User acceptance of vacuum toilets and grey water systems in The Netherlands, Norway and Germany

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Content of presentation

- Research results into user acceptance
 - Vacuum toilets
 - Grey water systems
- 5 projects
 - The Netherlands
 - Norway
 - Germany







Introduction

- Increasing interest
- Changes in households due to different working principles
- User acceptance key issue





Introduction

- Separation of black and grey water
- Vacuum toilets
- Decentralized grey water systems





Overview projects

Project (year of realization)	Short description
Kaja – Ås, Norway (1996)	24 student apartments equipped with a vacuum toilet system and a local grey water treatment system (biofilter + constructed wetland).
Torvetua – Bergen, Norway (1997)	40 single houses equipped with a vacuum toilet system and two local grey water treatment systems (biofilter + constructed wetland).
Wohnen&Arbeiten - Freiburg, Germany (1999)	14 apartments and 4 offices equipped with a vacuum toilet system and a membrane filter system for grey water treatment
Flintenbreite – Lübeck, Germany (2000)	30 houses equipped with a vacuum toilet system and two local grey water treatment systems (constructed wetlands).
Casa Vita – Deventer, The Netherlands (2007)	32 new apartments equipped with a vacuum toilet system, no local grey water treatment











Method interviews

- Standardized interview
 - household descriptors
 - invisibility
 - user comfort
 - robustness

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- 20 households, except for Wohnen & Arbeiten
- October 2005 December 2007





Results interviews

Satisfaction of households with their vacuum toilet systems







Results interviews

Average marks given by the households







Results interviews

Percentage of households that considers the flushing sound of their toilet unpleasant







Sound level measurements

- Casa Vita and Lemmerweg-Oost in Sneek, The Netherlands
- Different types/brands of vacuum toilets
 - Casa Vita (manufacturer Jets)
 - Lemmerweg-Oost (manufacturer Roediger)
 - Three other vacuum toilets
 - Jets (same type as in Deventer)
 - Evac
 - Roediger with silencer







Sound level measurements

- Lid open and closed
- Two conventional water flushing toilets
 - One standard flushing toilet
 - One shelf toilet ("Dutch toilet")





Method sound level measurements







Results in dB(A)	Lid	Maximal decibel production after correction for the reflections
Deventer (Casa Vita), Jets	closed	91
	open	95
Sneek, Roediger	closed	102
	open	104
Sneek, Evac	closed	93
	open	97
Sneek, Jets	closed	95
	open	99
Sneek, Roediger + silencer	closed	89
	open	93
Conventional Dutch toilet	closed	80
	open	87
Conventional toilet	closed	83
	open	85
Average results	Average decibel production after correction for the reflections	
Vacuum toilet: average with standard deviation	96 +/- 5	
Conventional toilet: average with standard deviation	84	++/- 3





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Other possible improvements

- Optimisation of:
 - pipe dimensions
 - piping of the system
 - valves of vacuum toilet/ backplate







Conclusions

- High appreciation of the grey water treatment systems (7.1 – 8)
- Average lower satisfaction level for vacuum toilets
- Appreciation generally high
- 40 65% considers the sound unpleasant vs. 25% of the control group





Conclusions

- Maximum sound level is 10 -12 dB louder
- To increase acceptance sound production has to be reduced
 - Optimisation pipe diameters/piping system
 - Optimisation of valve / backplate





Outlook

- Sound level → more attention of the manufacturers
- Results in user acceptance and operational functioning will be continued
- Tauw has installed energy meters and logs possible blockages/failures





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Questions?? 0





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