How to produce fertilizer from urine: Struvite

Urine contains valuable nutrients; it is an excellent fertilizer if applied to crops.

Struvite is a powder fertilizer produced from urine.

If urine cannot be applied directly because:
- storage space is not available
- transport is difficult
- its odour is unpleasant

You can produce struvite to benefit from the fertilizing properties of urine, because:
- volume and weight are reduced
- nutrients can be stored over time
- handling is more user-friendly in powder form

Further considerations
- small scale business approach
- commercialization of struvite as a fertilizer
- phosphorous prices are likely to increase further
- transportation of bittern from India to Nepal

Installation procedure
- assembly of reactor container (sheet metal tank with conical bottom) according to treatment volume (1 L reactor per 10 L of urine per day)
- construction of stirring mechanism & stand (welded metal bars and sheet); assure flow from storage to reactor to disposal.
- installation of fittings & filter (polypropylene fittings and nylon filter bag). Filter fabric: nylon fabric as used for shirts sewn to bag of 0.4 m² surface for 100 L reactor.
- set-up of reactor and storage tanks (plastic storage tanks with connections to reactor)

Dimensioning
- daily treatment capacity: 10 L urine / 1 L reactor
- 500 L urine yield approximately 1 kg struvite

Installation costs
- labour costs: 1 operator for a 500 L reactor

<table>
<thead>
<tr>
<th>Reactor set-up [NRs]</th>
<th>50 L</th>
<th>500 L</th>
</tr>
</thead>
<tbody>
<tr>
<td>steel tank for reactor</td>
<td>3'500</td>
<td>15'000</td>
</tr>
<tr>
<td>stirring system &amp; stand</td>
<td>2'000</td>
<td>10'000</td>
</tr>
<tr>
<td>urine storage tank</td>
<td>500</td>
<td>8'000</td>
</tr>
<tr>
<td>pipes &amp; fittings</td>
<td>500</td>
<td>2'000</td>
</tr>
<tr>
<td>effluent storage tank</td>
<td>500</td>
<td>8'000</td>
</tr>
<tr>
<td>total [NRs]</td>
<td>7'000</td>
<td>43'000</td>
</tr>
</tbody>
</table>

Further readings

Internet resources
- www.novaquatis.ch
- www.sandec.ch
- www.ceep-phosphates.org

Contact information
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STUN: Struvite recovery from urine in Nepal

The Struvite Harvesting Reactor

stirring mechanism:
• metal crank
• metal rod shaft
• sheet metal blades

stainless steel tank:
• crimped & riveted
• silicon sealed
• soldered at outlet

reactor outlet:
• metal connector
• seal tape
• plastic ball valve

filter module:
• plastic container
• nylon filter bag
• bottom outlet

How does the STUN reactor work?

1. fill reactor with urine
2. add magnesium & stir
3. open valve & filter struvite
4. sundry struvite

How is struvite formed?

Urine contains phosphate (PO₄) and ammonium (NH₄); both are important nutrients. If magnesium (Mg) is added to urine, these substances will bind and form struvite (MgNH₄PO₄·6H₂O) powder, which can be filtered out.

Process inputs

urine harvesting
• from urine diverting toilets
• from urinals
• on markets
• in public buildings etc.

magnesium (Mg)

magnesium (Mg) sources
• magnesium sulphate (MgSO₄): fertilizer powder
  magnesium content: 5 - 10%
• bittern: waste product of salt production
  magnesium content: 3 - 10%

magnesium (Mg) dosage
• determine phosphorus (P) content in urine
  Mg:P molar ratio 1:1.1

Process outputs

struvite as fertilizer

<table>
<thead>
<tr>
<th>fertilizer comparison (N:P:K)</th>
<th>urea</th>
<th>DAP</th>
<th>struvite</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>46:0:0</td>
<td>18:46:0</td>
<td>6:29:0+10Mg</td>
</tr>
</tbody>
</table>

struvite in practice – a valuable fertilizer
• slow-release – continuous nutrient flow
• bio-available – easy uptake by plants
• free of heavy metals and pharmaceuticals

effluent reuse potential

effluent characteristics – additional nutrients
• high nitrogen (N) content
• high potassium (K) content

reuse potential – fertigation
• fertigation: fertilization by irrigation
• no clogging in drip irrigation

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