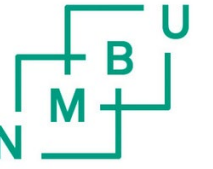




M4



Developing the Blue Diversion Toilet a case study on co-creation

Tove Larsen
Department of Urban Water Management
Eawag, Swiss Federal Institute of Aquatic
Science and Technology
Adjunct Professor DTU Sustain, Technical
University of Denmark
tove.larsen@eawag.ch

Global North

Brandt Line

Global South

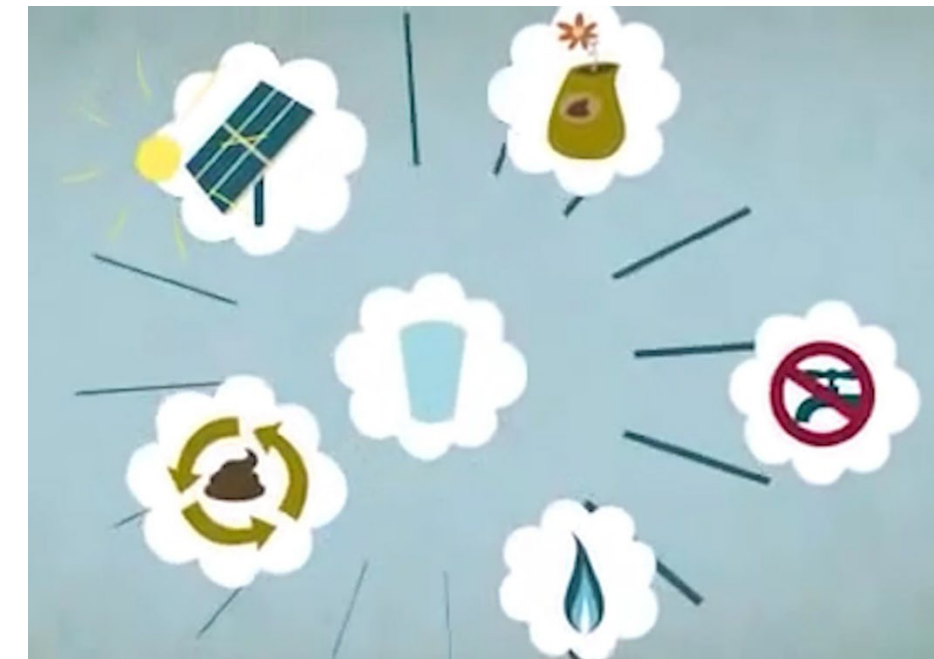


Timeline Reinvent the Toilet Challenge (RTTC)

2011

- Feb – Call (on invitation)
- Mar – Proposal to BMGF
- May – Contract signed
- Jul – Project starts – 100'000 US\$ awarded

Proof of concept



2012

- Aug – Presentation in Seattle (with prices)

The RTTC Eawag proposal team



Tove



Harald



Christoph



Eberhard

The RTTC Eawag proposal team



Engineer



Designer



Urban planner



Engineer

The RTTC Eawag project team 2011-2012



PhD student



Engineer



Engineer



Designer



Engineer



Designer



Project manager



Engineer



Engineer



Engineer



Business researcher



Urban planner



Psychologist



Engineer



Student

The RTTC Eawag project team 2011-2012



Innocent



Tove



Jennifer



Harald



Hansruedi



Bernhard



Ulrike



Charles



Rahel



Woute



Heiko



Christoph



Hansi



Eberhard



Rafael

The Eawag RTTC Proposal

Container-based sanitation in urban slums

Feature	Specification		
Scale of toilet	public	shared	private
Type of toilet	squatting	sitting	flexible
Mixing	all mixed	2 fractions	3 fractions

Logistics	on-site treatment	emptying	self-sealing container
Urine		pumping	
Feces			container
Water	on-site		

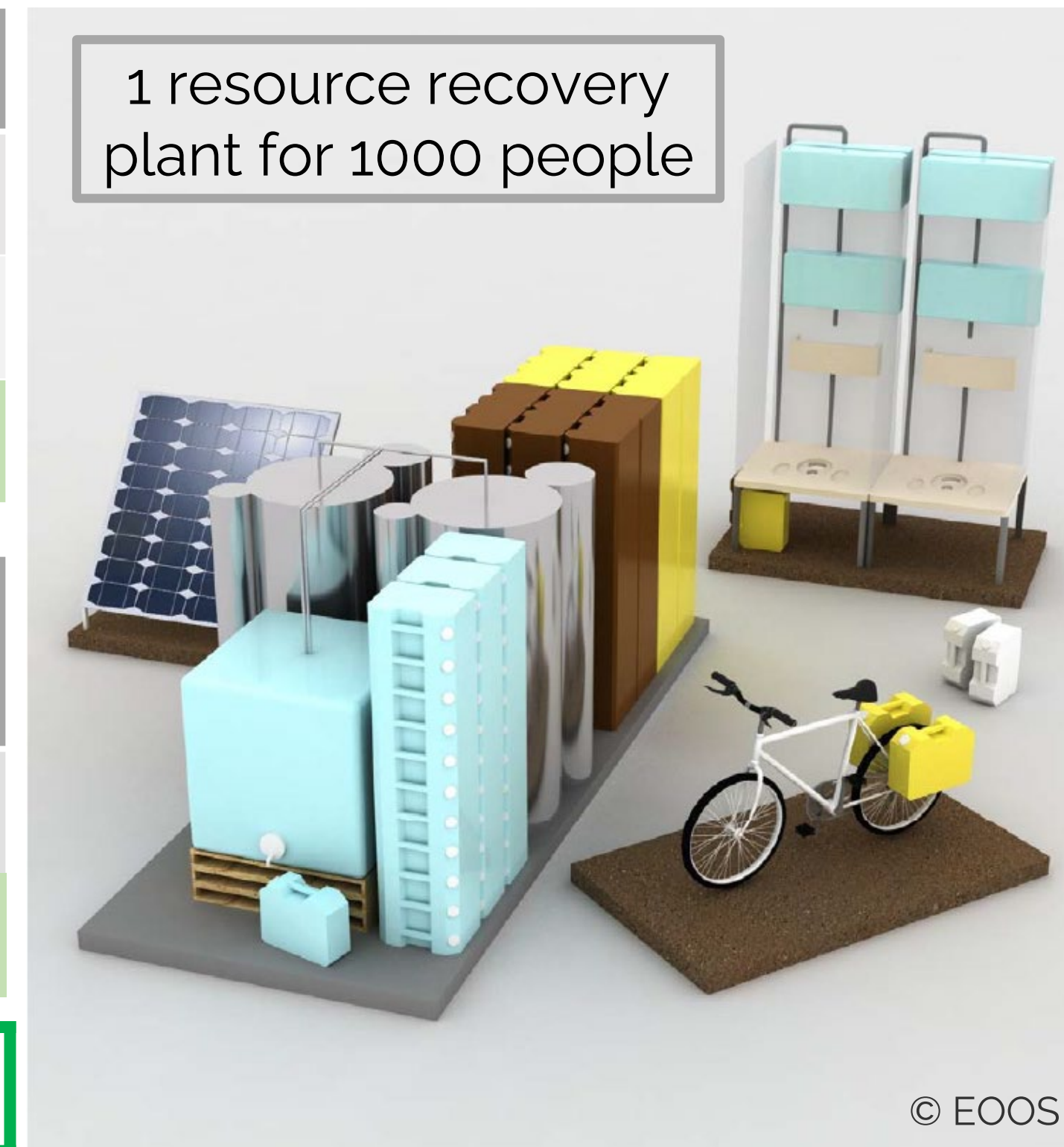


The Eawag RTTC Proposal

Container-based sanitation in urban slums

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Urine		pumping	
Feces			container

Water on-site → **10** people per toilet



On-site water treatment based on GDM filtration

Gravity Driven Membrane (GDM) filtration of surface water

Pre-filtration (Cloth)

Ultrafiltration membrane

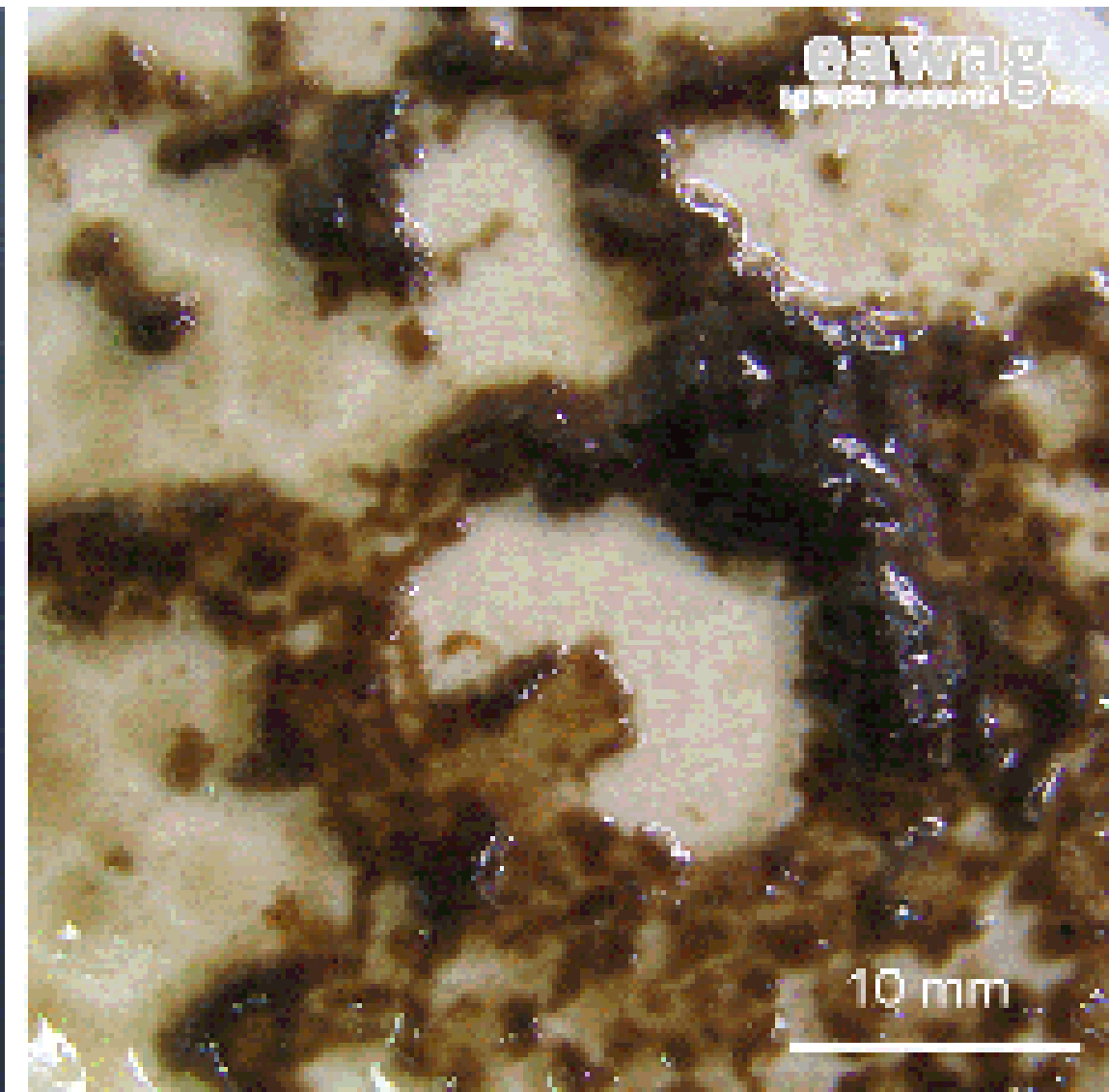
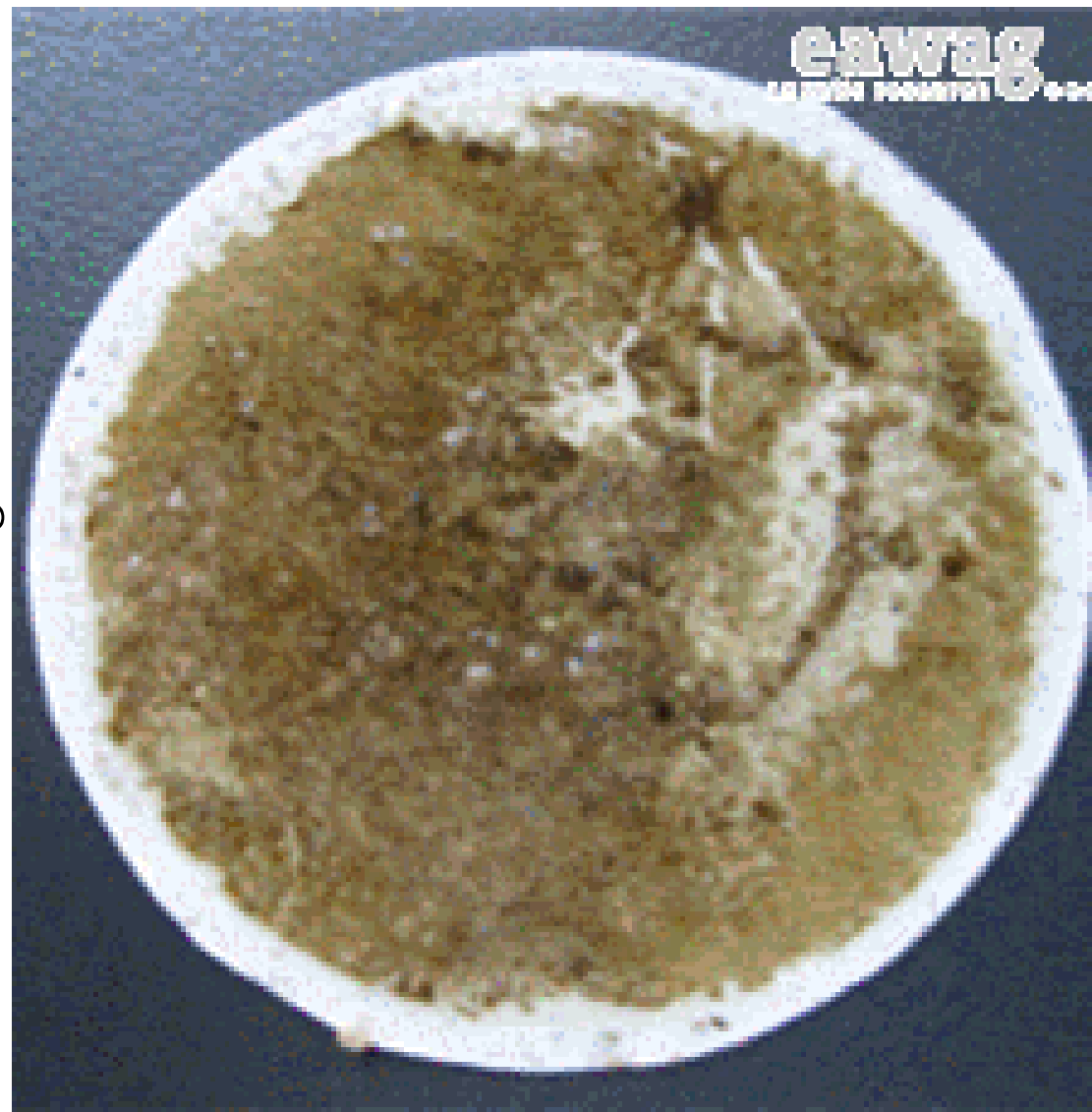
Clean water tank



On-site water treatment based on GDM filtration

Metazoan activity engineers biofilm structure

© Nicolas Derton, Eawag



On-site water treatment based on GDM filtration

How to adapt the GDM filtration the toilet?

Adapted from © Gates Foundation



Proof of concept: On-site wastewater recovery

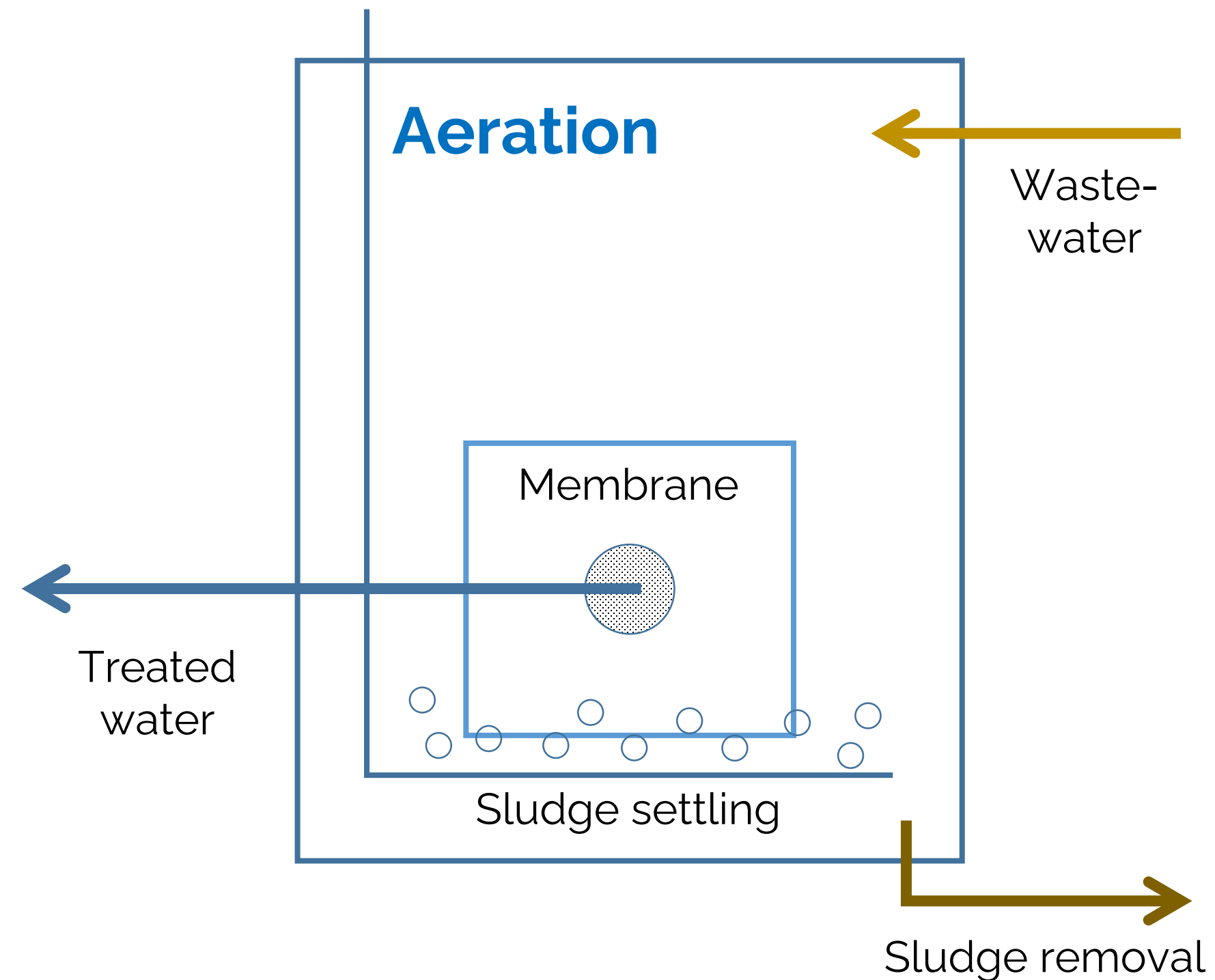
Gravity Driven Membrane (GDM) filtration of **surface water**

The simplest solution was the best

Pre-filtration (Cloth)

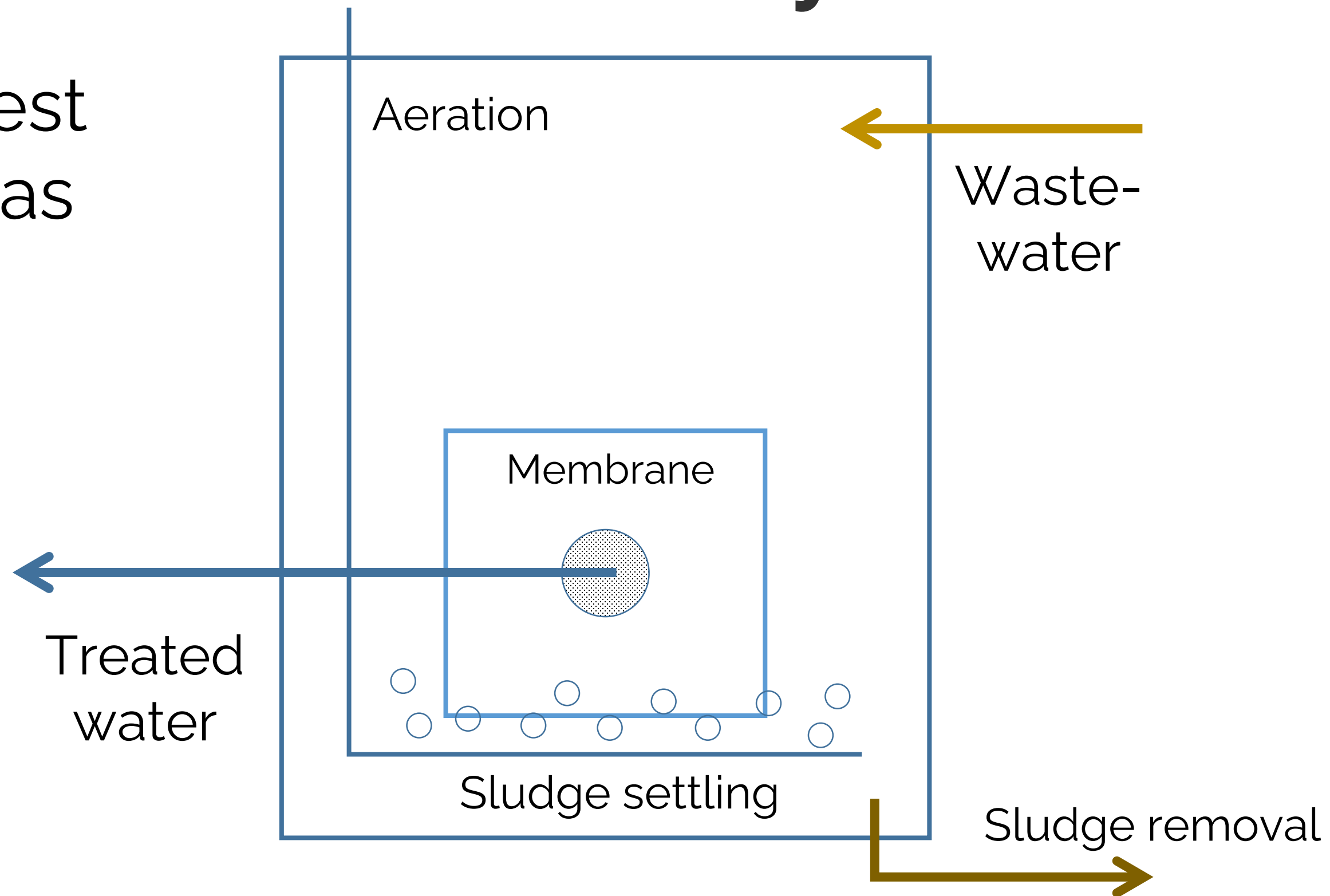
Ultrafiltration membrane

Clean water tank



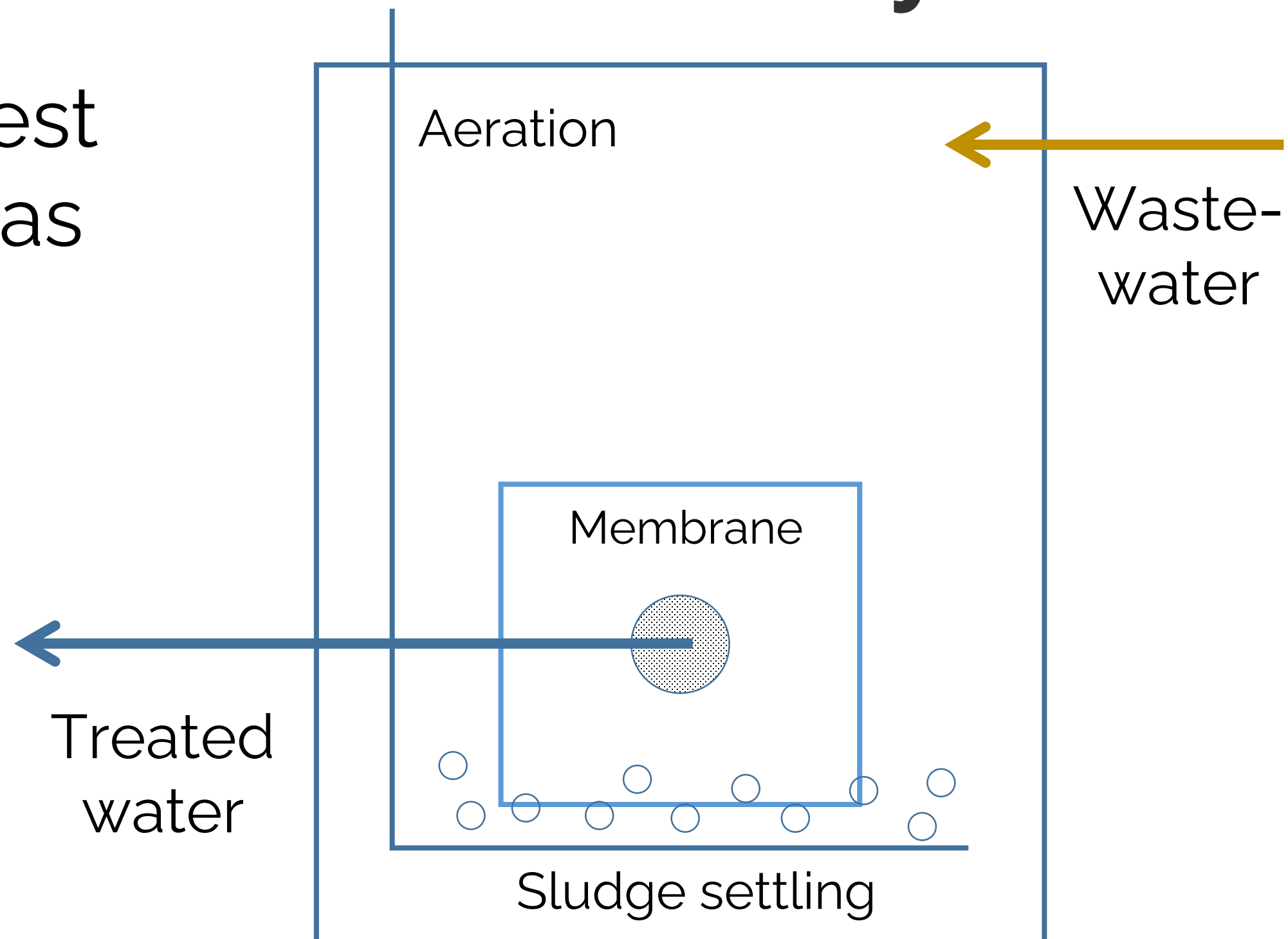
Proof of concept: On-site wastewater recovery

The simplest solution was the best



Proof of concept: On-site wastewater recovery

The simplest solution was the best



Proof of concept: On-site wastewater recovery

Lab experiments

In the lab, we had excellent water quality



Unsafe
Soiled water



Relatively safe from filter
Ultrafiltration treated



Stable and attractive
Polished by electrolysis

Presentation of concept in Kampala

October 2011

© EOOS/ Eawag



Co-creation of the toilet



Co-creation of the toilet



Co-creation of the toilet

Voting for a sitting toilet



Voting for a squatting toilet



Co-creation of the toilet



Co-creation of logistic

Community-Led
Urban Environmental
Sanitation Planning
(CLUES)

www.sandec.ch/clues



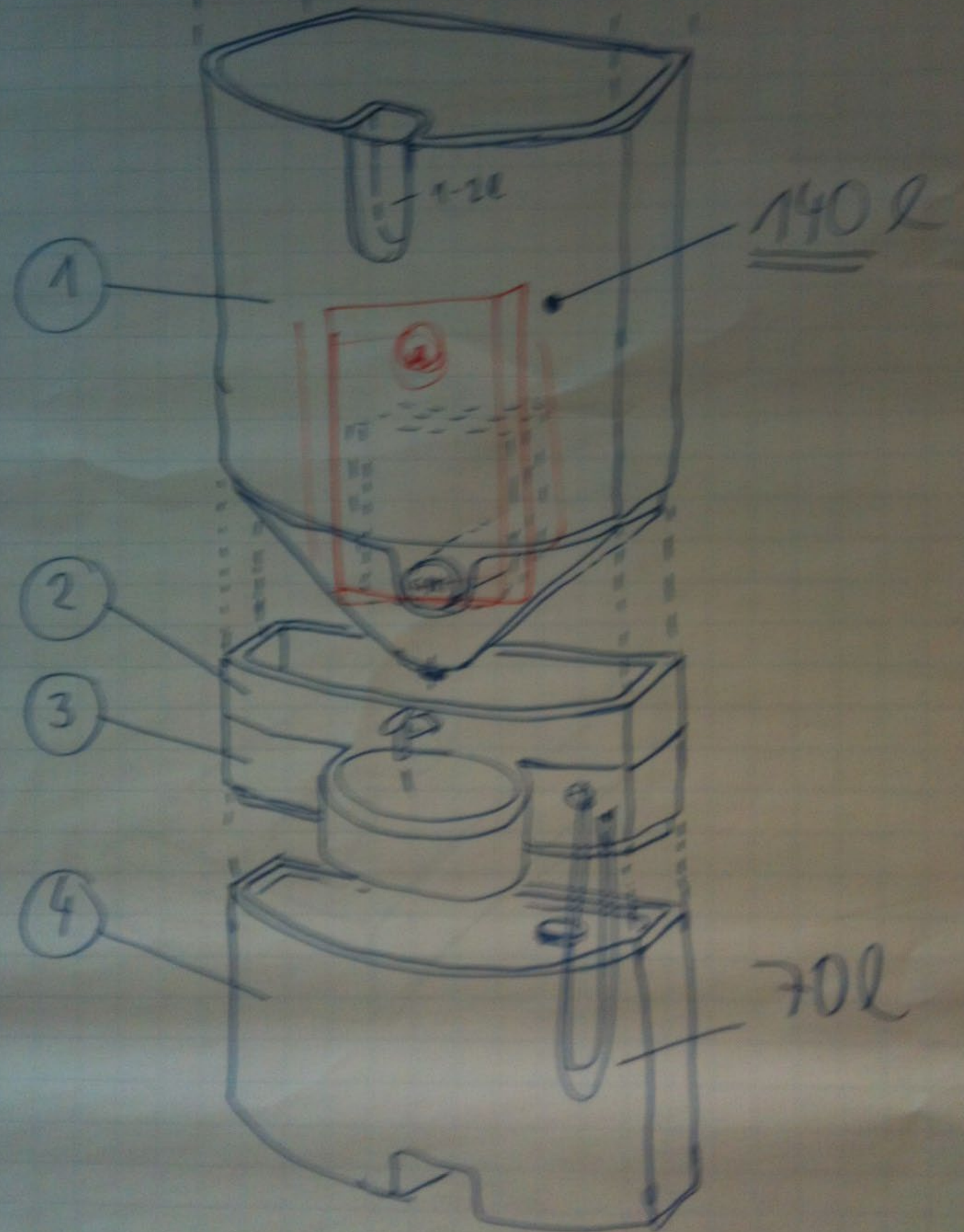
Co-creation of the toilet

Finally, we decided on the color of the toilet



From messy lab set-up to consumer product

First sketch by
Harald Gründl



From messy lab set-up to consumer product

Eawag lab,
2011



Presentation in Seattle

August 2012

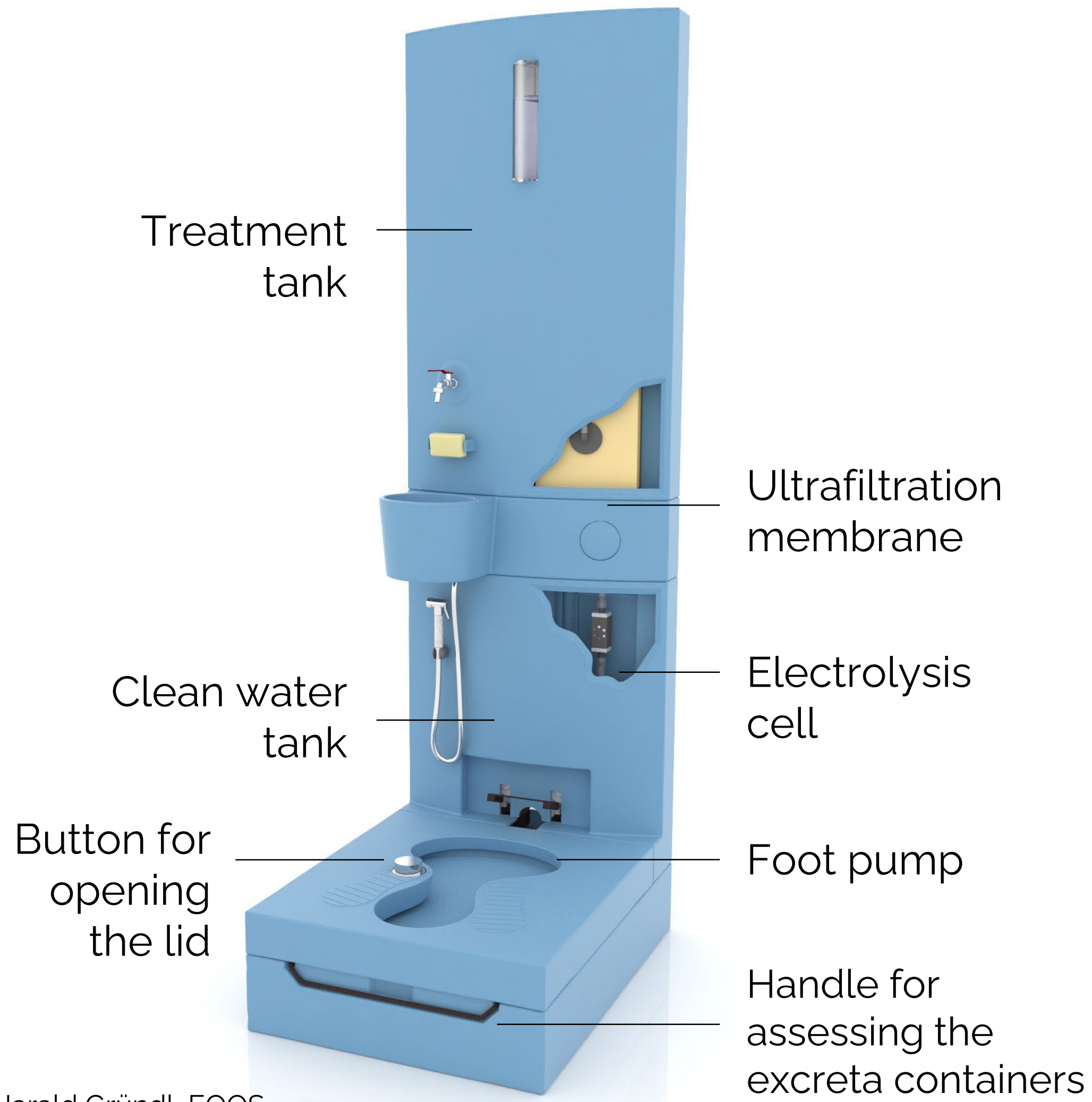


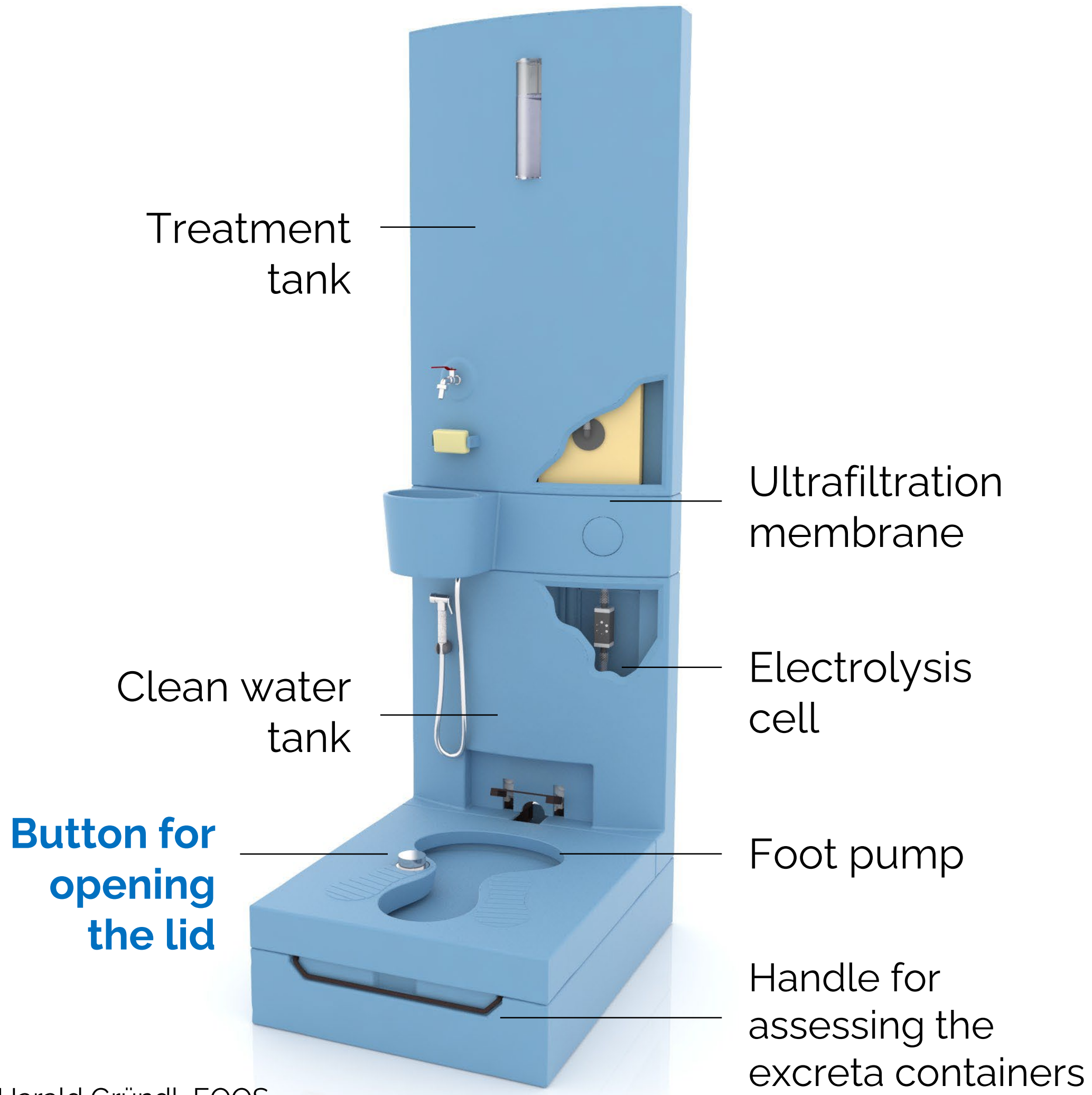
Presentation in Seattle

August 2012

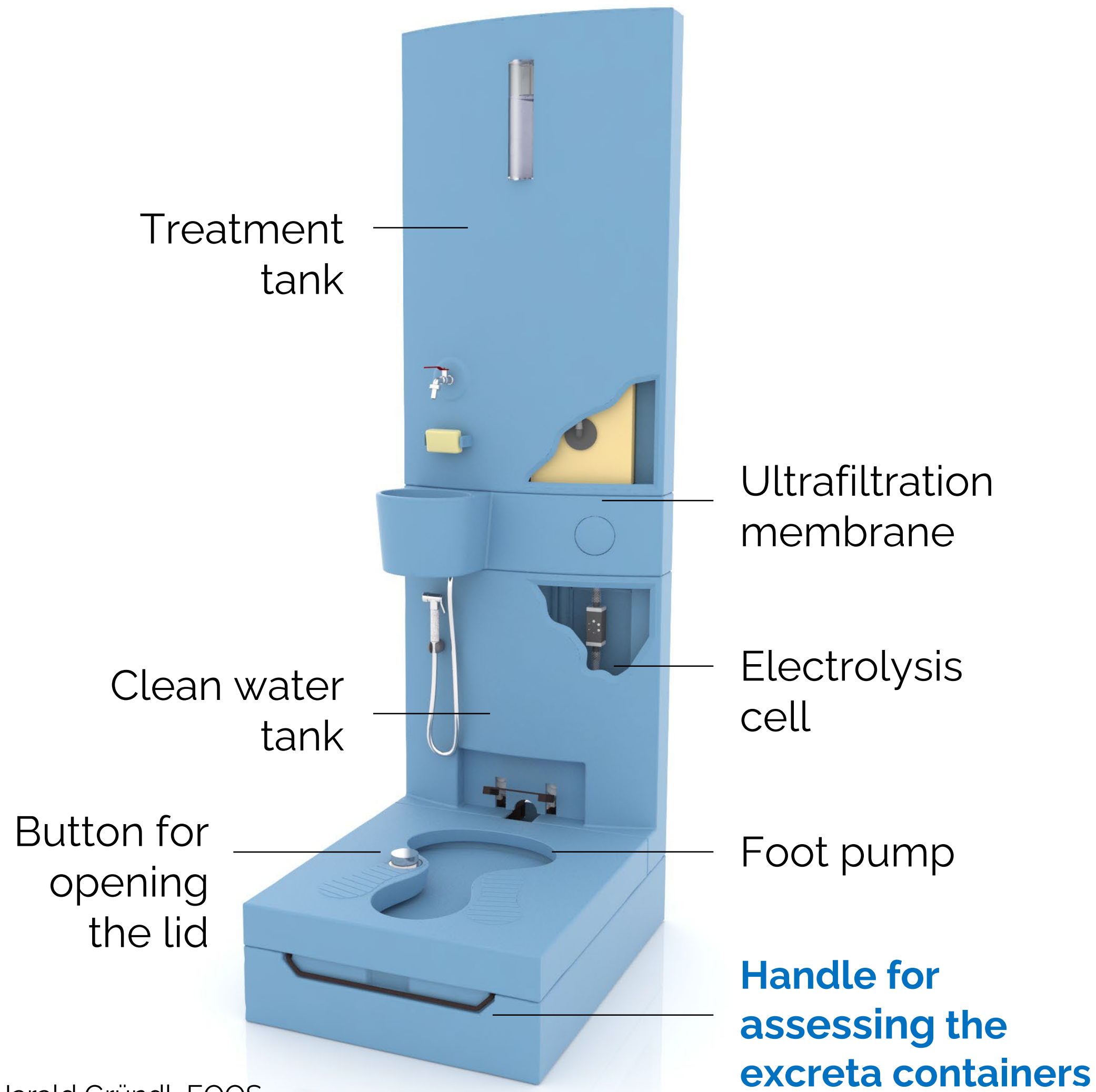


The (non-working) model presented Seattle August 2012

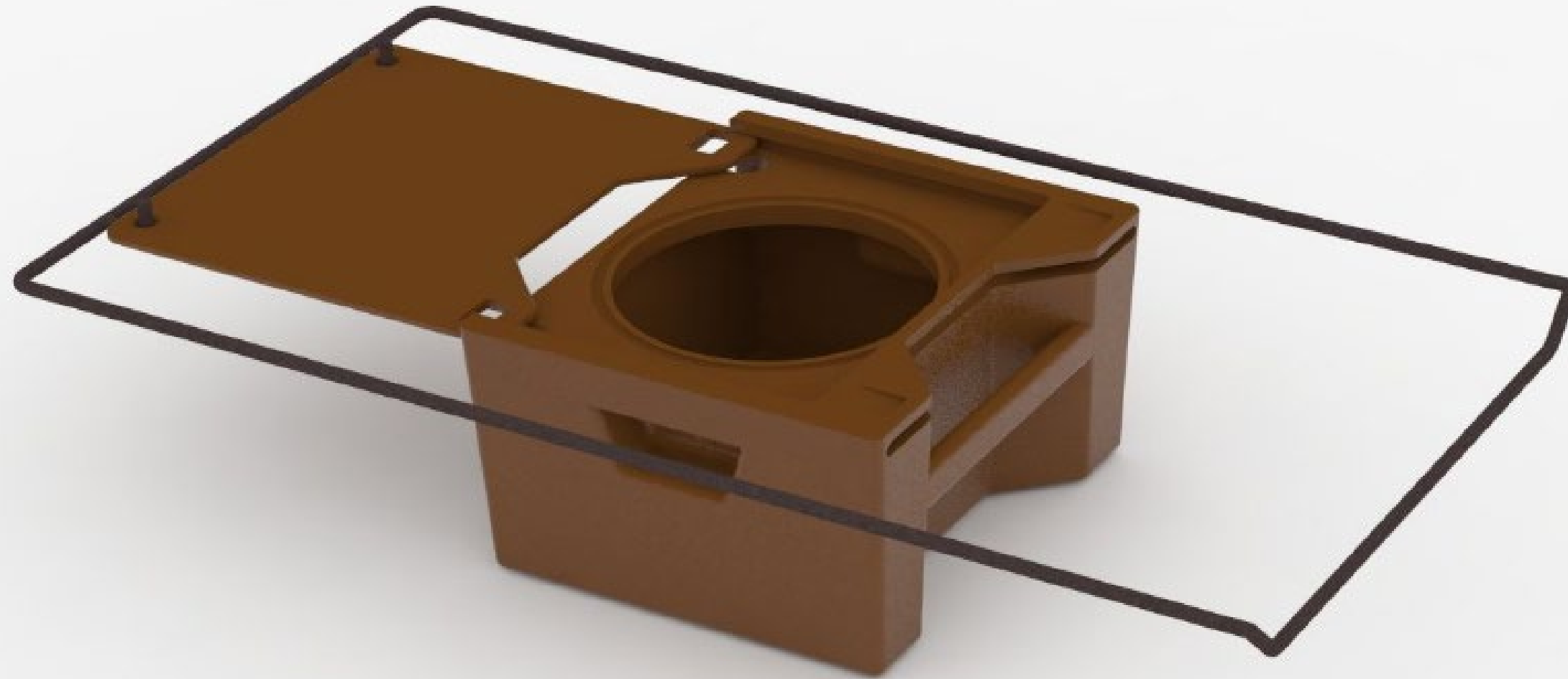




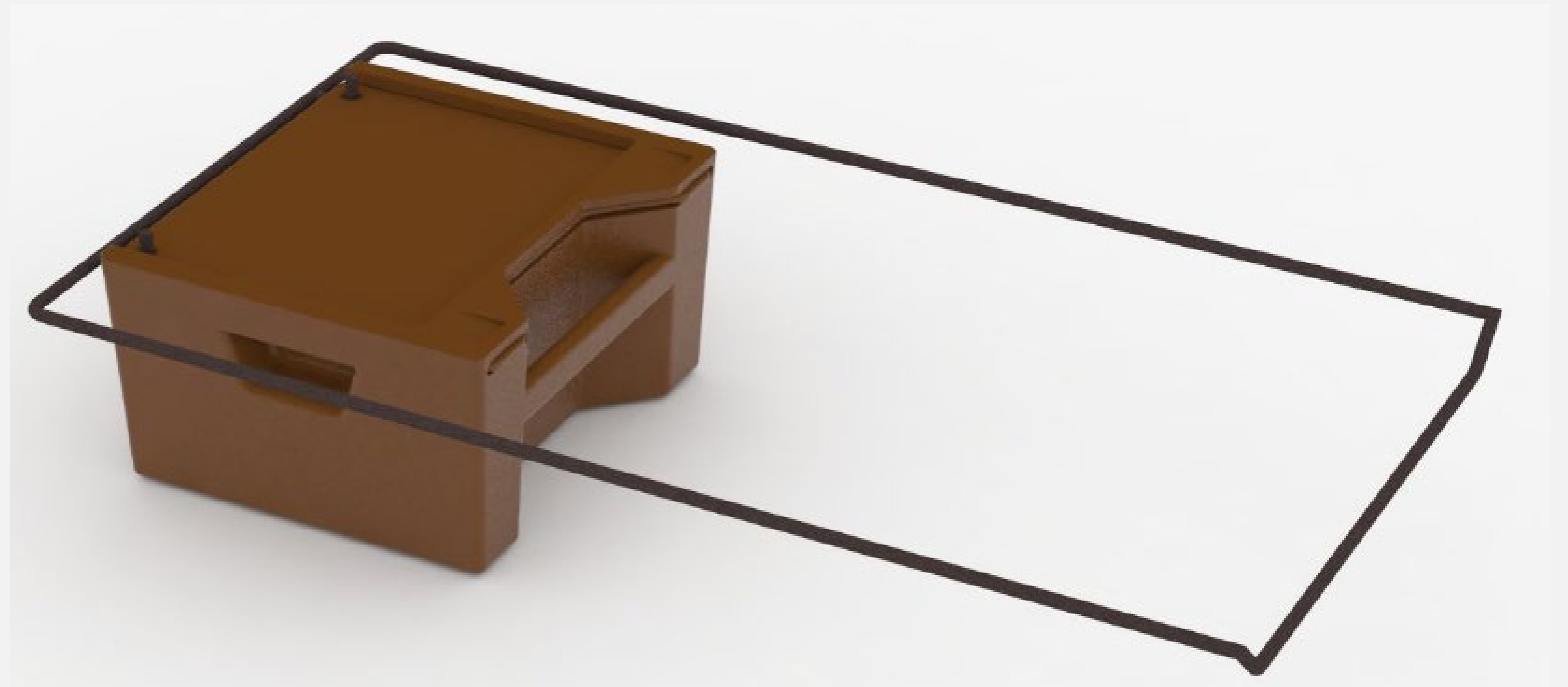
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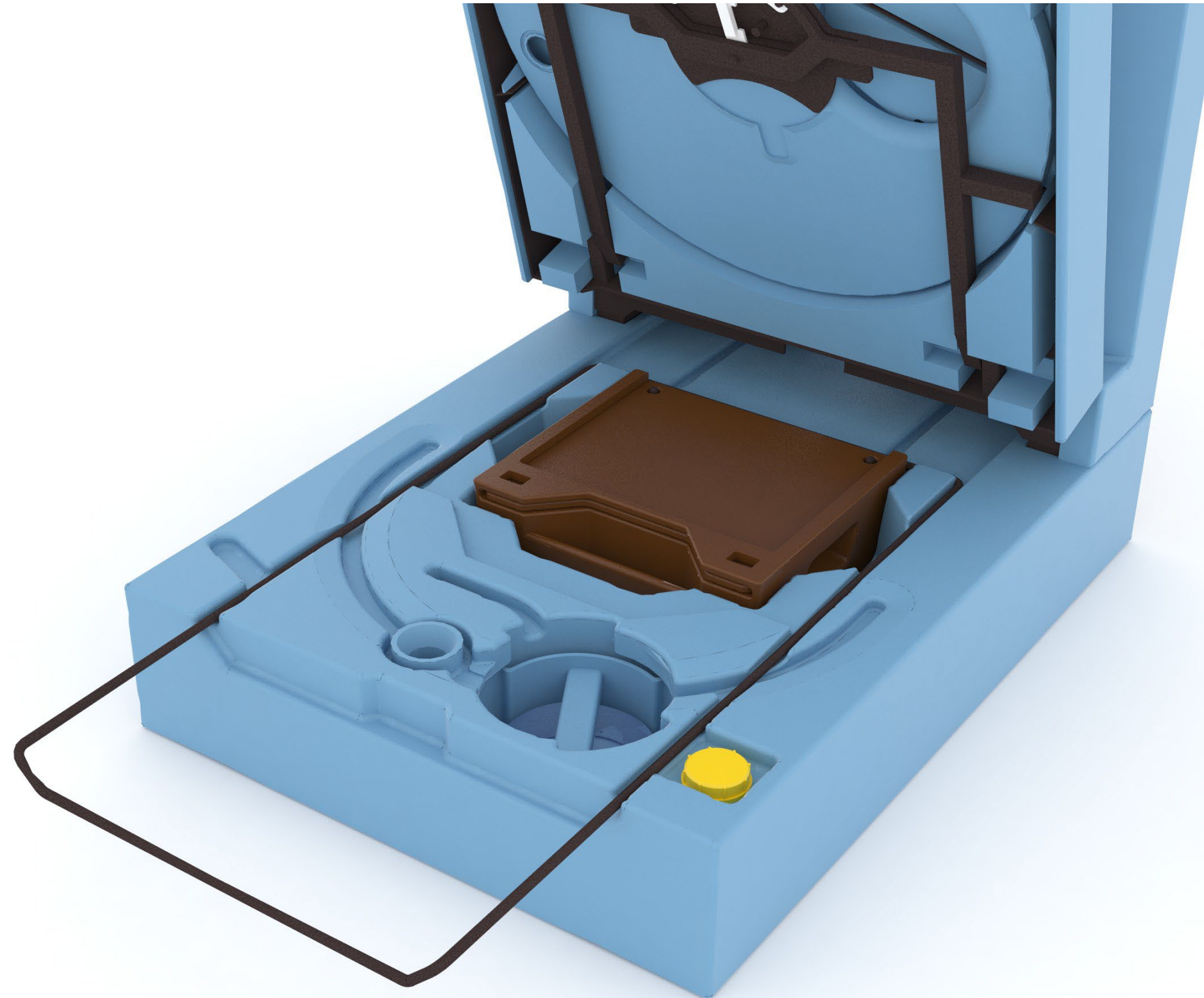
Sequence of feces removal



Sequence of feces removal



Sequence of feces removal



Sequence of feces removal



Phase 2: Test of the first working model in the field

April 2013



Phase 2: Water quality in the field

In the field we
needed
additional
measures

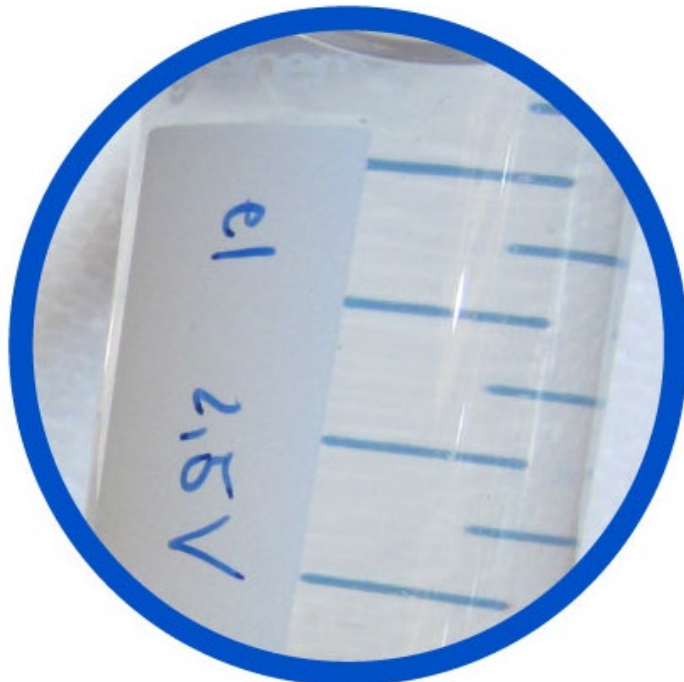


Unsafe
Soiled water

© Eawag



Relatively safe from filter
Ultrafiltration treated



Stable and attractive
Polished by **activated
carbon** and electrolysis

Phase 3: New version of the toilet tested in Nairobi

March-April
2014



Phase 3: New version of the toilet tested in Nairobi

March-April
2014



The Blue Diversion system (container-based sanitation)

100 toilets + collection
+ 1 resource recovery
plant for 1000 people

Künzle et al. (2015)
<https://doi.org/10.2166/washdev.2015.116>

Larsen et al. (2021)
<https://doi.org/10.1016/j.wroa.2021.100114>

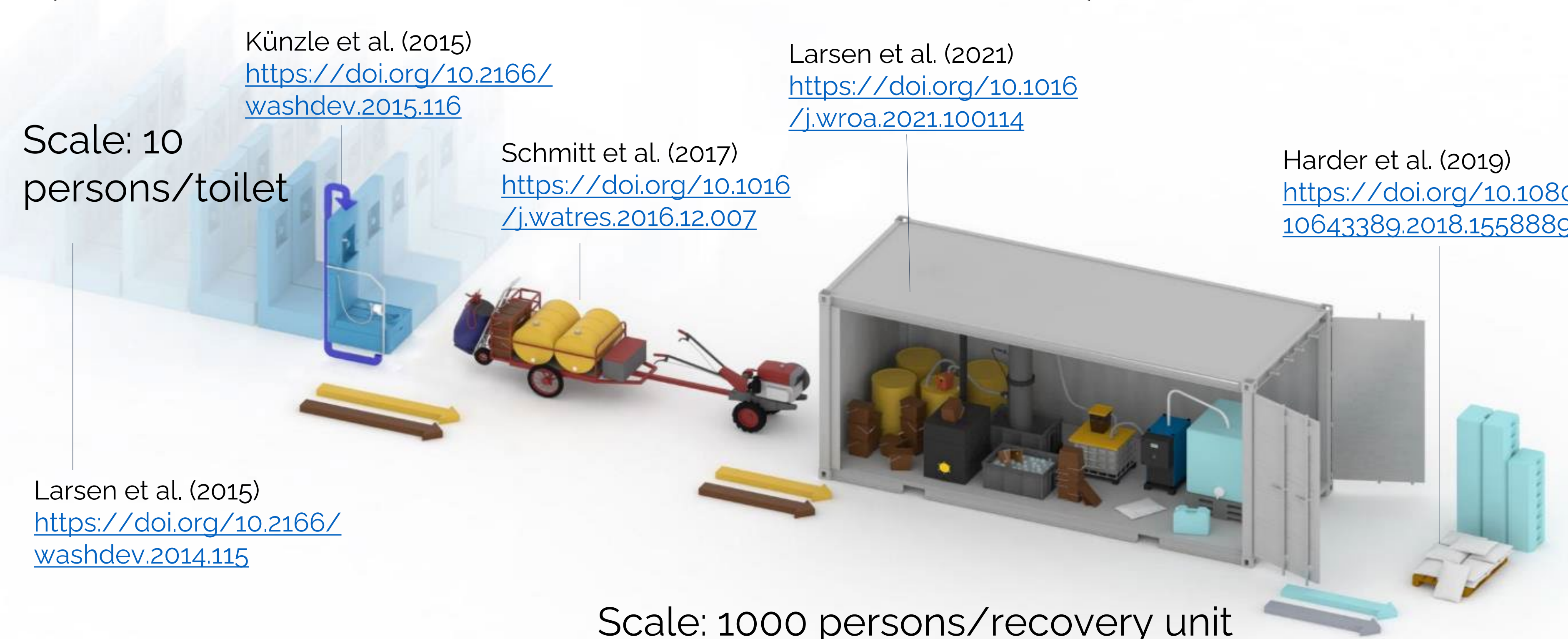
Schmitt et al. (2017)
<https://doi.org/10.1016/j.watres.2016.12.007>

Harder et al. (2019)
<https://doi.org/10.1080/10643389.2018.1558889>

Scale: 10
persons/toilet

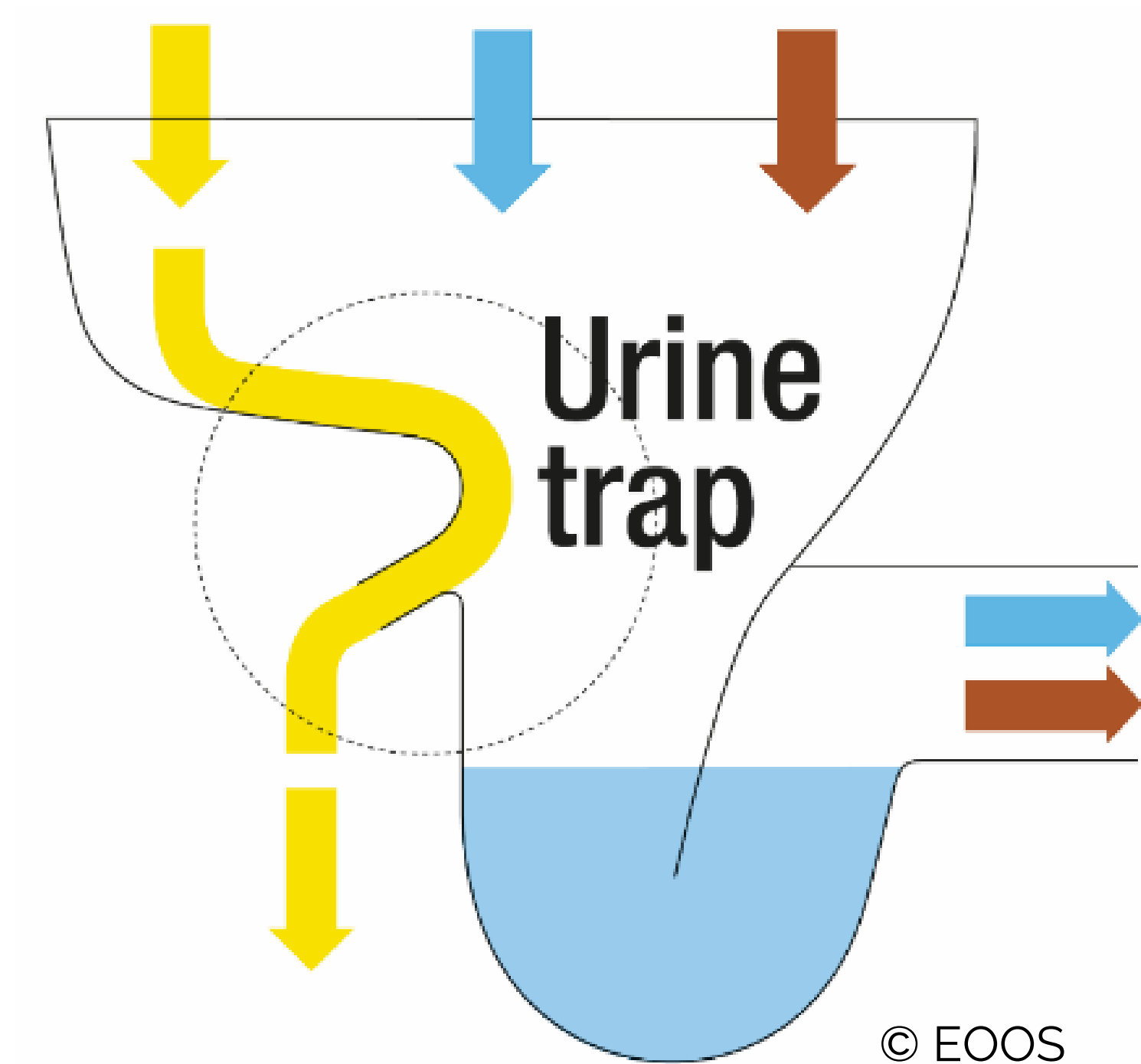
Larsen et al. (2015)
<https://doi.org/10.2166/washdev.2014.115>

Scale: 1000 persons/recovery unit



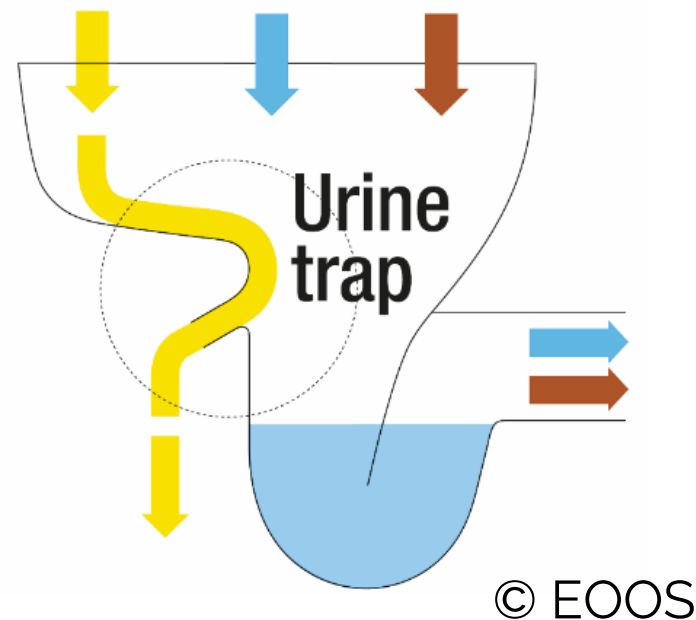
The challenges of the Blue Diversion Toilet inspired....

Easy separation of urine and water based on the teapot effect



The challenges of the Blue Diversion Toilet inspired....

Easy separation of urine and water based on the teapot effect



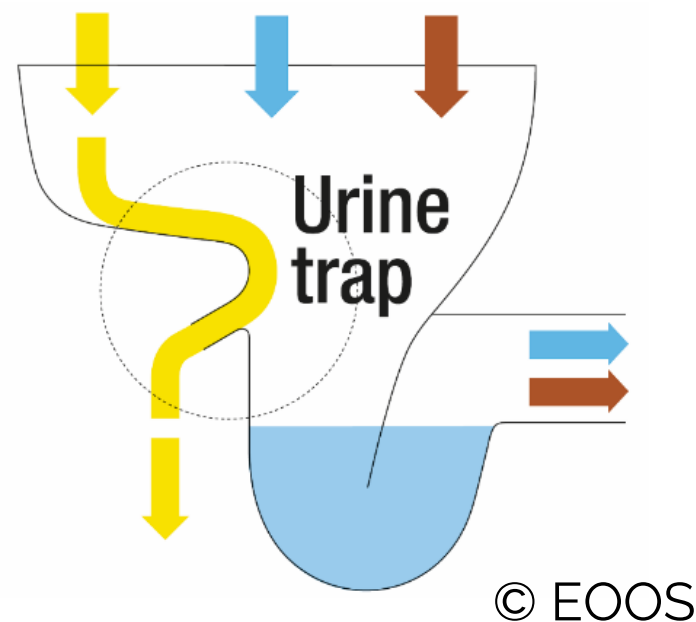
Gundlach et al. (2021)
Journal of Building
Engineering 33, 101500
<https://doi.org/10.1016/j.jobe.2020.101500>

Save! by Laufen

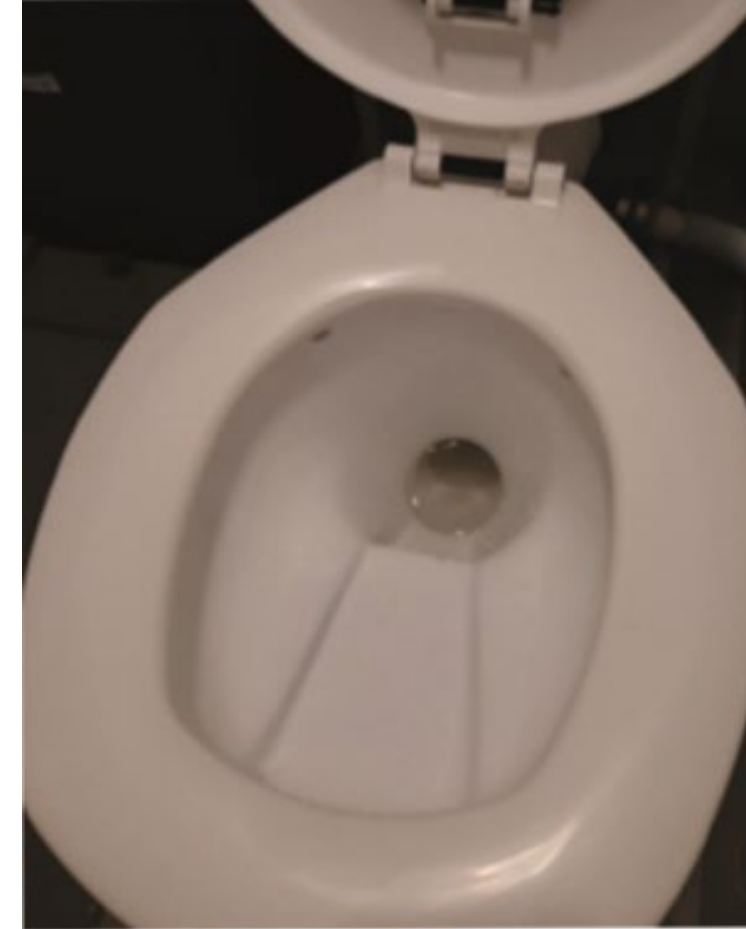


The challenges of the Blue Diversion Toilet inspired....

Easy separation of urine and water based on the teapot effect



Larsen et al. (2021)
Environmental Science:
Water Research and
Technology, 7(7), 1161-1176.
<https://doi.org/10.1039/D0EW01064B>



"Eazisplit" (insert)
Durban, SA



Indian squat pan
Coimbatore, IN



„better design“ squat pan
Bangalore, IN



Open Design UDDT
Chitwan, NP

Further
development
of the water
wall for
recycling of
water for hand
washing



Thank you!



ea wag
aquatic research **o o o**