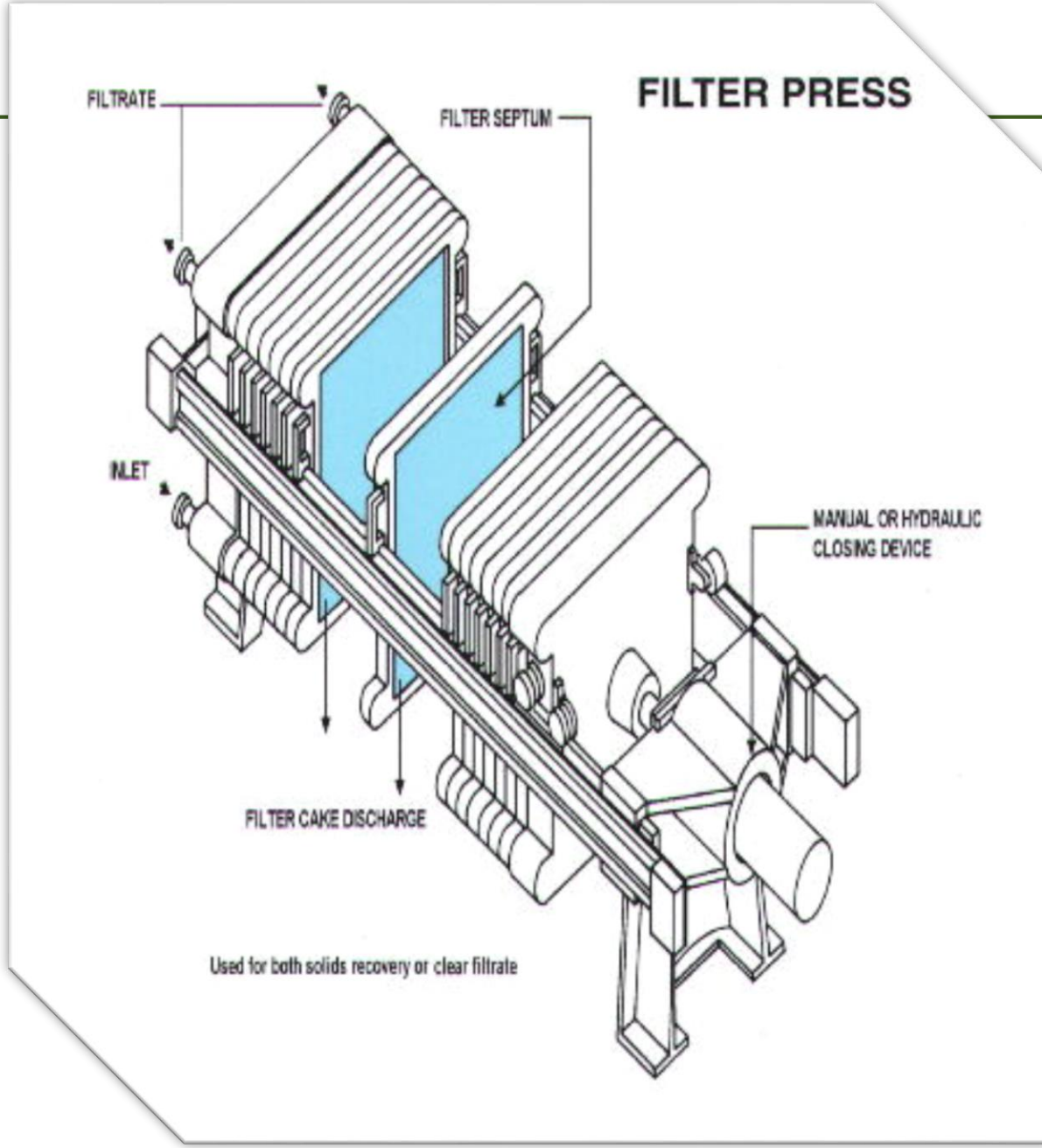
- The technologies used to treat wastewater sludges are also applicable for Faecal Sludge namely:
    1. Belt Filter Press
    2. Frame Filter Press
    3. Screw Press
    4. Centrifuge

- Advantages of mechanical treatment options include compactness and speed of the process

- Limitations of mechanical treatment options include high investment costs, O&M and electricity requirements

Frame Filter Press

- This is the simplest type of pressure filter.
- It consists of plates and frames arranged alternately and supported on a pair of rails.
- The plate is a solid piece having a ribbed surface.
- The frame is hollow and provides the space for the filter cake.
- By this alternate arrangement of frame and filter the chamber form in which cake will deposited.
- The plate and frame are square or rectangular in shape with Coated materials are used



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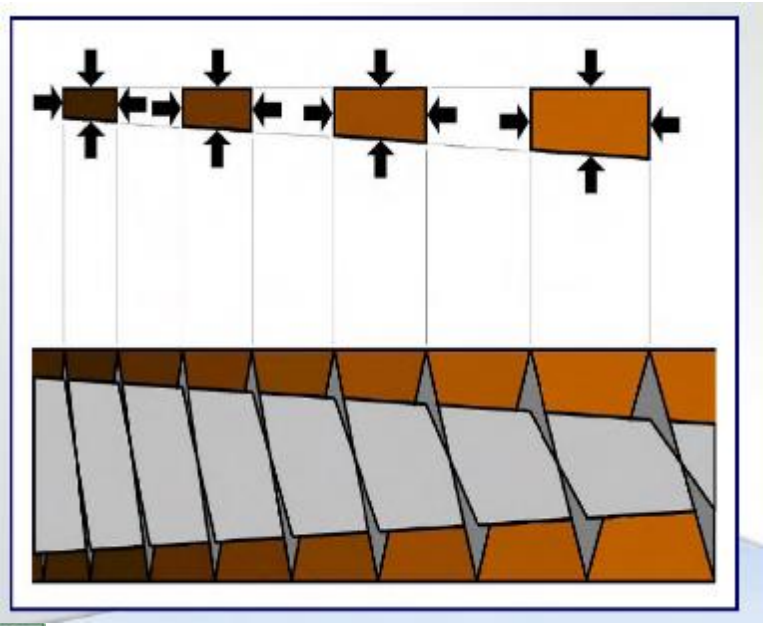
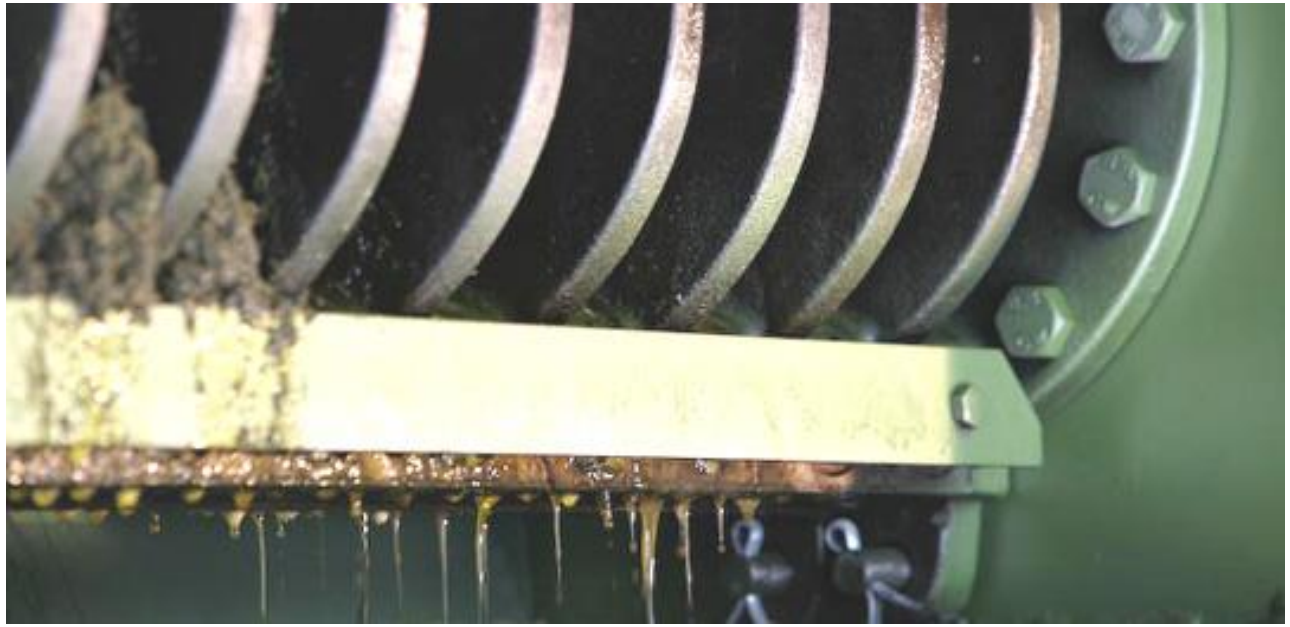
Screw Press

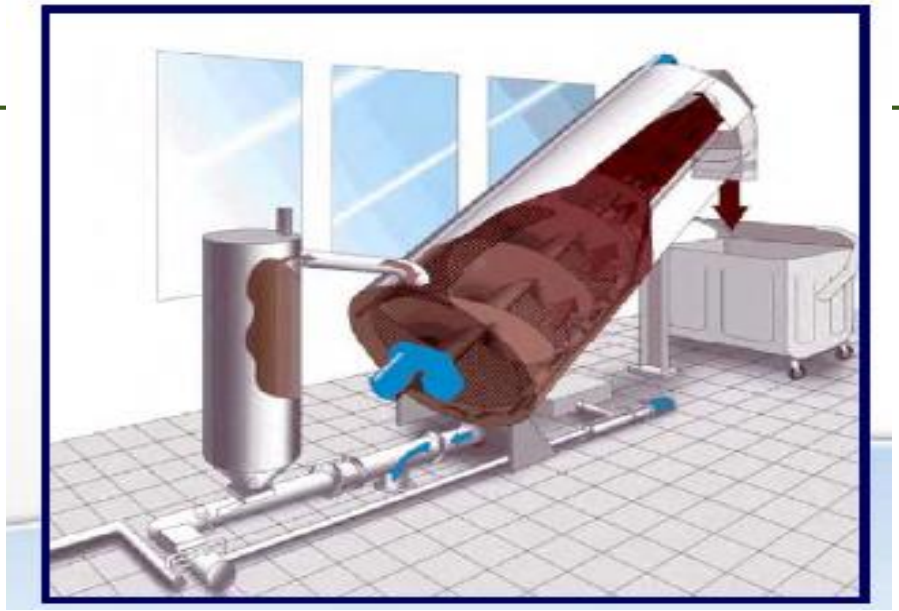
- It is the simplest machine for separation of solids and liquids.
- It is a cage style press.
- It is used for separation of Water from the faecal sludge
- Screw pressing is a continuous operation, hence these are also known as “expellers”
- It works on the principle of ‘compression and shear’.



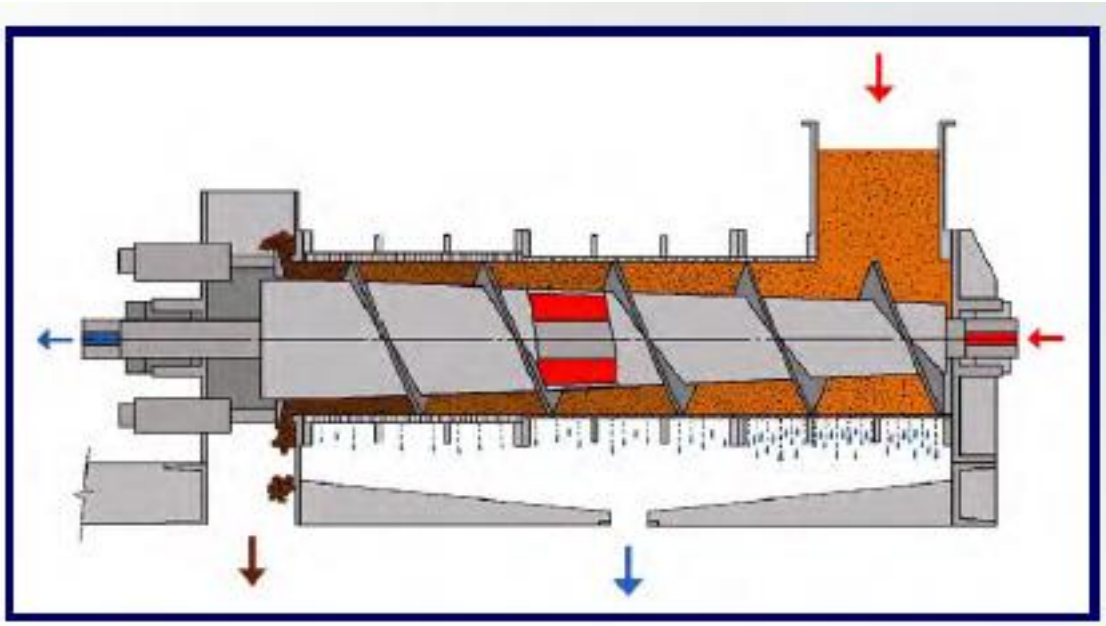


TYPES OF SCREW PRESS

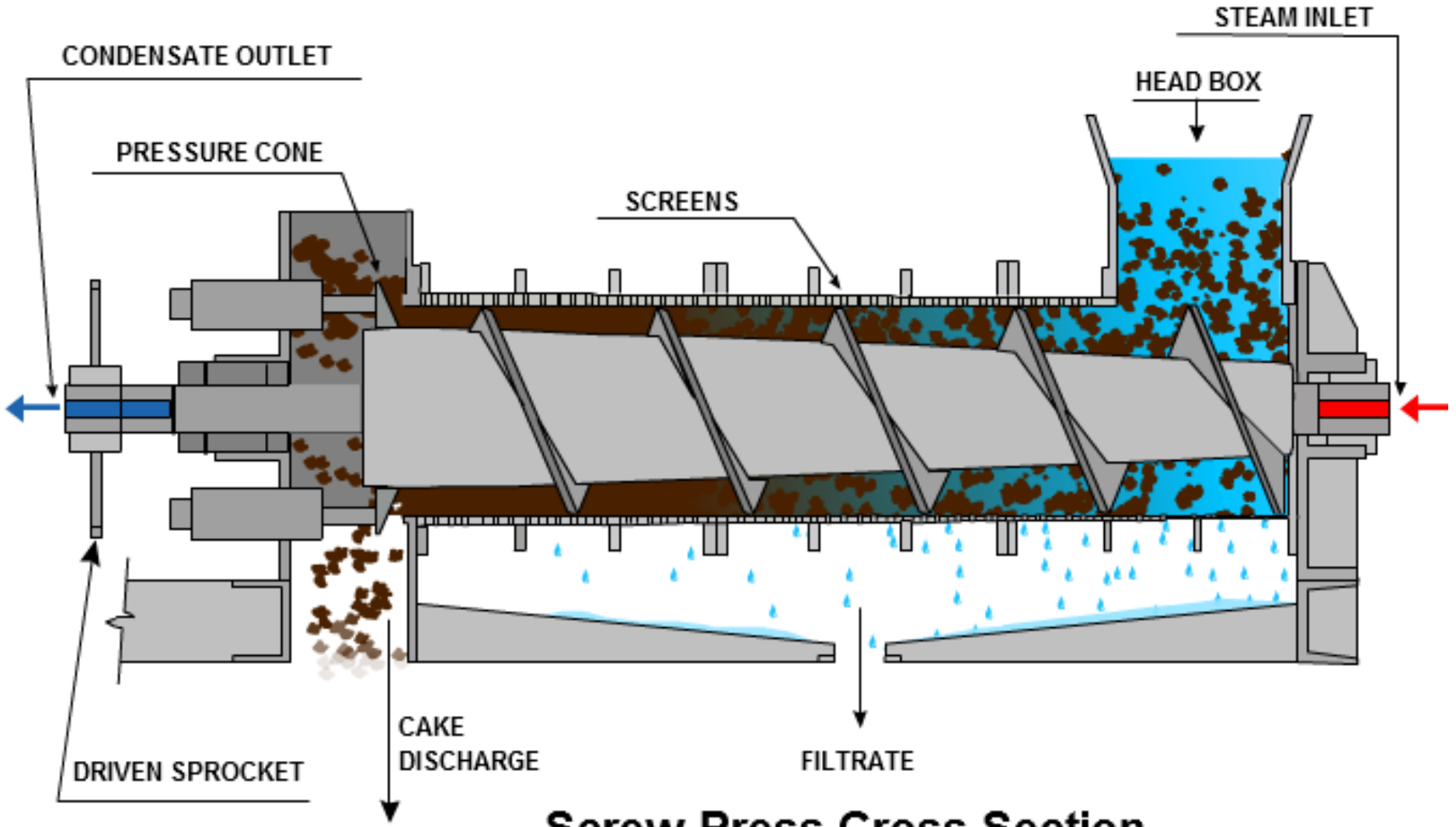
Huber inclined screw press



Horizontal screw press



CONSTRUCTION & WORKING



Screw Press Cross Section

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LaDePa pelletizer

- Pyrolysis is a process which decomposes matter using heat in the absence of oxygen.
- Modifying a commercially available pyrolysis unit and adding dewatering and water treatment units.

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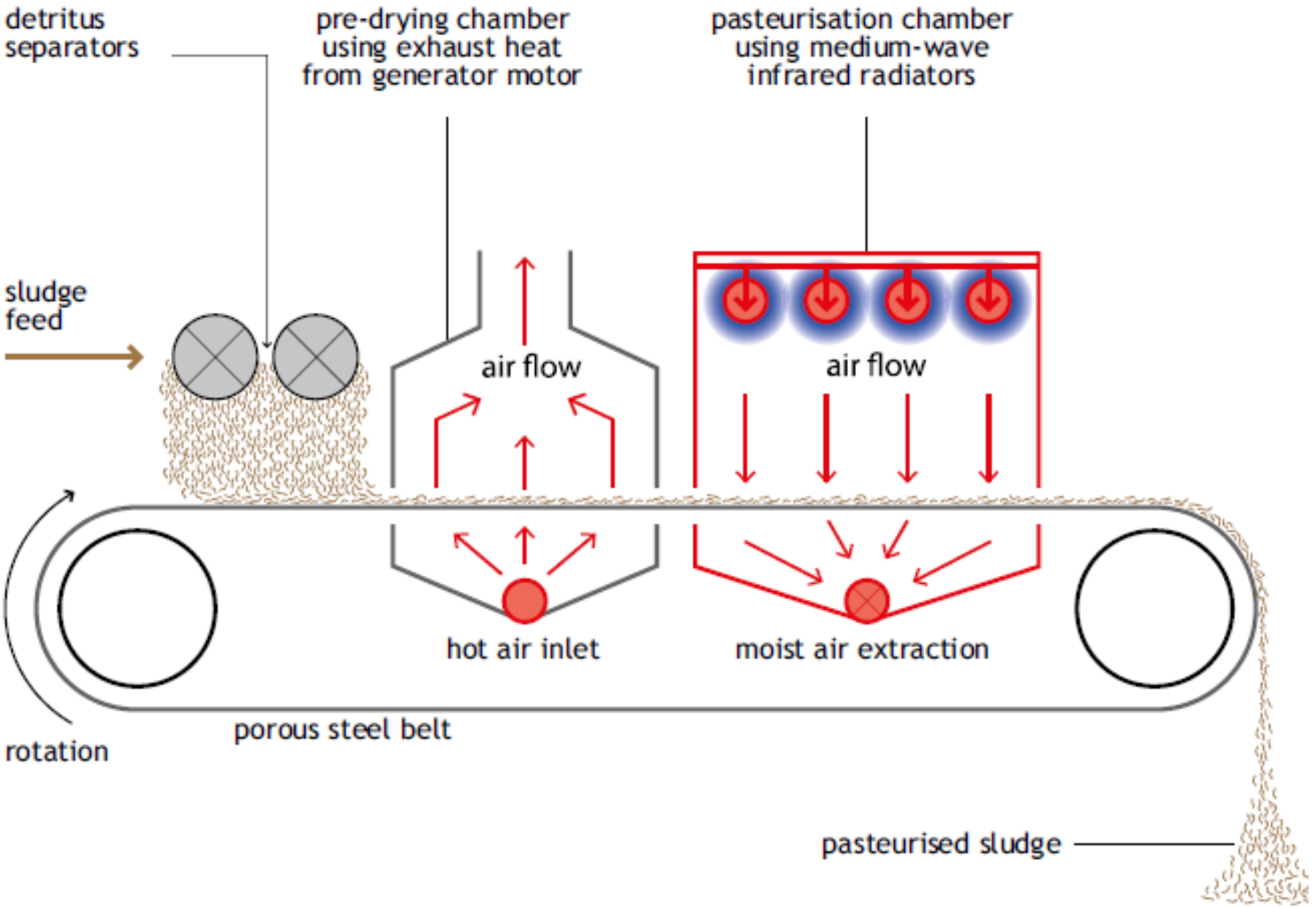
Schematic


detritus
separators
pre-drying chamber
using exhaust heat
from generator motor
pasteurisation chamber
using medium-wave
infrared radiators
sludge
feed
air flow
air flow
hot air inlet
moist air extraction
porous steel belt
rotation
pasteurised sludge

Lime Treatment

- Objective of lime addition is to achieve reduction of pathogens, odor and degradable organic matter
- The level of digestion depends on the degree of the initial stabilisation of FS, the temperature, and on the retention time inside the tank
- As per the experience in order to achieve the desired results, it is proposed to 5 kg of lime per cum of sludge

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Geo-tube bags

- Geo bags are porous tubular containers fabricated with high strength woven geo-textiles (polyethylene material) mainly used for dewatering sludge .
- Bags will help to achieve the capture of 98% of solids from the sludge
- Polymer will added to increase the solid settling
- Filtrates from the container should be collected and treated properly before discharge

Black soldier flies - BSF

Stages of life: Hermetia illucens (Black soldier fly)

BSF larvae feeds on

1. Municipal organic solid waste
2. Food waste
3. Animal waste
4. Faecal sludge

BSF larvae contains

1. 42% crude protein
2. 35% fat, amino and fatty acids

BSF-FS treatment end-products

1. Animal feed
2. Soil conditioner
3. Biochar

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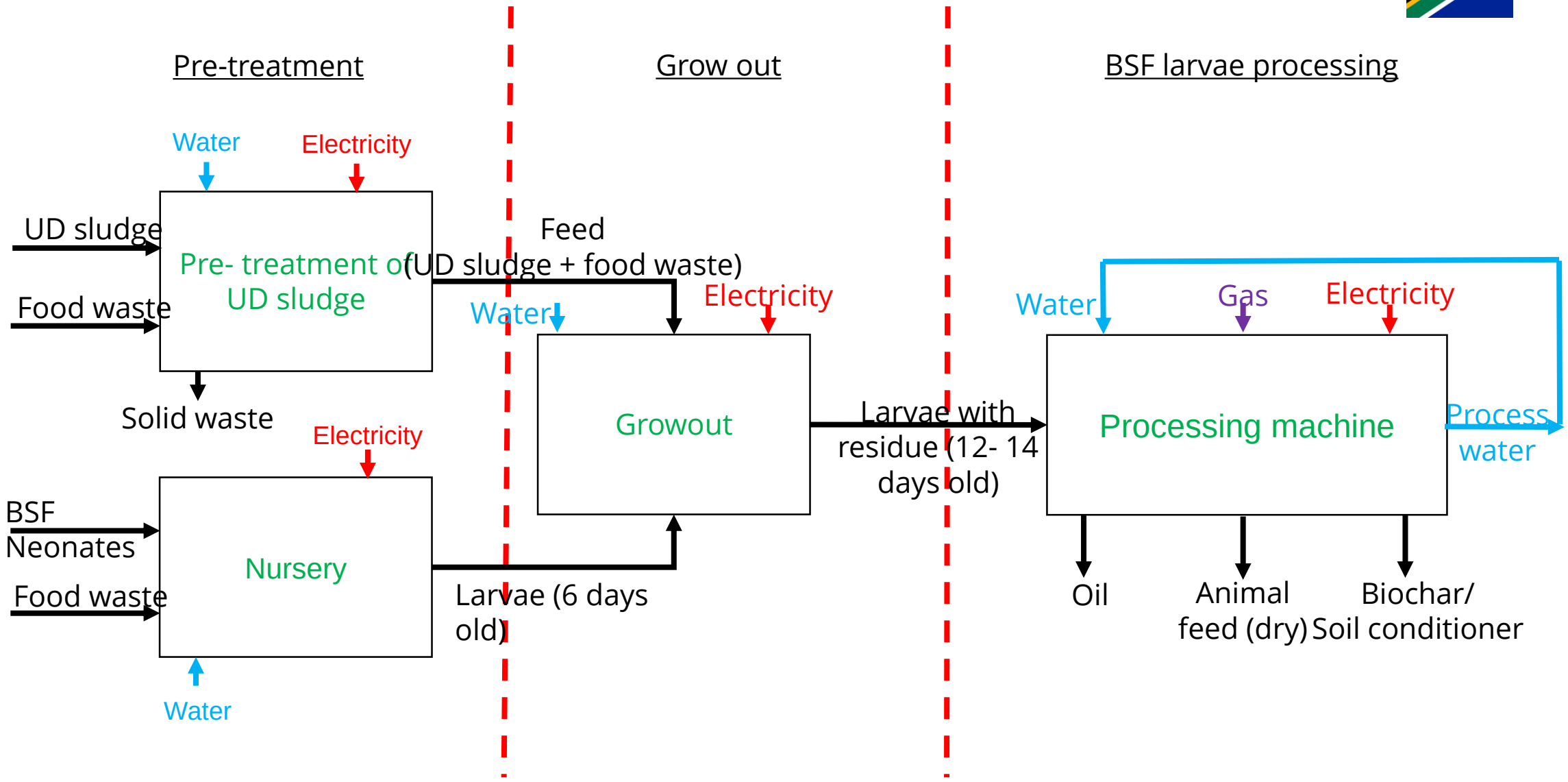
Treatment Methodology – UD sludge using BSF larvae in South Africa



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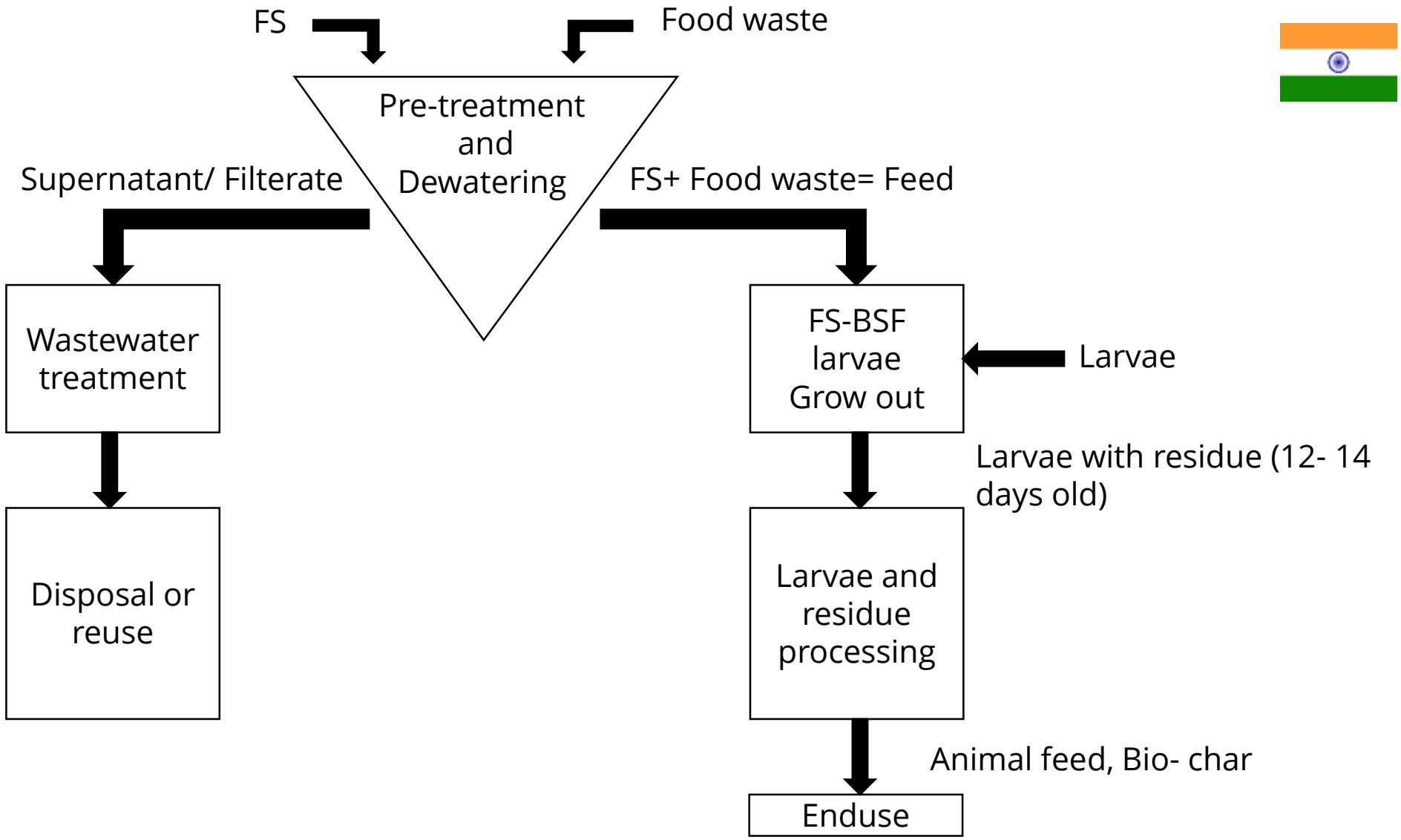
Treatment Methodology – FS using BSF larvae in India



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Reuse potential after BSF

Animal feed

Soil conditioner

Oil

(http://agriprotein.com/)

Intermediary solution: Trenching Technique

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Composting

- Controlled process by which biological decomposition of organic matter occurs
- The resulting end product is a dark, rich, humus-like matter that can be used as a soil amendment.

Criteria: Selection of Technology

- Design a system based on final end-use or disposal option of treatment products
- Designing a system for the actual quantity and characteristics of faecal sludge.
- Design system based on the collection and transport approaches
- Develop a system by understanding treatment mechanisms
- Develop system based on the resource required – land, cost, skills
- Develop system based on Operation and maintenance requirements

Source: 1. Fecal sludge management systems approach for implementation and Operation, IWA Publications, 2014
2. Sandec Training Tool- Fecal sludge management

Anaerobic based approach for Faecal sludge treatment

Faecal Sludge/Septage

Screen Chamber

Sand and grit removal

Settling Tank

Separation - free water

Liquid

Solids

Anaerobic digester

Stabilization

Liquid-solid separation

Liquid

Liquid Treatment

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Disposal

Effluent is discharged into agricultural fields, drain or water body

Liquid

Solids

Unplanted drying bed

Dewatering

Solids

Co-composting

Disinfection

Enriching fertilizer value

Disposal

End product is compost. Can be used as soil conditioner

Cost- INR: 25,000-40,000/cum

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Anaerobic based approach for Faecal sludge treatment

- Regular operator is required. O&M is simple
- Capital cost is high and recurrent cost is minimal
- Large area requirement (UG+OG)
- Suitable for large quantity (20cum)
- Good treatment efficiency
- Regular feeding is not a issue

PDB approach for Faecal sludge treatment

Faecal Sludge/Septage

Screen Chamber

Sand and grit removal

Planted Drying beds

Stabilization

Dewatering

Disinfection

Liquid

Solids

Co-composting

Disinfection

Disposal

End product is compost. Can be used as soil conditioner

Liquid Treatment

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Disposal

Effluent is discharged into agricultural fields, drain or water body

Cost- INR: 40,000-60,000/cum

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Aerobic based approach for Faecal sludge treatment

- Commonly practiced technique due to simplicity
- Moderate capital cost, Low recurring cost
- Large area requirement
- Good treatment efficiency
- Location of the treatment system may be an issue – odor, flies
- Operation and mainatainace may be an issue – acceptance
- Regular feeding may be an issue

Thank You