Reuse of biosolids from sewage and faecal sludge treatment plants

For: Consultation workshop on reuse of treated by-products

Date: 10th July 2023
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• What are biosolids
• Characteristics of biosolids
• Treatment and reuse options
• Management of biosolids
• Policy and Regulatory framework
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• Challenges and Enablers
• Key questions for discussions
Biosolids are solid, semisolid, or liquid residues generated during primary, secondary, or advanced treatment of domestic sewage that aims to reduce pathogens.
In some FS treatment technologies, dewatering and drying takes place in the same unit.
Characteristics

**Pathogens**
(fecal coliforms, Salmonella sp. bacteria, enteric viruses, small portion of active microorganisms and inert solids)

**Nutrients**
Macronutrients, nitrogen, phosphorous, potassium, sulphur and micronutrients.

**Industrial and manmade contaminants**
(ammonia, amines, heavy metals, Per- and polyfluoroalkyl substances, (PFAS) and reduced sulphur-containing compounds)

**Quantities**
3500 – 18000 tonne/day
(considering total sewage generation of 72000 MLD, 0.05 to 0.25 kg/m³ of sewage treated)

The final quality of the biosolids produced depends on the quality of the sewage entering the treatment plant and the treatment process efficiency.

*The changes of the chemical and physical characteristics of dried faecal sludge is less explored in India, whereas this has important repercussions on the reuse of the dried product.*
<table>
<thead>
<tr>
<th>End-product</th>
<th>Treatment Objectives</th>
<th>Technology Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil conditioner (dried sludge, compost, pellets)</td>
<td>Pathogen inactivation; dewatering; stabilization; nutrient management</td>
<td>Anaerobic reactor/digester; SDB; mechanical dewatering; Lime/ammonia addition; Co-composting; thermal drying</td>
</tr>
<tr>
<td>Fertiliser (with addition of NPK, reclaimed water)</td>
<td>Pathogen inactivation; dewatering; stabilization; nutrient management</td>
<td>Anaerobic reactor/digester; SDB; mechanical dewatering; Lime/ammonia addition; Co-composting; thermal drying</td>
</tr>
<tr>
<td>Animal fodder (planted drying beds, fish-aquaculture)</td>
<td>Dewatering; Stabilisation</td>
<td>Planted Drying Bed; Collection system for liquid component</td>
</tr>
<tr>
<td>Protein (black soldier fly larvae)</td>
<td>Dewatering;</td>
<td>Mechanical dewatering/SDB; Black soldier flies</td>
</tr>
<tr>
<td>Building materials (bricks, cement)</td>
<td>Dewatering</td>
<td>Mechanical or SDB</td>
</tr>
<tr>
<td>Fuel – liquid (biogas)</td>
<td>Stabilisation and digestion</td>
<td>Anaerobic (biogas) digester</td>
</tr>
<tr>
<td>Fuel – solid (combustion)</td>
<td>Dewatering; Incineration</td>
<td>Pyrolysis</td>
</tr>
<tr>
<td>Electricity (gasification)</td>
<td>Dewatering; Incineration</td>
<td>Pyrolysis</td>
</tr>
</tbody>
</table>
# BIOSOLIDS MANAGEMENT

## CPHEEO recommendations for managing various types of sludge

<table>
<thead>
<tr>
<th>Type of Sludge</th>
<th>Prescribed Management Protocol</th>
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<tbody>
<tr>
<td>raw sewage sludge</td>
<td>‘raw sludge as a soil filler directly on land for raising crops…is not desirable’</td>
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<tr>
<td>liquid sewage sludge</td>
<td>‘liquid sludge either raw or digested is unsafe to use…If used, it must be thoroughly incorporated into the soil and land should be given rest, so that biological transformation of organic material takes place’ ‘it should be used in such a way as to avoid all possible direct human contact’</td>
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<tr>
<td>dewatered septage sludge</td>
<td>‘for dewatered septage/sludge agricultural application, it should satisfy the Class A biosolids criteria of US EPA either by lime stabilization, solar drying or composting’</td>
</tr>
<tr>
<td>sewage sludge from drying beds</td>
<td>‘sludge from drying beds should be ploughed into the soil before raising the crops. Top dressing of soil with sludge should be prohibited.’ ‘dried sludge may be used for lawns and for growing deep-rooted cash crops and fodder grasses where direct contact with the edible part is minimum’</td>
</tr>
<tr>
<td>heat-dried sewage sludge</td>
<td>‘heat-dried sludge is the safest from the public health point of view. Though deficient in humus, it is convenient in handling and distribution.’ ‘dried sludge can be used as manure/soil conditioners’ ‘dried sludge pellets can also be used as a fuel source in coal-fired power plants and in cement kilns’</td>
</tr>
</tbody>
</table>
• Water Act
  • Air Act.

Emphasizes to maintain and restore the ‘wholesomeness’ of aquatic resources by not discharging sewage or pollutants into water bodies including lakes.

In schedule IV (Part A & Part B) of this act, characteristics of compost are defined.

Reuse of treated sludge for agriculture application should comply with the standards notified for compost under US EPA /WHO guidelines and MSW Rules.

It describes various sludge treatment processes so that it can be reused as a resource material into other forms.

Describes the case studies on reuse of treated sludge for various purposes and suggests replication of reuse at all the locations.
<table>
<thead>
<tr>
<th>Commodity</th>
<th>Price per kg</th>
<th>Availability</th>
<th>Awareness</th>
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</thead>
<tbody>
<tr>
<td>Cow dung Manure</td>
<td>₹ 0.50</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Fresh Faecal Sludge</td>
<td>₹ 0.12</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Chemical Fertilizer</td>
<td>₹ 20.00</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Compost</td>
<td>₹ 10.00</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

**Markets for cow manure and farm waste**

- Are informal:
- Traded as commodities
- No commercial branding and packaging.
- Usually purchased as truck/trailer loads weighting approximately 4-6 tons.
- For Rs 2500/load + Transportation Charges (in Bangalore)
- Shift towards such products with rising awareness
- Farmers use anything from 19 to 54 tons/acre of cow dung manure in a year
- Dry Faecal Sludge can replace Cow dung manure as Soil Conditioner
CHALLENGES

Public perception and awareness

Compliance with standards

Integration and coordination

Financing and viability
ENABLERS

- Awareness
- Standards
- Pricing
- Regulatory environment
AIM & OBJECTIVES OF THE RESEARCH

Aim: To collect evidences for non-use of bio-solids at STPs and FSTPs, list the barriers and propose measures to enable the usage.

Objectives:
- Conduct in-depth research to collect information on current policies, institutions responsible, standards for use at National and state level for use of bio-solids.
- The research (both secondary and primary) will be conducted across the following themes:
  - Policies and quality standards
  - Regulatory and Institutional arrangements
    - Monitoring protocols, capacities and awareness among the government authorities about use of bio-solids
  - Treatment technologies – efficiency and possible reuse options
    - Which technologies can achieve the required quality for use.
  - Economical viability (how much revenue can be generated – giving an example)
    - At what cost should it be sold.
    - Is there any marketing done to promote the use of bio-solids
  - Social and cultural acceptance (perception on reuse)
    - Why are the farmer’s not willing to take bio-solids for use – is it because it is from faecal sludge or they are not aware on how to use and what would be the implications of applying it on crop
**Innovative technologies**

What type of technologies and systems have to be adapted so as that the by-products are free of heavy metals and pathogens?

**Agricultural reuse**

What are the optimal application rates and methods for bio-solids in different crops and soil types?

**GHG Emissions**

What are the effects on soil, crops produced, greenhouse gas emissions pertaining to reuse of bio-solids?

**Socio-cultural acceptance**

What are the cultural and religious taboo associated with reuse? What are the ways to integrate reuse of bio-solids into existing agricultural practices?

**Monitoring**

What are the monitoring mechanisms to ensure bio-solids are meeting the standards?

**Economic benefits**

What are the economic benefits of application of bio-solids versus synthetic fertilizers?

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Thank you