SANITIZATION OF FAECAL SLUDGE BY AMMONIA

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Sanitation crisis

• 1.9 million people die each year of unsafe water, lack of sanitation and poor hygiene
• Avoid transmission of pathogens
• Unsafe disposal:
  • Disease outbreaks
  • Endemic disease
  • Eutrophication

→ Building toilets is not enough!

UN Faecal sludge management at Haiti
Source: http://solutionshaiti.blogspot.se/
Fertilizer potential

- Faecal sludge
  - Organic matter
  - Nitrogen, Phosphorous, Potassium
  - Micronutrients
- Fertilizer potential of faecal sludge compared to mineral fertilizer use:
  - Vietnam: 14 % N, 24 % P
  - Uganda: 1300% N, 1700% P
- Health loss as DALY in low and mid income countries:
  - Unsafe water and sanitation: 3.7 %
  - Mal- and Undernutrition: 15.4 %

→ Need for treatment regarding pathogen content!

Foto: Peter Morgan
**Ammonia sanitization**

- Inactivating effect of uncharged ammonia
  - Bacteria
  - Viruses
  - Protozoa
  - Helminth eggs, for example Ascaris eggs
- Ammonia source in faecal sludge
  - Urine (intrinsic)
  - Urea (added)

→ *How can this be applied?*

Urea nitrogen fertilizer
Source: www.chimicare.org/
Application of Ammonia Sanitization

• Airtight storage to avoid that the ammonia escapes as gas
  • Storage facility
  • Storage in pit, alternating pits.

• Requirement:
  • Sufficient concentration of ammonia
  • Sufficient treatment time

→ What is sufficient ammonia concentration?
Ammonia concentration

- $\text{NH}_3$ depends on
  - Total ammonia
  - pH
  - Temperature
  → *Simple validation*
- $\text{NH}_3$ in faecal sludge
  - Urine:faeces ratio
  - Flush water
  - Leakage in pit
  - Ventilation in toilet
  → *What is sufficient treatment time?*

\[
\text{NH}_4^+ \rightleftharpoons \text{NH}_3 + \text{H}^+
\]
Treatment time at 28°C

1% Urea → 2% Urea

- Pour-flush latrine
- Vacuum toilet
- UDDT post-toilet mixing

NH₃ concentration [mM]

Organisms:
- Salmonella 6 log10
- Reovirus 3 log10
- Enterococcus 5 log10
- Adenovirus 3 log10
- Ascaris 3 log10
Treatment time - Ascaris

- 1% Urea
  - Pour-flush latrine
- 2% Urea
  - Vacuum toilet
  - UDDT post-toilet mixing

Graph showing NH₃ concentration [mM] over days for different temperatures and urea concentrations.
Recommendations

- Reduce flushwater volumes
- Keep the ammonia
- Add urea if necessary
- Validate
  - Measure ammonia, temperature and pH
- Airtight storage for sufficient time
Double gains

→ Fertilizer product where the nutrients are kept
→ Sanitized material reducing the risk of disease transmission

Foto: Peter Morgan