on site sanitation case study 03: Vacuum Flush Installations in the US and Beyond

Vacuum Toilet Installations
Vacuum toilets are economical choices for boats, trains, marina and cluster systems.

Vacuum Sewer Installations
Small cities in Europe are finding the most economical option for addressing a cluster of failing septic tanks to be installing vacuum sewers. Conventional toilets connect to vacuum sewers.

A Suburban town outside of Warsaw with 145,200 people installed a vacuum sewer system for an area of 620 square kilometers to serve 5,600 of residents outside of town.

Vacuum piping is typically less than 2” in diameter allowing construction to happen in narrow trenches along sidewalks instead of requiring road closures during construction. Roedigger 2007.

Gloskow vacuum station for a vacuum sewer system for a suburban town in Poland. Roedigger Vacuum Systems. roevac.com

Vacuum sewers were installed for 670 buildings along a sensitive water way along the Rhine with 2 pump stations. Roedigger Vacuum Systems. roevac.com
Regulations permitting the system:

None.

Barriers to vacuum systems:

**Plumbing Code Requires Gravity Drainage Where Ever Practicable.**

Plumbing code 709.0
Vacuum sewage is covered under IAPMO IGC 150-2009, but is not in the Oregon Plumbing Specialty Code.


Barriers to cluster systems:

**Vacuum Sewers are Not Permitted Outside Urban Growth Boundary**

660-011-0060 Sewer Service to Rural Lands and Rule 11
As vacuum systems are usually cost effective only for 2 or more households, they would classify as “sewer systems” and would not be permitted outside urban growth boundaries without a determination from the DEQ that there is “no practicable alternative” to abate a public health hazard, and the connected structures existed prior to 1998.

An Acorn/EVAC vacuum system has been installed at The Wilsonville Women’s Prison and Intake facility (Interpretive Ruling 97-6).

**Vacuum Toilets Can Not be Connected to Composting System**

340-071-0320 Split Waste Method
Currently only non-water carried systems (compost and oil flush toilets) are approved for split waste methods. The low-water flush of a vacuum system would not qualify if connected to a non-water carried treatment system, such as a composting system.

Barriers to ultra low flow blackwater systems:

**Vacuum Flush Effluent is more Concentrated, Requiring Special Permits**
Vacuum flush toilets use 1/5 the water of ultra low flow toilets, which means the blackwater is less diluted, potentially lowering treatment costs. However less diluted blackwater could cause it to be considered higher than residential strength blackwater.
on site sanitation case study 03: Vacuum Flush + Anaerobic Digester

Anaerobic Digester Explained
(Adapted from Tilley et al 73-74).
An Anaerobic Biogas Reactor is a means of treating water carried waste that produces (a) a digested slurry that requires further treatment to be used as a soil amendment and (b) biogas which can be used for energy. Biogas is a mix of methane, carbon dioxide and other trace gases that can be converted to electricity, light and heat. Also known as ‘biogas plant, anaerobic digester, anaerobic biogas reactor (ABR).

Anaerobic digesters are air less tanks above ground or below ground where blackwater is collected and allowed to sit while bacteria already present in the liquid reproduce and produce methane which is siphoned off. The retention time in the air less tank ranges from 15 to 60 days depending on temperature and activity of bacteria in the system.

Operation and Maintenance: Tank should be stirred weekly to encourage mixing of new waste with old waste. Grit and sand that have settled to the bottom should be removed yearly.

Pros & Cons:
+ Generation of a renewable, valuable energy source
+ Underground construction minimizes land use
+ Long life span
+ No electrical energy required
+ Small land area required (most of the structure can be built underground)
- Requires expert design, skilled construction and operation oversight.
- Gas production below 15°C is not economically feasible
- Digested sludge and effluent still requires treatment

Citations
Dometic Sanitation. Phone Interview. 1 May 2012.


UK portable vacuum systems: http://www.flexiloofirst.co.uk/gallery.php

On-site Sanitation Case Study 03: Vacuum Flush +Anaerobic Digester
Recode 2012

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How it Works

In Use: The toilet bowl is designed to capture liquid coming in from the front and hold it in a tank for separate treatment from feces and flush water. Men cannot stand up to pee, waterless urinals recommended.

User Responsibilities: Instruct small children to sit back on the toilet and not perch on the lip. Don’t let the urine diverting plate clog up. Urine pipes must be rinsed occasionally (every 3-4 months) with hot water & vinegar to remove mineral build-up from pipes.

Operations and Maintenance: The system must be pumped at regular intervals, based on the size of the holding tank (usually once a year).

Can the homeowner do it or is a professional needed? Homeowner can rinse out pipes if trained or provided educational materials.

Benefits

• Low cost method to meet the strictest nitrate reduction standards in effluent.
• Can be added to an existing septic system
• Urine can be applied directly to land as an effective fertilizer because it is mostly sterile and a low disease risk.

Quantity: of urine produced by a family of 5 (est. 32 gallons per week) about 1,664 gallons per year (von Muench 2011).

$ Value as a fertilizer: Less than $200/year for a family of 4

Costs

Installation*
New: $12,600-18,600
(installation + toilet, septic tank, urine tank and sand filter)

Retrofit: $3,900-6,500
(installation, toilet and urine tank)

O&M: $150-300/year
for once a year pumping of urine and septic tank

*All numbers based on Swedish prices as of 2006 including 25% tax. Avloppsguiden.se

Land Required: 10’ x 10’ (approximate space for a 1,500 to 2,000 gallon tank for a family of 5

Treatment
Can it meet La Pine limits?
Yes