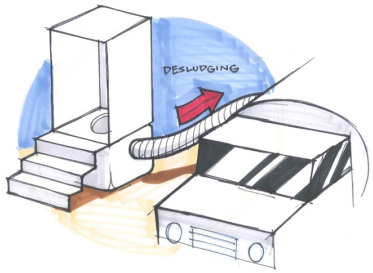


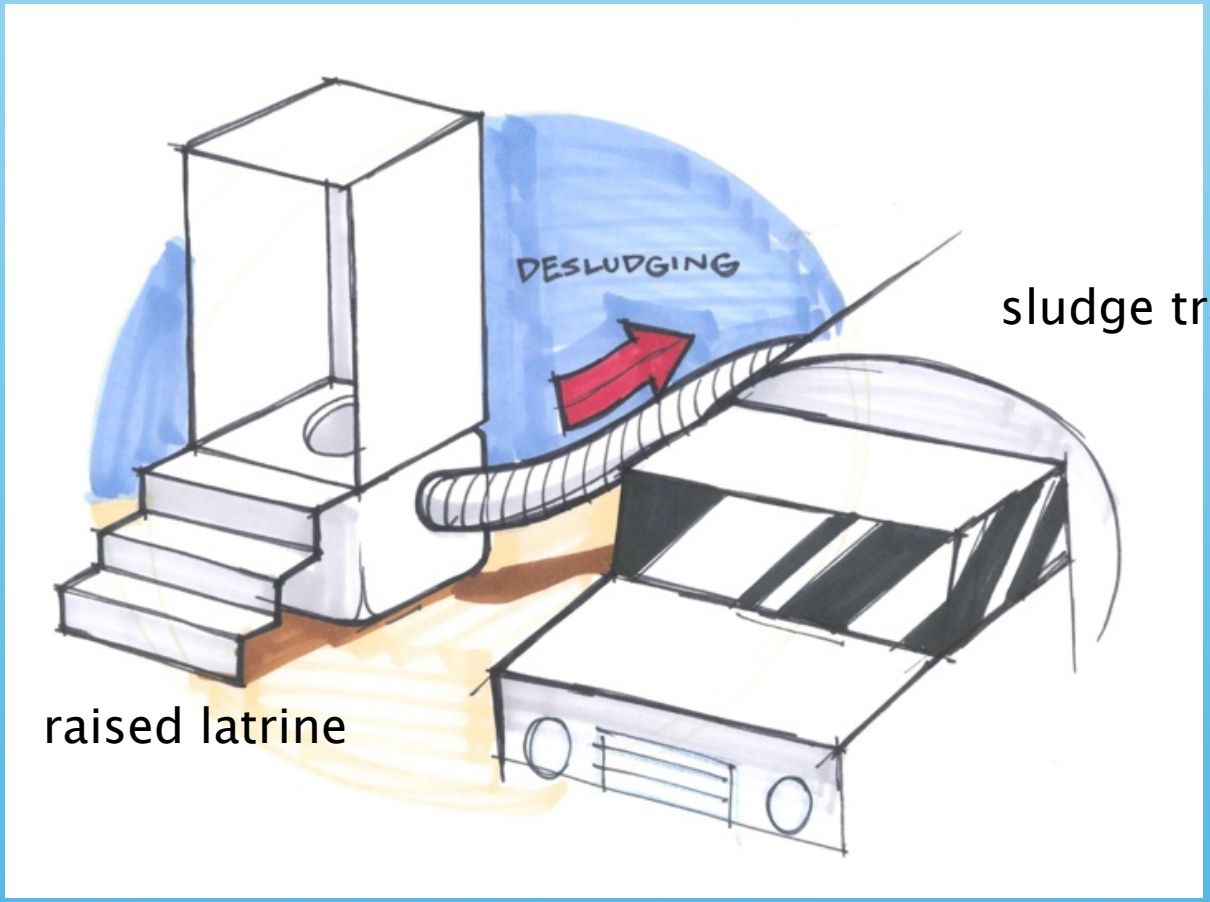
Inspiration for product development; Desludging

June 14th 2012

Aldus bouwinnovatie

eigenwijze ingenieurs I inventieve adviseurs

Desludging



Desludging

Research into desludging requirements

New technology inspiration

- Desludge tools
- Large volume removal
- Local sludge reduction
- Temporary sewerage system

Challenges & discussion points

Research into desludging requirements

Problem:

there is no acceptable desludging method available to be deployed in all emergency situations and for all types of latrines and all types of sludge viscosity

Goal:

to establish an unambiguous set of requirements for desludging:

1. General consensus
2. Feasible solution for all emergency situations

Research into desludging requirements

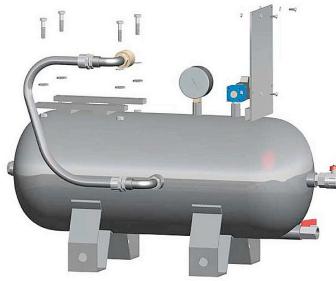
Method:

1. Evaluating current solutions
2. Response to concept requirements
3. Search for new inspiration
4. Reaching consensus in workshop

Research into desludging requirements

Different system:

* Manual driven mechanical systems
* Mechanical systems:
  * pumping
  * vacuum
  * screwing
  * scooping



Research into desludging requirements

Evaluation of current solutions: based on experience reports

System type	Activity	Product or category	Safety	Affordability Product Costs	Affordability Lifecycle Costs	Ability of local manufacturing	Speed	Volume in case of tank	Limited Physical exertion	Limited Labour intensity	Limited Knowledge intensity	Accessibility & Manoeuvrability	Sludge Robustness	Limited use of resources	Sludge transportability	Total Score
Weighting factor →			3.	2.	2.	1.	2.	1.	1.	2.	2.	3.	3.	2.	3.	
MANUAL DRIVEN SYSTEMS	Emptying	Manual desludging	- -	++	0	++	- -	N.A.	- -	-	++	++	+	++	- -	3
		Gravitational emptying	0	+ +	+	++	+	N.A.	+	+	++	+	+ +	+	- -	22
	Filling (bag)	Pee poo bag	+	++	0	0	N.A.	N.A.	++	++	++	++	++	+	-	29
MANUAL DRIVEN MECHANICAL SYSTEMS (semi mechanised)	Compressing	Vacuum tank & hand pump	+	0	+	+	-	-	0	-	0	0	-	+	0	0
	Pumping	MDHP / LSHTM gulper	0	+	+	+	-	N.A.	-	0	+	+	0	+	- -	3
		Diaphragm hand pump	0	+	+	- -	0	N.A.	-	0	+	+	0	+	- -	
	Screwing	Pit screw auger (PSA)	0	+	+	+	-	N.A.	-	0	+	+	+	+	- -	6
	Scooping	Continuous chain device (cibbled)	0	+	+	+	-	N.A.	-	0	+	+	+	+	- -	6
		Gobbler	0	-	+	+	-	N.A.	0	0	+	+	++	+	- -	7
MECHANICAL SYSTEMS	Compressing	Vacuum truck	++	- -	- -	- -	++	++	++	++	0	- -	0	- -	++	4
		Micravac	++	-	-	- -	+	+	++	++	0	-	0	- -	++	9
		Dung beetle	++	-	-	- -	++	+	++	++	0	-	0	- -	++	10
		Vacutug	+	-	-	- -	+	+	+	+	0	-	0	-	0	-2
		eVAC	+	-	-	- -	+	+	+	+	0	-	0	-	0	-2
	Pumping	Submersible pump	0	+	+	- -	0	N.A.	+	+	+	+	-	0	-	4
		Diaphragm pump	0	+	+	- -	0	N.A.	+	-	+	+	-	0	-	0
	Screwing	Power-operated pit screw	0	0	0	- -	0	N.A.	+	+	+	+	+	0	-	6

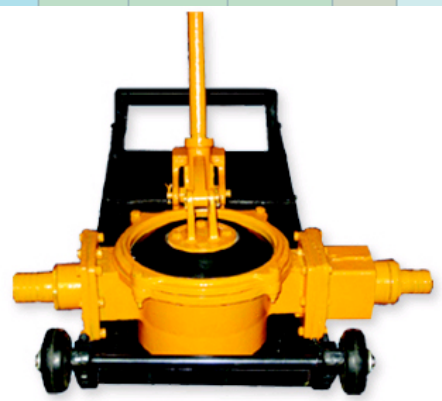
Research into desludging requirements

Evaluation of current solutions: diaphragm hand pump

-/- Labour intensive and limited transport distance

+/+ low product and lifecycle cost and high accessibility

System type	Activity	Product or category	Safety	Affordability Product Costs	Affordability Lifecycle Costs	Ability of local manufacturing	Speed	Volume in case of tank	Limited Physical exertion	Limited Labour intensity	Limited Knowledge intensity	Accessibility & Manoeuvrability	Sludge Robustness	Limited use of resources	Sludge transportability	Total Score
	Weighting factor →		3.	2.	2.	1.	2.	1.	1.	2.	2.	3.	3.	2.	3.	
MANUAL DRIVEN SYSTEMS	Emptying	Manual desludging	- -	++	0	++	- -	N.A.	- -	-	++	++	+	++	- -	3
		Gravitational emptying	0	+ +	+	++	+	N.A.	+	+	++	+	+ +	+	- -	22
	Filling (bag)	Pee poo bag	+	++	0	0	N.A.	N.A.	++	++	++	++	++	+	-	29
MANUAL DRIVEN MECHANICAL SYSTEMS (semi) mechanised)	Compressing	Vacuum tank & hand pump	+	0	+	+	-	-	0	-	0	0		+	0	0
	Pumping	MDHP / LSHTM gulper	0	+	+	+	-	N.A.	-	0	+	+	0	+	- -	3
		Diaphragm hand pump	0	+	+	- -	0	N.A.	-	0	+	+	0	+	- -	
	Screwing	Pit screw auger (PSA)	0	+	+	+	-	N.A.	-	0	+	+	+	+	- -	6
	Scooping	Continuous chain device (cabled)	0						-	0	+	+	+	+	- -	6
		Gobbler	0						0	0	+	+	++	+	- -	7
MECHANICAL SYSTEMS	Compressing	Vacuum truck	++						++	++	0	- -	0	- -	++	4
		Microvac	++						++	++	0	-	0	- -	++	9
		Dung beetle	++						++	++	0	-	0	- -	++	10
		Vacutug	+						+	+	0	-	0	-	0	-2
		eVAC	+						+	+	0	-	0	-	0	-2
	Pumping	Submersible pump	0						+	+	+	+		0	-	4
		Diaphragm pump	0						+	-	+	+	-	0	-	0
	Screwing	Power-operated pit screw	0						+	+	+	+	+	0	-	6



Research into desludging requirements

Evaluation of current solutions: vacuum truck

-/- High product and life cycle costs and low accessibility

+/+ good safety, speed, volume and operability

System type	Activity	Product or category	Safety	Affordability Product Costs	Affordability Lifecycle Costs	Ability of local manufacturing	Speed	Volume in case of tank	Limited Physical exertion	Limited Labour intensity	Limited Knowledge intensity	Accessibility & Manoeuvrability	Sludge Robustness	Limited use of resources	Sludge transportability	Total Score
	Weighting factor -->		3.	2.	2.	1.	2.	1.	1	2.	2.	3.	3.	2.	3.	
MANUAL DRIVEN SYSTEMS	Emptying	Manual desludging	--	++	0	++	--	--	--	--	++	++	+	++	--	3
		Gravitational emptying	0	+ +	+	+	--	--	--	--	++	+	+ +	+	--	22
	Filling (bag)	Pee poo bag	+	++	+	+	--	--	--	--	++	++	++	+	--	29
MANUAL DRIVEN MECHANICAL SYSTEMS (semi) mechanised)	Compressing	Vacuum tank & hand pump	+	0	-	-	--	--	--	--	0	0		+	0	0
	Pumping	MDHP / LSHTM gulper	0	+	-	-	--	--	--	--	+	0	+	-	--	3
		Diaphragm hand pump	0	+	-	-	--	--	--	--	+	0	+	-	--	
	Screwing	Pit screw auger (PSA)	0	+	-	-	--	--	--	--	+	+	+	-	--	6
	Scooping	Continuous chain device (cobbled)	0	+	+	+	--	--	--	--	+	+	+	-	--	6
		Gobbler	0	-	+	-	--	N.A.	0	0	+	+	++	+	--	7
MECHANICAL SYSTEMS	Compressing	Vacuum truck	++	--	--	--	++	++	++	++	0	--	0	--	++	4
		Micvavac	++	-	-	-	+	+	++	++	0	-	0	-	++	9
		Dung beetle	++	-	-	-	++	+	++	++	0	-	0	-	++	10
		Vacutug	+	-	-	-	+	+	+	+	0	-	0	-	0	-2
		eVAC	+	-	-	-	+	+	+	+	0	-	0	-	0	-2
	Pumping	Submersible pump	0	+	+	-	0	N.A.	+	+	+	+		0	-	4
		Diaphragm pump	0	+	+	-	0	N.A.	+	-	+	+	-	0	-	0
	Screwing	Power-operated pit screw	0	0	0	-	0	N.A.	+	+	+	+	+	0	-	6

Research into desludging requirements

Conclusions:

1. None of the products performs sufficiently on all aspects
2. Only expensive mechanically driven equipment is really safe to use
3. Good accessibility is only provided by simple manual tools
4. Handling of different types of sludge is best provided by (semi) manual tools
5. There is a technology GAP between small desludge tools and large vehicles
6. Gravitational emptying has good potential

Responses to concept requirements

Conclusion 1:

Ideal product:

* completely safe
* low-tech
* unlimited accessibility
* all types of sludge
* all types of latrines
* no physical exertion
* minimum costs (CAPEX and OPEX)

Responses to concept requirements

Conclusions 2:

Consensus regarding priorities of requirements:

1. high safety
2. modular capacity
3. different sludge types

Responses to concept requirements

Conclusions 2:

* Some specifications are not quantified:

e.g. nr. of operators, nr. of liters/sec.,weight and size, distance of sludge transport, diameter of suction unit

* Negative correlated specifications lead to challenging requirements:

e.g. limited physical exertion versus speed of desludging

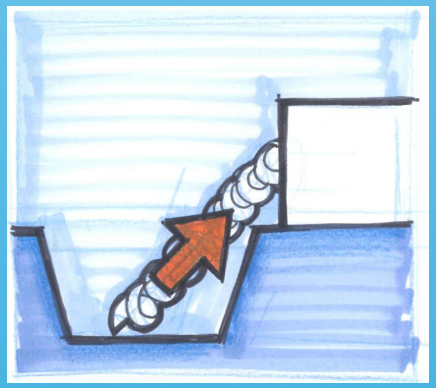
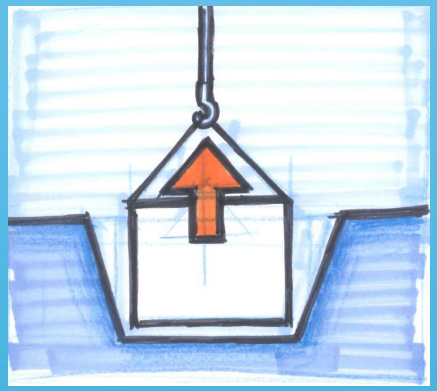
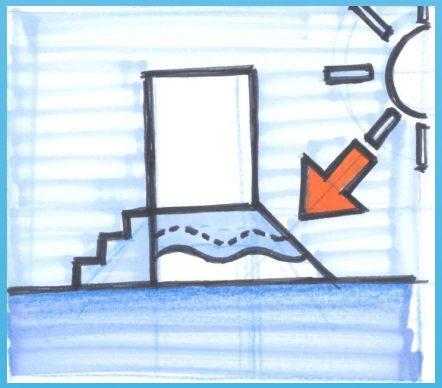
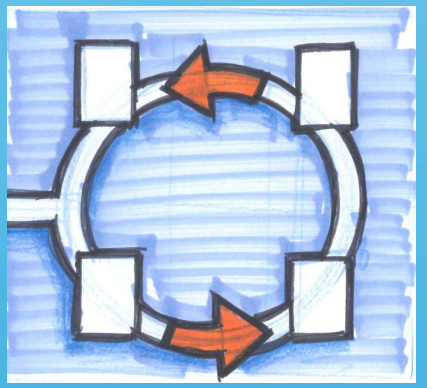
Responses to concept requirements

Conclusions 3:

- Not enough consensus on quantitative specifications
- Doubts on feasibility of requirements….
- Ability to service both pit and raised latrines makes challenge even bigger

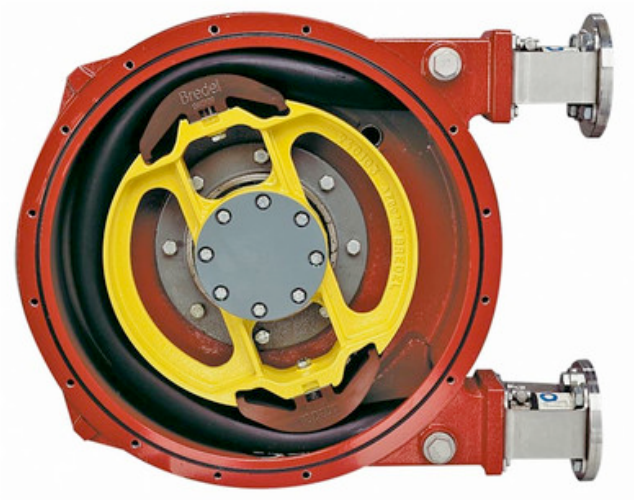
New technology inspiration;

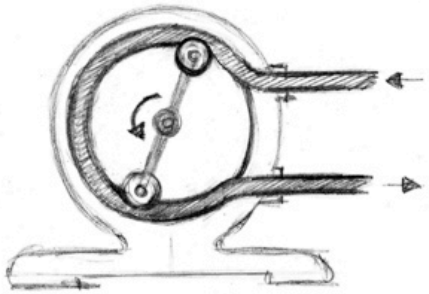
- Desludge tools
- Large volume removal
- Local sludge reduction
- Temporary sewerage system

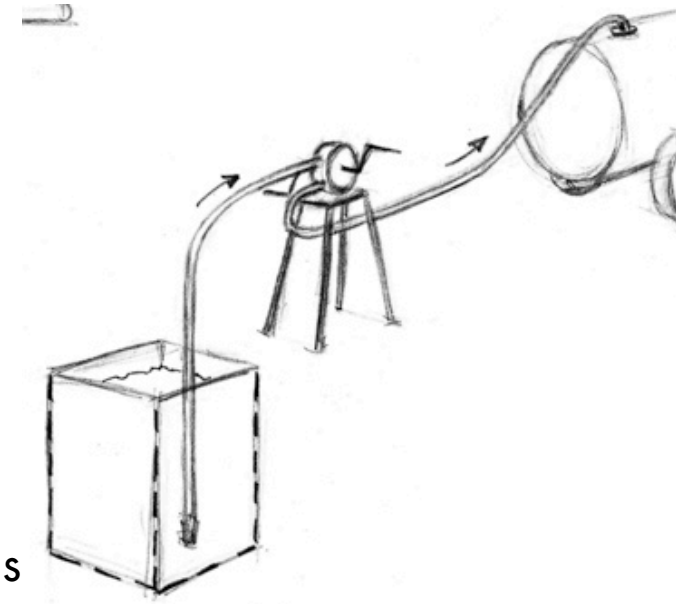





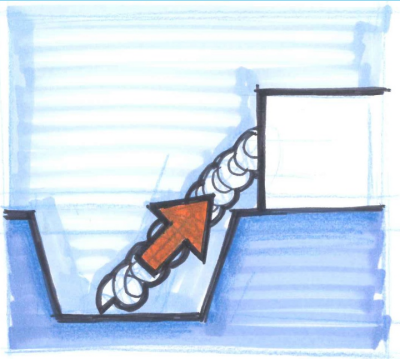
Desludge tools

Peristaltic pump system





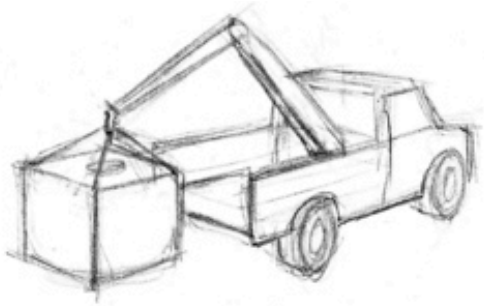




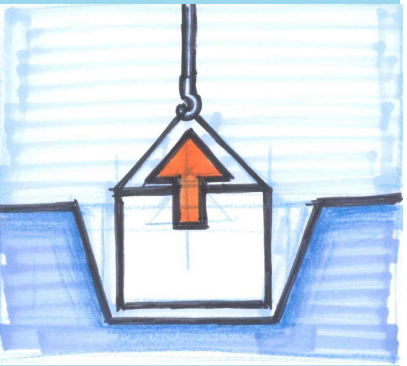
* Robust and simple mechanism
* Unique design for viscous fluids
* Relatively easy to include manual drive

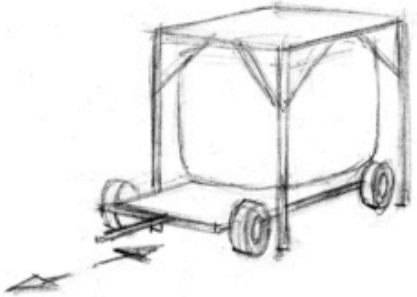
Large volume removal

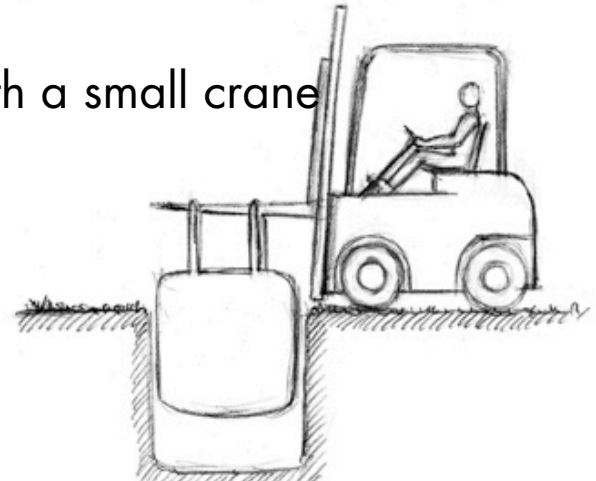
Removal by (common) vehicles



- commonly available vehicle
- vehicle can be well equipped with a small crane

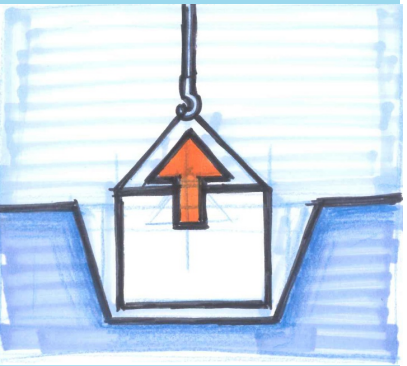


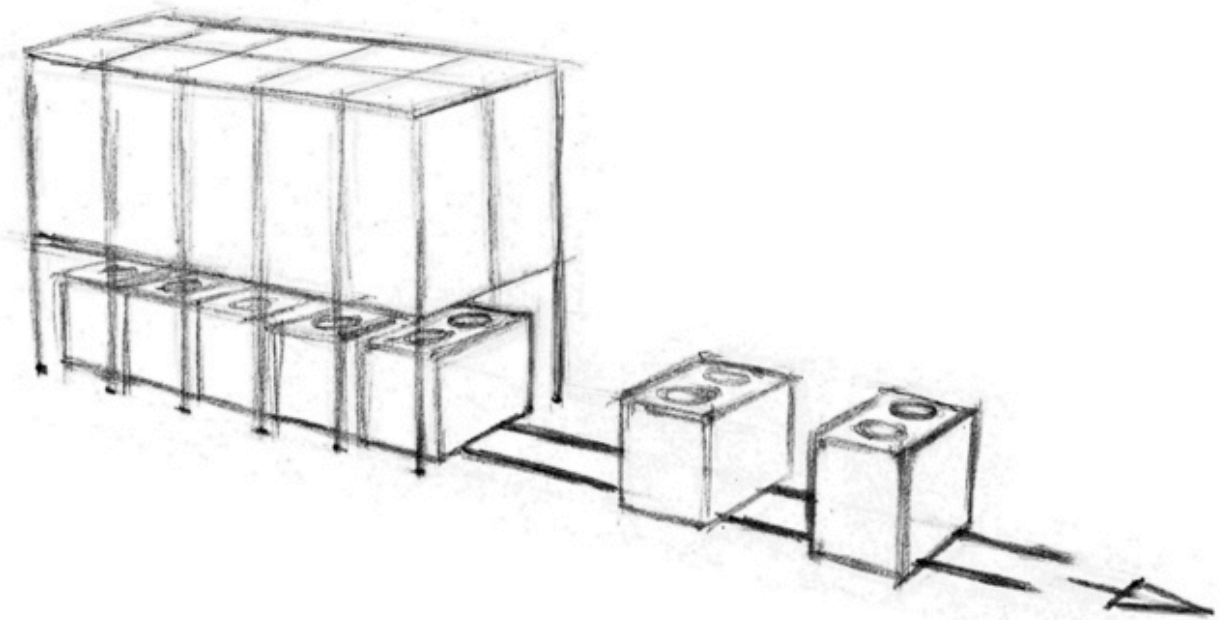




Large volume removal

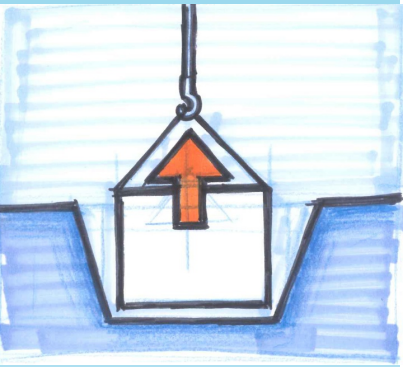
Conveyor belt/sliding system with tanks

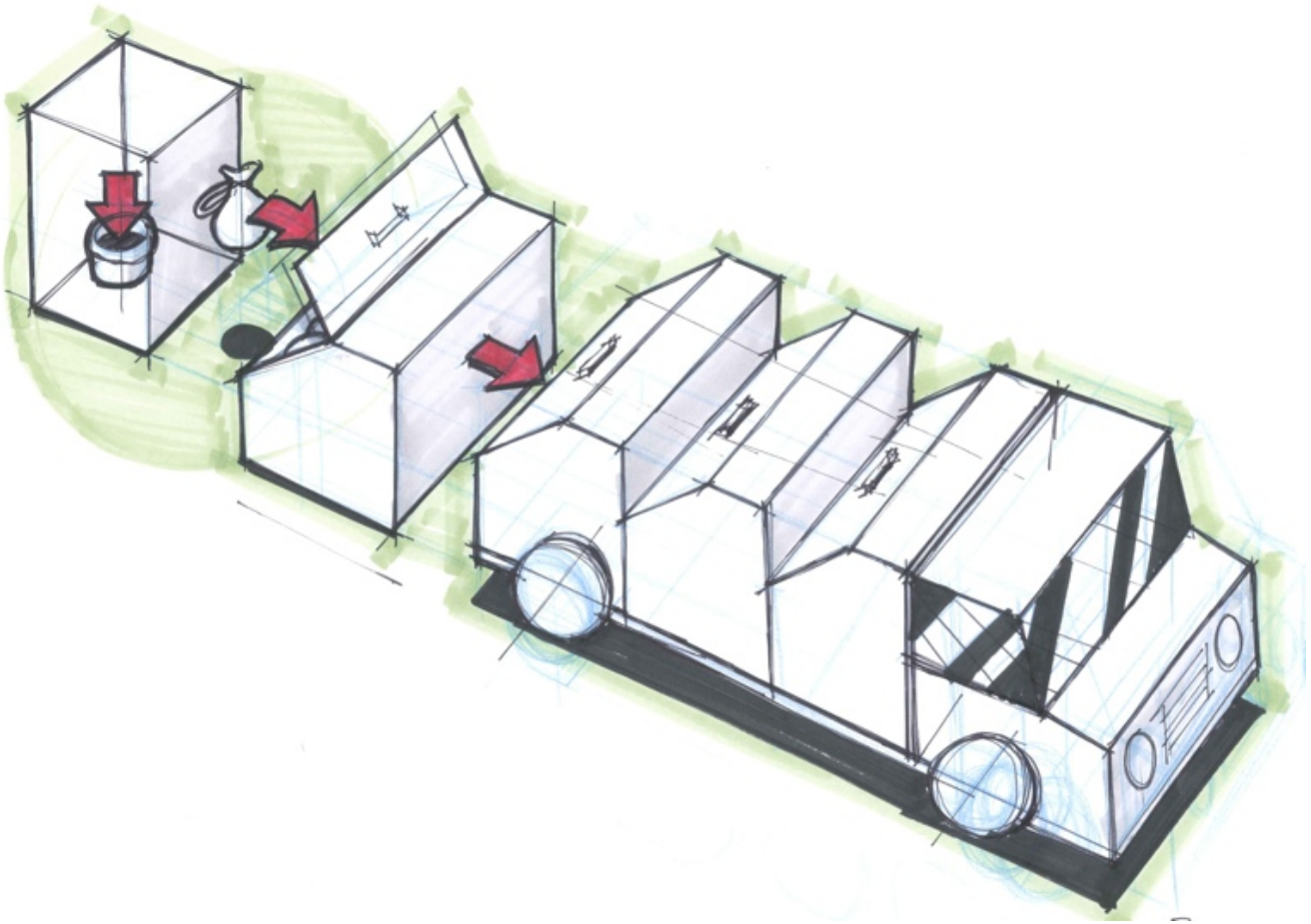




Small volume removal

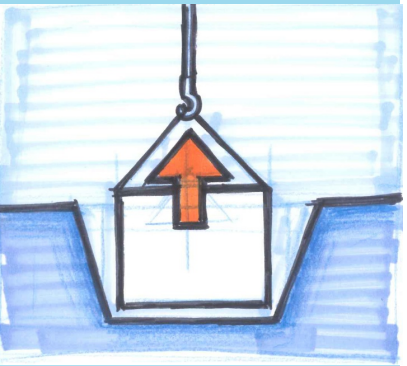
Small bag disposal system





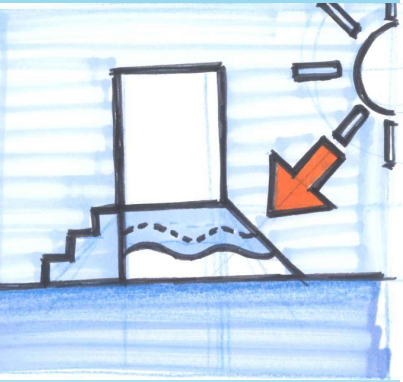
Large volume removal

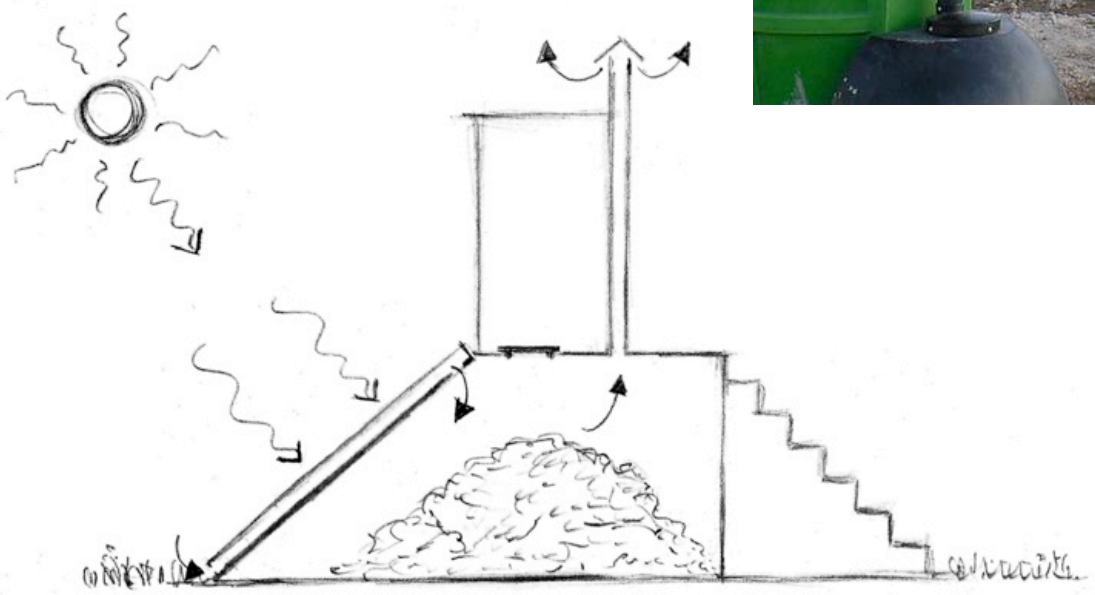
Tank transport



Local sludge reduction

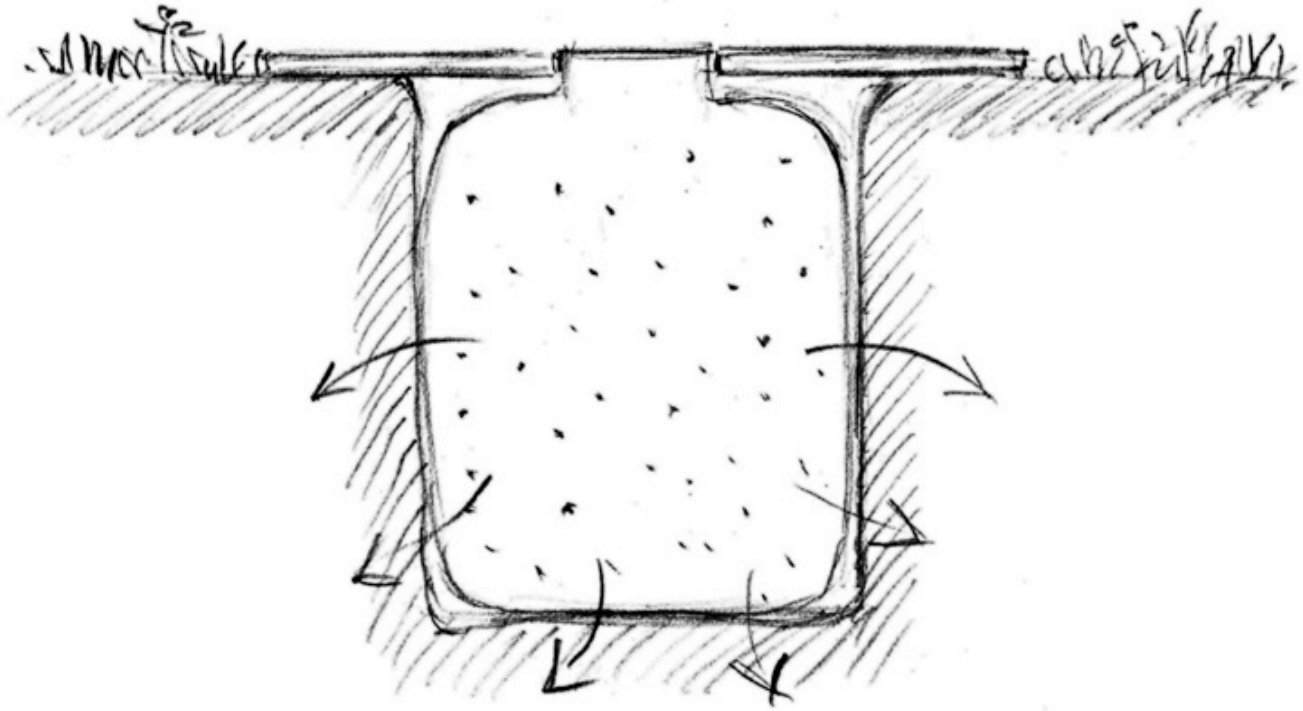
Sludge drying systems

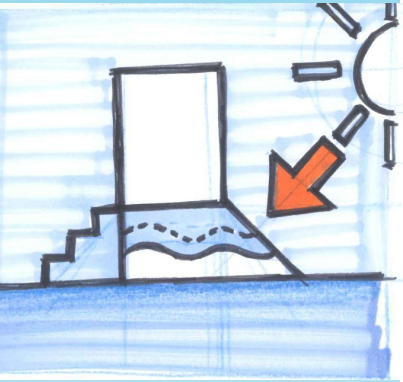




Local sludge reduction

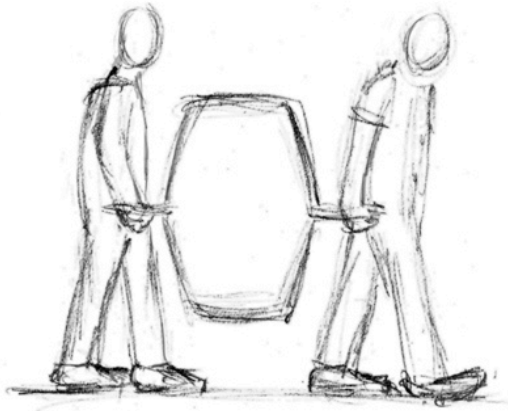
Pit latrine with permeable bag

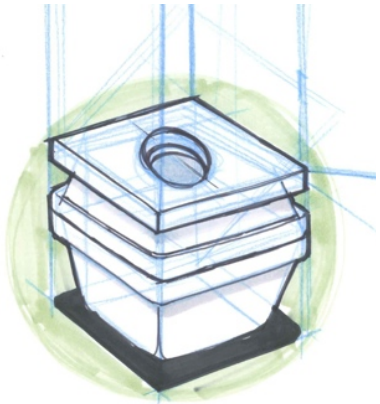


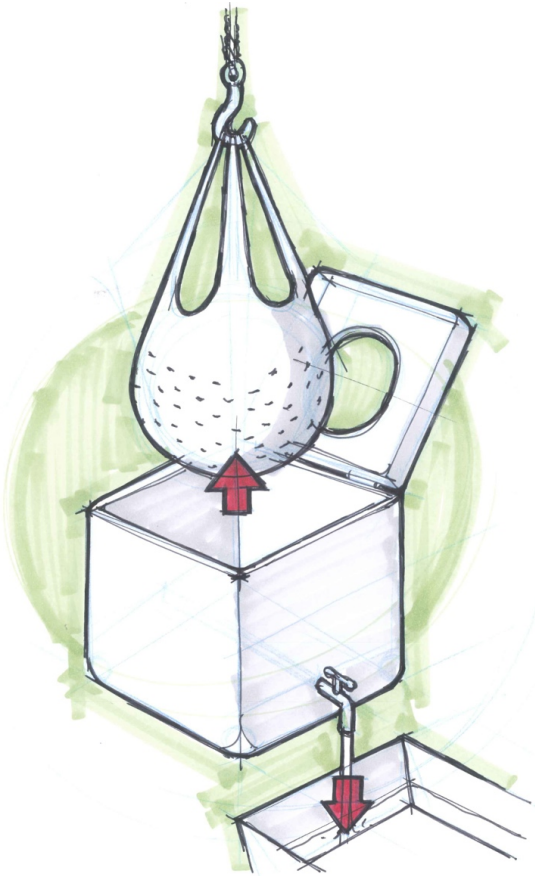


Local sludge reduction

Infiltration and sludge removal by hand or mechanical system

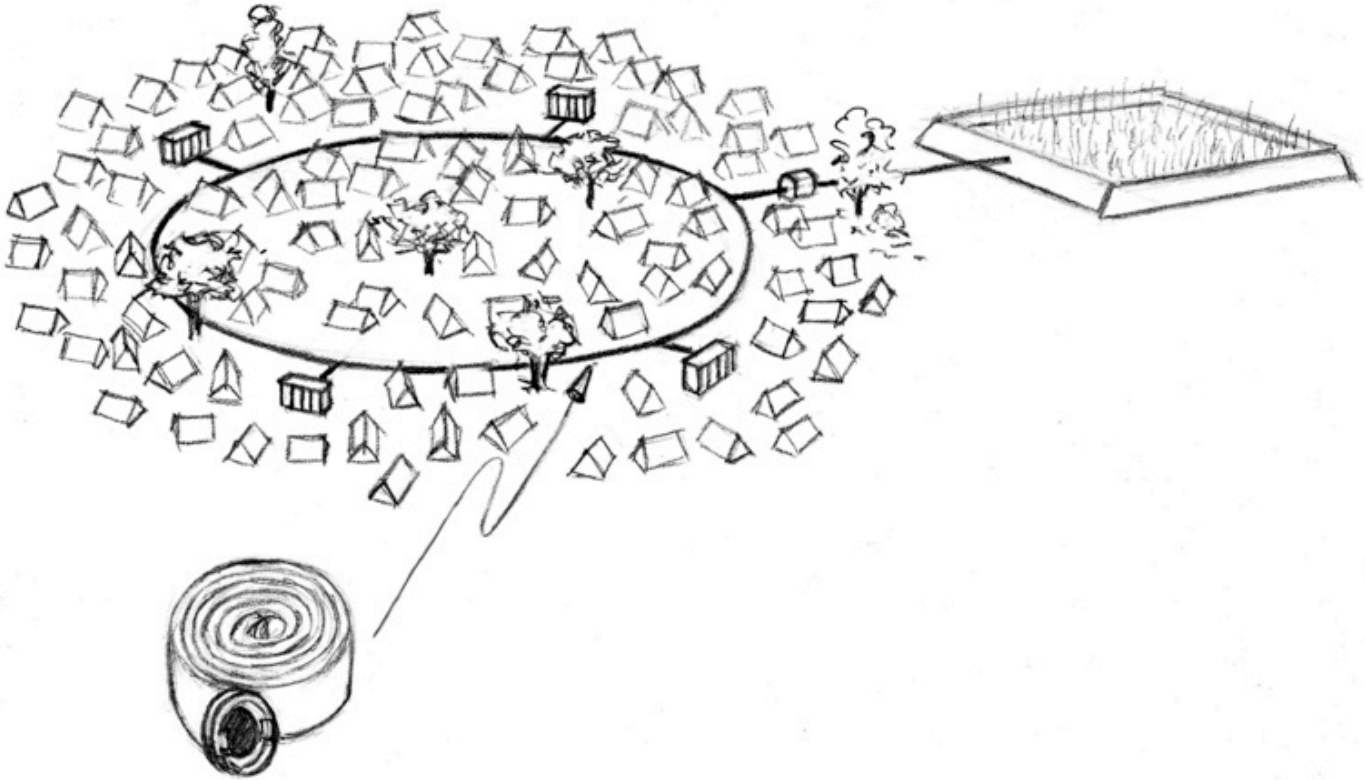


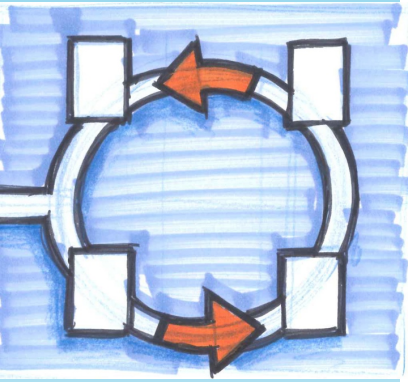




Temporary sewage system

Sewerage system connected to sanitation clusters





Challenges & discussion

Challenges

- Ability to handle ALL different types of sludge
- Ability to service both pit and raised latrines
- No contact with or spilling of faecal matter
- Small device dimensions versus high capacity (speed and volume)
- Device robustness/operational liability

Discussion points

- Could choice for specific range of sludge viscosity solve problems?
- Could investment in temporary sewage system save life cycle costs in the end?
- Is local sludge reduction feasible in crowded emergency camps?
- Could adding water when desludging solve some essential problems?
- Can urine diversion solve some essential desludging problems?
- Can self-responsibility for collection of sludge be managed properly?
- How could gravitational desludging work?

Group sessions

Group session

All participants divided in 7 groups

Each group receives a short briefing and emergency context scenario

Group assignment:

1. Decide with your group what desludging solution is best suited in your given context. Draw how it would work! 20 minutes

2. Evaluate the criteria stated in your group briefing: 40 minutes

* Quantify and specify all 8 specifications
* Add 3 most relevant specifications missing

Requirements to be discussed:

A13. Device is sufficiently robust to withstand extreme conditions in terms of weather (extreme cold and heat, humidity, dust, etc.), handling, and transport

E4. Favorable weight (maximum weight of X kg) and size (maximum dimensions Xl*Xw*Xh) of the desludging device to allow common handling and transportation available in the field (man power and pick-up truck)

A3. Ability to handle different types of sludge

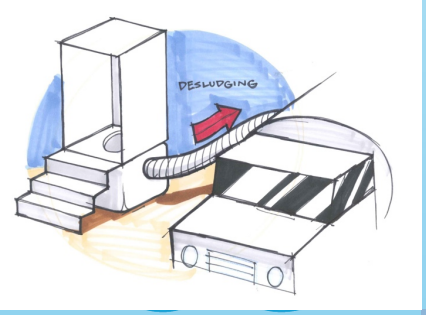
Requirements to be discussed:

A5. Speed of sludge volume reduction in sludge tank (minimum volume reduction of X liters/sec)

E1. Capacity to convey sludge to alternative (e.g. pre-positioned) holding/transfer unit (with a minimum volume of X m3) while using a certain desludging device

E2. Ability to move the device within confined spaces, poor road conditions etc.

F1. The minimum life span of the device should be at least X months


DESLUDGING


MANISCOPIC
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