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SUPPORT PROGRAMME

**iihs**<sup>TM</sup>  
INDIAN INSTITUTE FOR  
HUMAN SETTLEMENTS

In Association With:

**Keystone**  
A GROUP FOR RSD DEVELOPMENT INITIATIVES

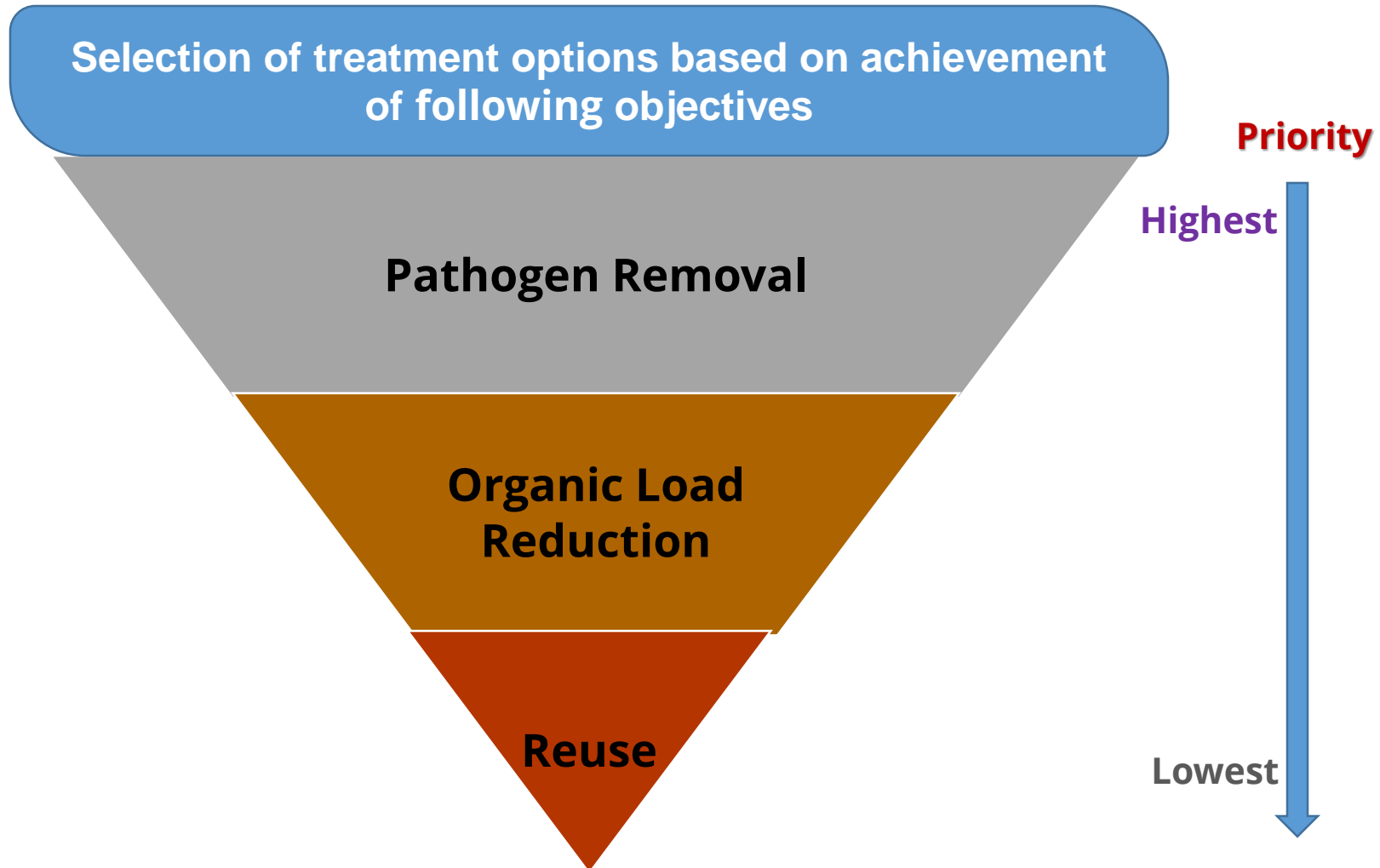


**CDD** Consortium for  
DEWATS  
Dissemination  
Society

# Training programme on Fecal Sludge Management for Engineers in Trichy Corporation

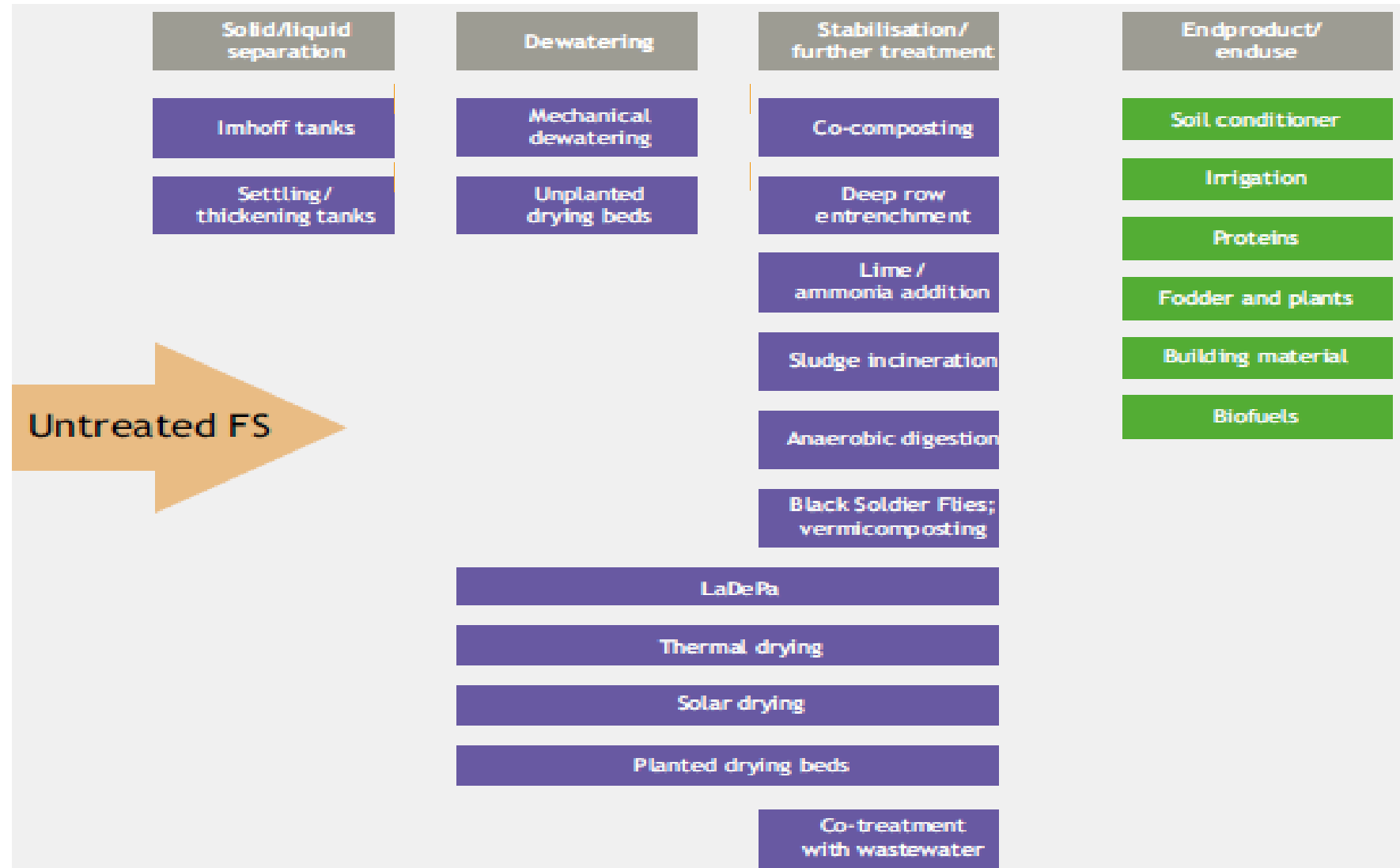
Faecal Sludge Treatment  
Approaches

# Treatment - Objectives



# Different treatment approaches

- Solid liquid separation
- Dewatering
- Stabilization
- End-use



Source: Fecal sludge management systems approach for implementation and Operation, IWA Publications, 2014

# Pre-treatment - Screening & grit chamber

- The screen and Grit chamber is a basin to trap large solids (rags, paper, plastics, and metals) using different size screens and for settling of grits (sand, gravel, cinder)



# Pre-treatment - Screening & grit chamber

- The screens are provided with parallel bars vertically or horizontally with a opening size of 2 to 5cm
- The solids collected in this chamber removed regularly and disposed safely



# Treatment Mechanisms

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- **Physical mechanisms**

- Physical methods of wastewater treatment accomplish removal of substances by use of naturally occurring forces, such as gravity, electrical attraction, and van der Waal forces, as well as by use of physical barriers.

- **Biological mechanisms**

- Removal and transformation of organic constituents, nutrients and pathogens via the activity of microorganisms.

- **Chemical mechanisms**

- Employing additives to optimize and control desired reactions
- Mainly used for disinfection and enhanced dewatering

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# PHYSICAL MECHANISMS



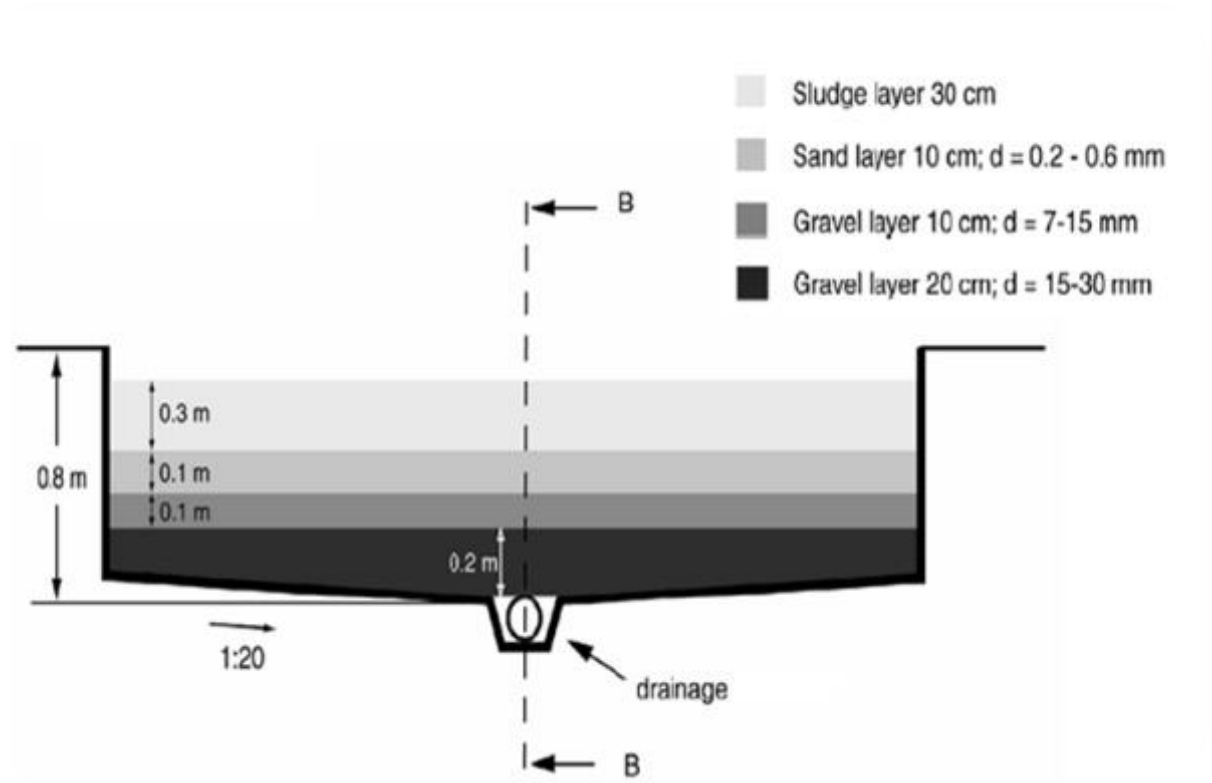
# PHYSICAL MECHANISMS

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- When water is physically bound to solids, it is difficult to remove it.
- Dewatering is based on physical processes such as:
  - Filtration
  - Gravity Separation
  - Evaporation and evapotranspiration
  - Centrifugation
  - Heat drying

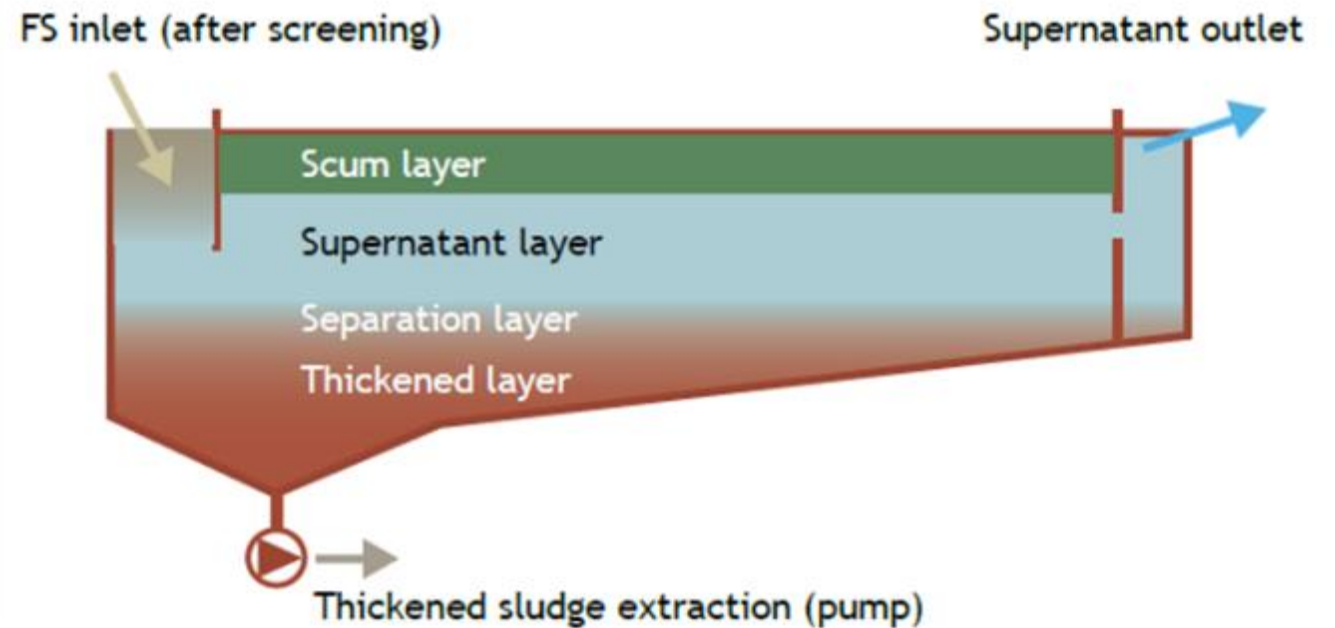
# Filtration

- Common types are :
  - Unplanted drying beds
  - Planted drying beds
- These processes use filter media to trap solids on the surface of the filter bed, while the liquid percolates through the filter bed and is collected in a drain.



# Gravity separation

- most commonly employed method of liquid – solid separation in FSM.
- separation of suspended particles and unbound water
- The four types of settling mechanisms include :
  - ✓ Discrete particle
  - ✓ Flocculent
  - ✓ Hindered
  - ✓ Compression



# Evaporation and evapotranspiration

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- **Evaporation**
- Evaporation - water is released as vapour
- Transpiration- plants release water vapour as part of their metabolic processes

# Evaporation and evapotranspiration

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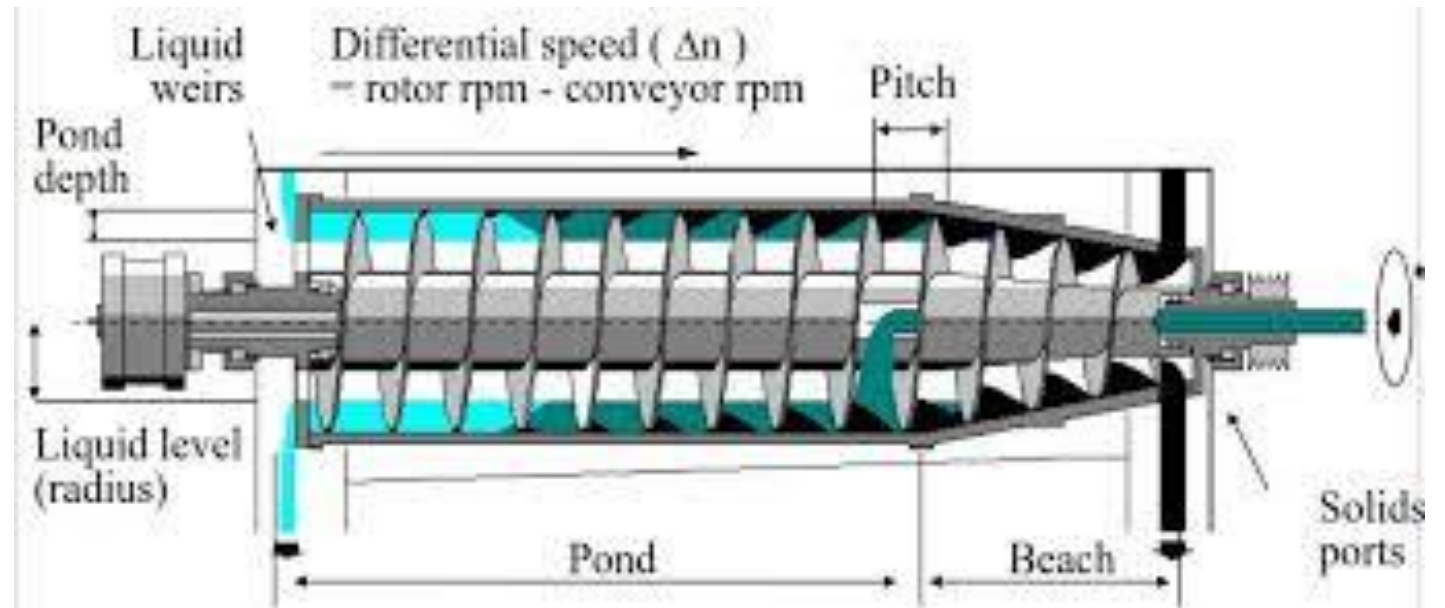
- Evapotranspiration – Evaporation + Transpiration

- **Dewatering**

- In drying beds – filtration + evaporation
- In planted drying beds - evapotranspiration
- Evaporation - influenced by climate, available heat, moisture content of air and wind speed.
- Rate of evapotranspiration > Rate of evaporation alone

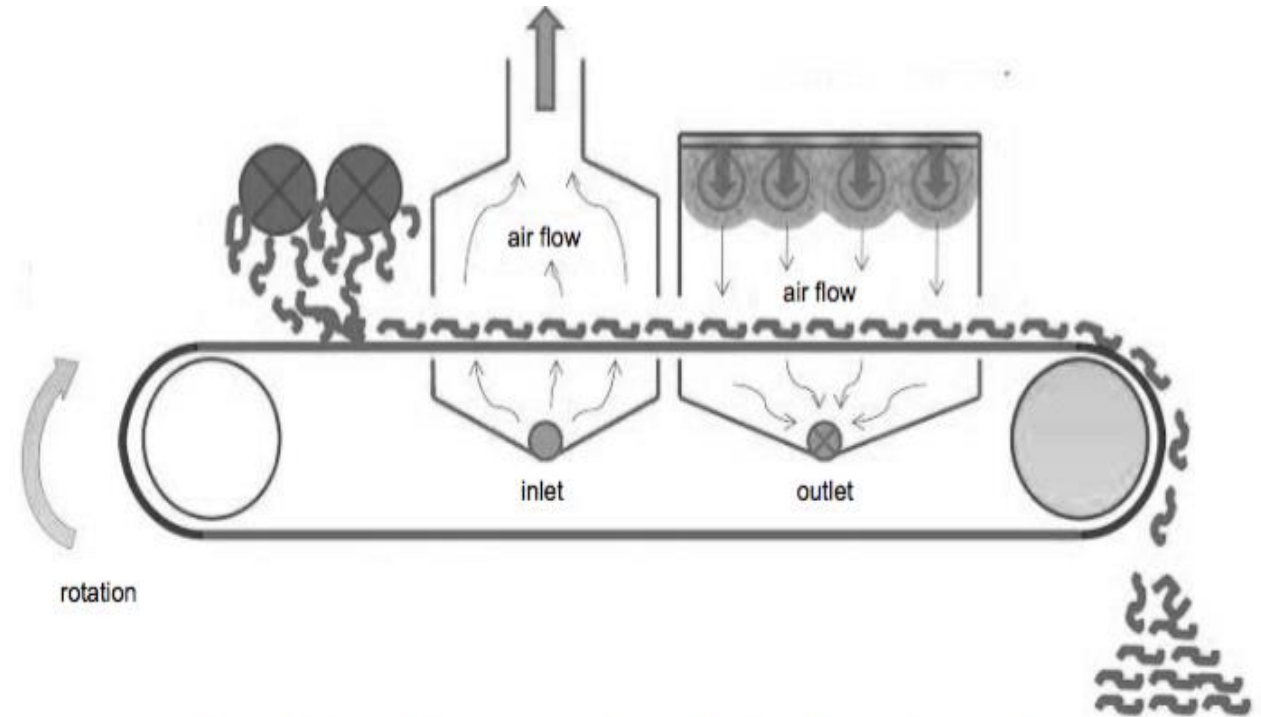
# Centrifugation

- Sludge is placed inside the centrifuge while it rotates at a high speed.
- centrifugal forces accelerate the sedimentation process
- Solids settle out at the centrifuge walls, where they are pressed and concentrated
- liquid and solid fractions are then collected separately



# Heat Drying

- The temperature of the sludge is increased through energy transferred from an external heat source
- Heat drying is used to evaporate and dewater wastewater sludge.
- Currently, heat drying is applied more for wastewater sludge processing than for FS.
- achieves both weight and volume reduction



# Physical Treatment Options

Centralised Sludge Treatment Facility



Belt Press



Mobile Dewatering



Mechanised

Centrifuge Decanter



Filter Press





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# Biological Mechanisms

# Biological Mechanisms

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- Transformation of organic matter and nutrients.
- Harnesses the metabolism and growth rate of microorganisms in naturally occurring processes
- Employs them in controlled situations to optimize the desired outcomes

# Biological Mechanisms

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## Metabolism

- For growth microorganisms need energy and carbon sources.
- Energy can be provided through solar energy or chemical forms
- The carbon source used for the synthesis of new cells can be obtained from organic matter or carbon dioxide.
- Metabolism can be either
  - Aerobic
  - Anaerobic
  - Anoxic

# Aerobic treatment

- Aerobic organisms rely on oxygen for their respiration.
- Typical aerobic treatment processes in wastewater treatment include activated sludge, sequencing batch reactors, trickling filters and facultative or maturation ponds.
- Aerobic processes occur in any solid or liquid treatment process where oxygen is present, including FS drying beds and composting.



# Anaerobic treatment

- Anaerobic degradation occurs where oxygen has been depleted, for example anaerobic and facultative waste stabilization ponds, septic tanks, and settling tanks.
- Results in the production of biogas that can be used for energy generation
- less sludge is produced during anaerobic digestion.



# Factors affecting Biological mechanism - Temperature

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- Biological activity often doubles for every 10°C increase in temperature within a given growth range for each organism.
- Types of organisms defined depending on their optimal temperature range :
  - psychrophilic (optimal temperature at 15°C or lower),
  - mesophilic (optimal temperature 20-45°C),
  - thermophilic (optimal temperature 45-80°C) a
  - hyper thermophilic (optimal temperature at 80°C or greater).

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# CHEMICAL MECHANISMS

# CHEMICAL MECHANISMS

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- Chemicals can be mixed with FS to improve the performance of other physical mechanisms or to inactivate pathogens and stabilize FS.
  - Alkaline stabilization
  - Ammonia treatment
  - Coagulation and flocculation
  - Chemical conditioning



# Alkaline stabilization

- Alkaline additives, such as lime, can be used for the stabilization of FS, either pre- or post-dewatering.
- The addition of adequate quantities of lime to FS raises the pH to 12, which stops the microbial activity.



# Ammonia treatment

- It is well established that aqueous ammonia is effective at inactivating microorganisms, but the exact mechanisms are not yet fully understood



# Coagulation and flocculation

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- additives are added that destabilize particles, allowing them to come in contact with each other, form larger flocs and settle
- Results in achieving enhanced sedimentation

# Conditioning

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- can be carried out prior to physical forms of dewatering to enhance performance.
- Common additives include ferric chloride, lime, alum, and organic polymers.
- Iron salts and lime can increase the total solids of dried sludge (increasing bulk), whereas polymers do not increase the total solids.

# Thank You