Requirements Faecal Sludge Treatment and disposal in emergency situations

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Content

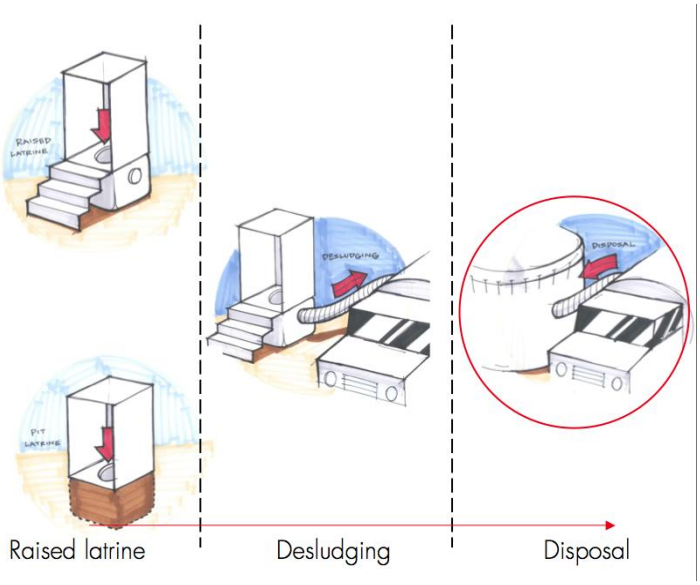
1 Introduction

1.1 General description

In many emergency situations access to adequate sanitation is one of the strongest determinants of survival by people directly affected by the emergency. When disaster strikes they are often trapped in extreme conditions, putting them at very high health risk because of the collapse of crucial sanitation infrastructure. This situation tends to exist for a prolonged period after the disaster due to inadequate relief response. At times, especially in difficult contexts such as urban disasters or flooding, humanitarian actors lack sufficient capacity to ensure affected people have access to adequate sanitation. Besides the provision of good sanitation, faecal sludge management and logistics in emergency settings are always a major challenge for the humanitarian organisations. Especially the development of suitable treatment and disposal methods of large quantities of human excreta in (post) emergency settings has been often neglected due to other priorities. This has often led to undesired landfill with dangerous health- and environmental implications, and thus far never resulted in appropriate disposal and treatment solutions.

This report is one in a series of three that aims to establish a set of requirements for the next generation of (1) raised latrines, (2) desludging devices and (3) faecal sludge treatment and disposal facilities. See Figure 1. This document will only discuss the requirements proposed for treatment and disposal of faecal sludge. Although we use the term requirement, the numbers mentioned are target values.

Figure 1: Treatment and disposal third step sanitation management system



1.2 General problem definition

The common problem regarding treatment and disposal facilities for emergency situations is the unavailability of a cost-effective, rapid-deployable, low-tech and effective method for the treatment and disposal of faecal sludge.

1.3 Definitions and frequently used terms

It is useful to explain the most frequent appearing definitions such as:

- Faecal sludge treatment and disposal facility: A facility for the treatment and disposal of human waste (excreta and urine) in order to prevent hazardous situations
- Faecal sludge treatment and disposal module: functional unit or full kit (building block) for the processing of human waste (excreta and urine)
- Solids fraction:
    - Liquid sludge: sludge that contains less than 15% solids
    - Solid sludge: sludge that contains more than 15% solids
- Treatment efficiency:
    - 1 log reduction: 90% eradication of pathogens
    - 2 log reduction: 99% eradication of pathogens

2 Introduction to the functional requirements

2.1 Background information

The final list of requirements presented in chapter 3 is determined through literature research, through questioning humanitarian organizations and during workshop discussions with sanitation experts from the humanitarian sector, knowledge institutes and the private sector ('sector-wide work shop'). The most valuable literature sources are included in the literature list (Chapter 5).

The questionnaires resulted into valuable input of 14 different humanitarian organizations, which have prioritized and commented the preliminary version of the list of requirements. This list was further refined during the sector-wide work shop.

2.2 Context and product development

For the topic faecal sludge treatment and disposal two contexts have been set up according the emergency and post-emergency situation. The given contexts provide two directions that allow the development process for two separate product designs. The contexts are as following:

CONTEXT I

Rapid installation kit; complete kit for storage and treatment and disposal of faecal sludge

Key figures:

- Life span: minimum of 3 years
- Storage volume: medium (500m^3)
- Ability of local establishment: the total emergency kit should be imported
- Installation: deployable within 2 weeks
- Volume factor for transport: flat packed, compact design
- Sludge type: liquid sludge to semi-liquid
- Option for plug-in faecal sludge treatment

CONTEXT II

Rapid installation kit for communal centres such as health care facilities: Complete import kit for temporary storage, treatment and disposal of contaminated human waste.

Key figures:

- Life span: minimum of 5 years
- Volume: low (350m^3)

- Installation: deployable within 2 weeks
- Volume factor for transport: flat packed, compact design
- Sludge type: liquid sludge

3 Requirements

3.1 Reading guide

The requirement categories are numbered in alphabetical order. The individual requirements have been numbered A1, A2, A3, etc. Besides requirements, optional requirements are added to the program of requirements. Optional requirements are numbered as AA1, AA2 etc. The majority of the requirements are general; however a few have a distinction between Context I and Context II as being described in paragraph 2.2.

To structure the list of requirements the following distinctions have been made:

- Contextual requirements (and optional requirements)
- Manufacturing and maintenance requirements
- Transportation requirements
- Operation and maintenance requirements (and optional requirements)
- Cost and return requirements (and optional requirements)
- Re-use requirements

3.2 Requirements and optional requirements

A. CONTEXTUAL REQUIREMENTS	
A1.	*Space availability:* The facility requires a limited amount of space (preferably within 500 m^2).
A2.	*Placement*: The facility is designed to be able to be installed above ground (in case of rocky surfaces or risk of flooding). If applicable the facility can be placed semi-underground/ dug in.
A3.	*Ability of local establishment:* The facility is to be manufactured locally. If the facility requires inputs that cannot be obtained locally those inputs do not have any international flight restrictions.

AA. Contextual optional requirement	
AA1.	*Integration in urban context*: The disposal facility can be integrated in an urban context.

B. MANUFACTURING AND INSTALLATION REQUIREMENTS		
B1.	*Labour intensity:* The installation of the facility does not require a large amount of labour.	
	I	The construction of the facility does not require more than 96 hours.
	II	The construction of the facility does not require more than 48 hours.
B2.	*Installation tools and/ or machinery*:	
	I	The facility can be installed using manual tools only.
	II	The facility can be installed using manual tools only.
B3.	*Deployment:* Ability to deploy the facility within short period upon arrival in the field	
	I	The facility can be deployed within 2 weeks
	II	The facility can be deployed within 2 weeks
B3.	*Dimension*: The facility is able to store, either in single or multiple units, a total sludge volume of:	
	I	500m^3
	II	350m^3
B4.	*Modular configuration and scalability:* The facility is modular (so e.g. one unit should be able to handle small volumes and can be easily upgraded to large volumes).	
B5.	*Safe handling:* The facility is prepared for easy and safe filling and emptying.	
B6.	*Robustness:* The disposal facility has a robust design.	

C. TRANSPORTATION REQUIREMENTS	
C1.	*Volume factor*: Items required for the facility are small according to the following factor: 1 m^3 transport volume: 100 m^3 operational volume. The facility can be transported in a standard freight aircraft.

C2.	*Transport weight*: Items required for the disposal facility should be light (easy to transport as airfreight).

D. OPERATION AND MAINTENANCE REQUIREMENTS		
D1.	*Treatment capacity:*	
	I	The facility (with treatment plug in) is able to treat or process at least 20 m^3 sludge per day.
	II	The facility is able to treat or process at least 10 m^3 sludge per day.
D2.	*Treatment capability:* Ability to process different types of sludge (liquid, solid, semi-solid).	
	I	The disposal facility is designed to process liquid and semi-liquid sludge.
	II	The disposal facility is designed to process liquid sludge.
D3.	*Treatment efficiency*: The disposal facility should be an effective solution to decrease and remove pathogens. The treated sludge should fulfil WHO criteria.	
	I	The disposal facility has a minimum of 2 log pathogen reduction = 99% eradication of pathogens and the treated sludge contains less than 3-8 Helminth eggs/litre sludge.
	II	The disposal facility has minimum of 2 log pathogen reduction = 99% eradication of pathogens and the treated sludge contains less than 3-8 Helminth eggs/litre sludge.
D4.	*Treatments effectiveness*: Leachate and sludge (output) do not require additional, secondary treatment and can be disposed in a landfill or similar.	
D5.	*Health implications:* Ease of adhering to safety, health and environmental norms and standards during operation and maintenance.	
D6.	*System robustness*: The disposal facility is capable of processing common types of debris present in the sludge (such as menstrual cloth, bottles, stones etc.).	

D7.	*Treatment period*: The process time is limited.	
	I	The process does not require more than 25 days.
	II	The process does not require more than 14 days.
D8.	*Process continuity*: Ability to function intermittently (shock loading as opposed to continuous flow).	
D9.	*Safety measure overload*: The facility has a safety measure to prevent possible overload or spills.	
D10.	*Level of independency*: Ability to function as stand-alone unit for at least 3 months: no need for external inputs such as power grid, water supply, etc.	
D11.	*Power supply:* If power supply is required, the facility includes a stand-alone generator.	
D12.	*Ease of sludge disposal:* The facility is easy to operate and maintain (medium skills trained staff required).	
D13.	*Vector breeding*: Access by vectors and vector breeding is minimized (to allow the possibility to be put up close to human settlements).	
D14.	*Odour release:* Limited smell (to allow the possibility to be put up close to human settlements).	
D15.	*Noise production*: Production of noise is acceptable (especially in urban context).	
D16.	*Local maintenance:*	
	I	The facility is totally imported including some essential spare parts.
	II	The facility is totally imported including some essential spare parts.
D17.	*Accessibility:* The outputs produced by the facility are easy to empty using a desludging device.	

DD. Operation and maintenance optional requirements	
DD1.	*Nutrient recovery:* The disposal facility is capable of recovering nutrients (such as nitrogen (N), phosphorus (P), and potassium (K).

E. COST AND RETURN REQUIREMENTS		
E1.	*Affordability Product Costs for each stand-alone module (CAPEX: Capital Expenditures):*	
	I	The CAPEX of the facility does not exceed 75,000 USD.
	II	The CAPEX of the facility does not exceed 50,000 USD.
E2.	*Affordable operational costs* The facility has low and affordable operational costs (OPEX), of which a transparent calculation is included in each tender application. The ratio OPEX : CAPEX is part of the evaluation of different solutions.	

EE. Cost and return optional requirements	
EE1.	*Market value*: The output product has economic value to ensure a sustainable operation as local business.

F. RE-USE REQUIREMENTS	
F1.	*Re-use in local settings*: Components are sufficiently durable to allow for upgrading by (future) users/ owners and integration into local settings and household solutions for permanent use.
F2.	*Re-use in emergency situations*: Product can be disassembled for disposal.

4 Top list of requirements

Respondents from different humanitarian organisations were asked to prioritize the list of requirements. They were asked to assign a number from 1 (lowest priority) to 5 (highest priority) to each individual requirement. This resulted in the following top 10 list of requirements:

1. Ease of adhering safety, health and environmental norms and standards during operation and maintenance (D5)(3.4)
2. Deployment: ability to deploy the facility within short period upon arrival in the field (B3)(weeks) (3.45)
3. Modular configuration and scalability (B4): should be modular (so e.g. one unit should be able to handle low volumes and can be easily upgraded to high volumes by adding more units) (3.45)
4. Treatment efficiency (D3)(3.45)
5. Treatment capability (D2): ability to process different types of sludge (liquid, solid, semi liquid) (3.36)
6. Treatment period (D7)(3.36)
7. Adaptability (A2): can be easily adapted or has the ability to function aboveground (for areas with hard surface or at risk of flooding) (3.,27)
8. The outputs produced by the unit should be accessible by standard emptying/transport devices (D17)(3.27)
9. Power supply: if power supply is required, the disposal method should include a stand-alone power generator (S11)(3.2)
10. Treatment effectiveness (D4)(3.18)

5 Literature

Selection of relevant web resources:

http://www.who.int/water_sanitation_health/publications/2011/tn14_tech_options_excreta_en.pdf

http://pakresponse.info/LinkClick.aspx?fileticket=HO1W1fDtFIc%3D&tabid=105&mid=652

http://www.sswm.info/sites/default/files/reference_attachments/EAWAG%20SANDEC%202008%20Module%205%20FSM%20Lecture.pdf

http://www.lboro.ac.uk/well/resources/technical-briefs/64-wastewater-treatment-options.pdf

http://www.eawag.ch/forschung/sandec/publikationen/sesp/dl/compendium_high.pdf

The central platform for international discussion and information sharing on emergency sanitation is www.susana.org. Workgroup 8 is focusing on emergency and reconstruction situations.

More background information about this project is available on: http://susana.org/lang-en/working-groups/wg08/workshops/242-workshops-on-emergency-sanitation-/760-workshop-on-emergency-sanitation-in-delft-the-netherlands-june-2012-