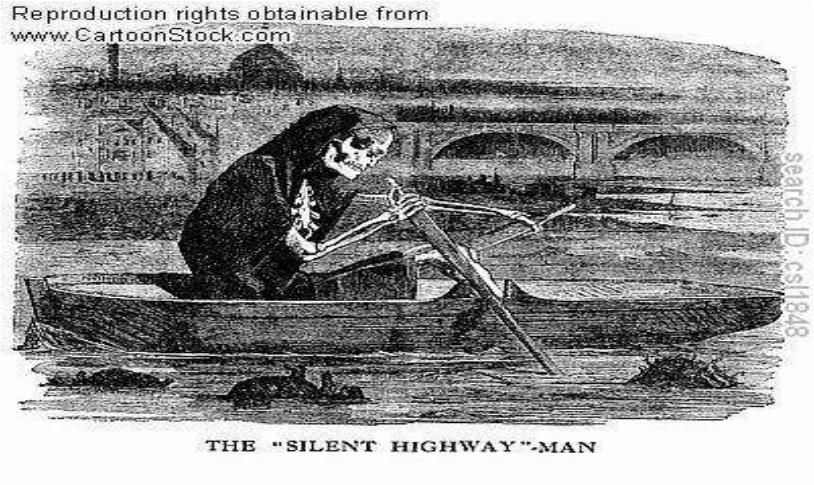
ODOR PREVENTION AND CONTROL IN SANITATION

Tuula Tuhkanen
Department of Chemistry and Environmental Engineering
Tampere University of technology

Odors

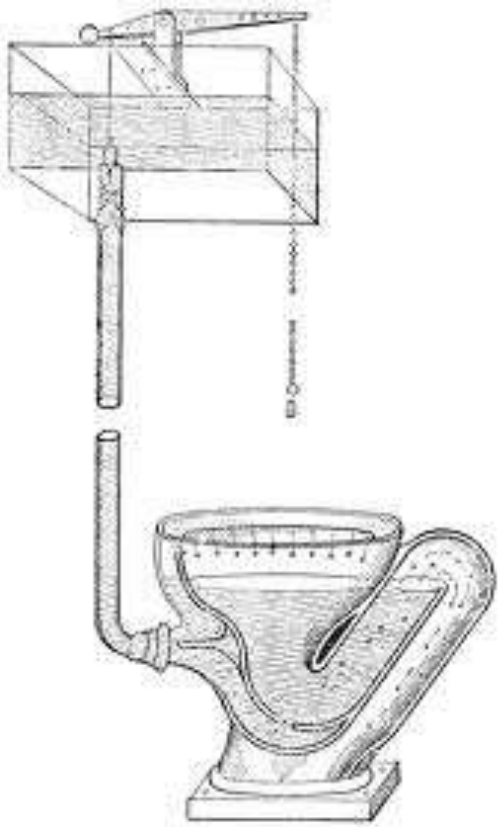
- History
- Olfactory system
- Sociological aspects of odors
- Volatile compounds in urine and feces
- Effects of volatile compounds
- Prevention of odor formation
- Ventilation
- Treatment of odorous compounds
- Role of separating toilet for odor control

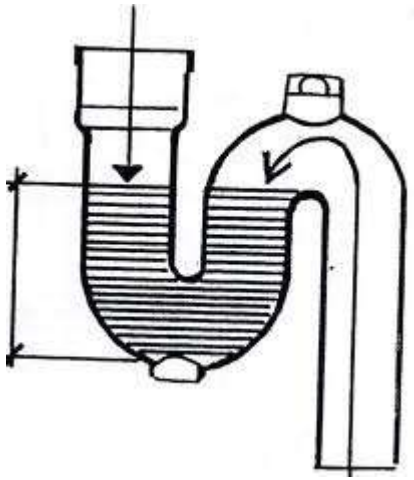
A representation of the cholera epidemic of the 19th century depicts the spread of the disease in the form of poisonous air



- There seems to be a general social norm for avoidance, and particularly touching and handling, of foul smelling material such as excreta.
- This relates to the miasma theory, accepted from ancient times until late 1800's, which held that the infectious diseases were caused by a *miasma* or "bad air".

Development of water closets





Olfactory system

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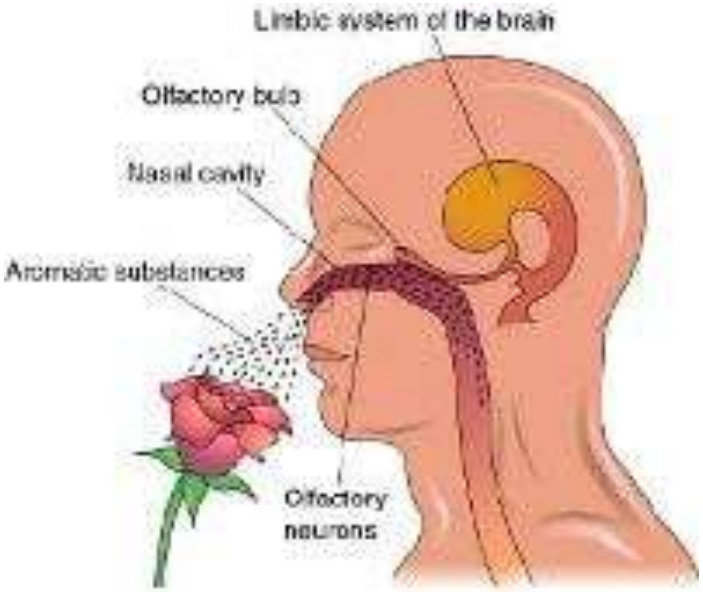


Odorous compounds must be volatile

- High Henry's law constant
- Temperature
- Humidity

Compounds in Urine	Odour threshold (air)	Odour description	Occupational safety values
Ammonia	0,13-15,3 ppm; 2,6 ppm; 1,5 ppm	Sharp, pungent	20 ppm at 8h; and 50 ppm at 15 min
Dimethyl disulfide	0,3-11 ppb	Putrefaction	
4-heptanone		Characteristic	50 ppm
Methyl propyl ketone	0,028	Ketone-like	200 ppm at 8 h; 250 at 15 min
Methyl ethyl ketone	0,44 ppm	Ketone-like	100 ppm 15min
Formaldehyde	0,50 ppm		0,3ppm 8h; 1ppm 15 min
Methyl mercaptan	0,000070 ppm	Unpleasant	
Trimethyl amine	0,02-5 ppm	Unpleasant	5 ppm 8h; 15 ppm 15 min
Methanol	33 ppm	Alcoholic	200 ppm 8h; 250 ppm 15 min
Acetone	42 ppm; 13 ppm	Acetone	500 ppm 8h; 630 ppm 15 min

Some odorous compounds found in feces

Compound	Odour threshold (air)	Odour description
Limonene	0,038 ppm	pleasant
Alfa-pinene	0,018 ppm	pleasant
Methanethiol		foul, striking, odour of flatus
Dimethyl disulfide	0,3-11 ppb	foul, striking, putrefaction
Hydrogen sulphide	0,00041 ppm	foul, striking
HHexanoic acid	0,00060 ppm	unpleasant

Hydrogen sulfide

- Although it smells in very low concentration, the exposure to high concentration saturate the smell receptors.
- Higher concentrations cause dizziness, confusion, cyanosis and pulmonary edema.
- The death is a consequence of respiratory system paralysis
- Rabid death can occur in 2-3 minutes in concentrations higher than 800-1000 pm.
- Low concentration such as 600 pm is lethal in 30 minutes.
- **H_2S can for a serious occupational hazard to workers that handle sledges while emptying septic tanks an pits**.

Common VOC and VIC removal tehniques

- Physical:
  - Condensation
  - Membranes
  - Masking
  - Dilution
  - Absorption
  - Adsorption
    - Activated carbon
    - Zeolites
    - Aluminum
    - Silica gel

Smooth and antibacterial surfaces

- No biofilom →
- No ureaolytic bacteria
- No struvite

- Easier to keep clean
- Photoactive surfaces, Ag, ..

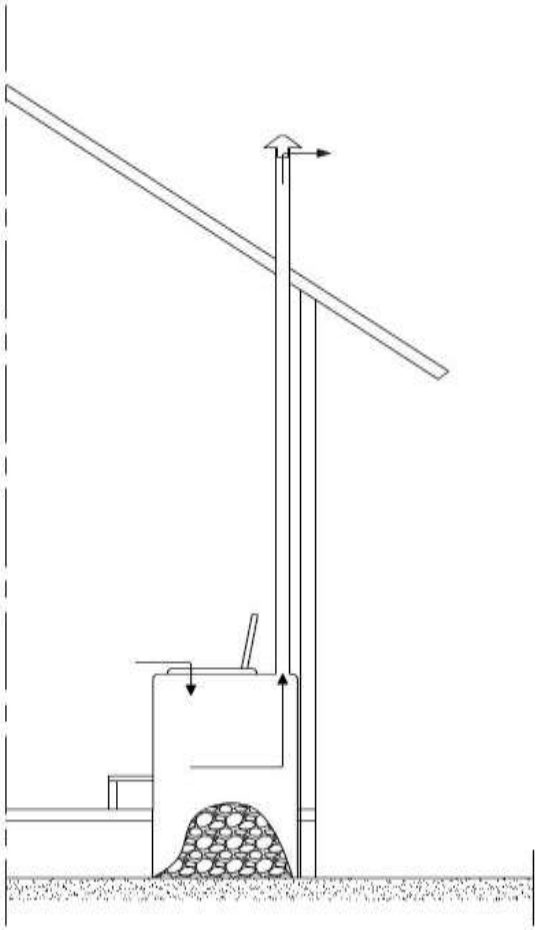
Masking

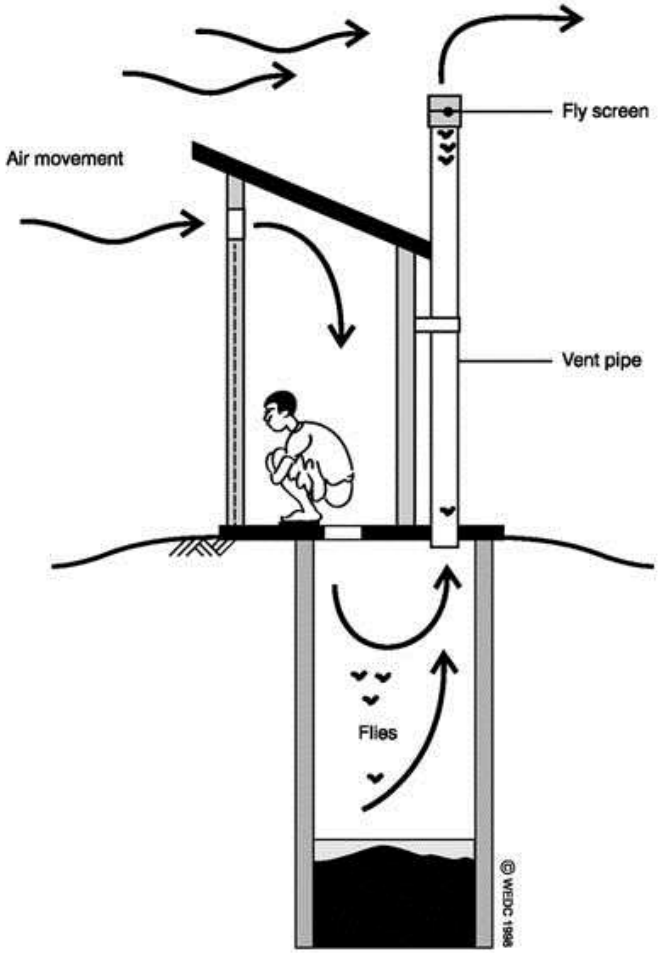

AIR WICK
STICK'UP
2 in 1
CITRUS
AIR WICK
STICK'UP
2 in 1
LAVENDER


TOILET ODOR
Odoreze


Poo~Pourri Traps the Odor

Proper ventlation





http://helid.digicollection.org/en/d/Js2669e/7.6.5.html

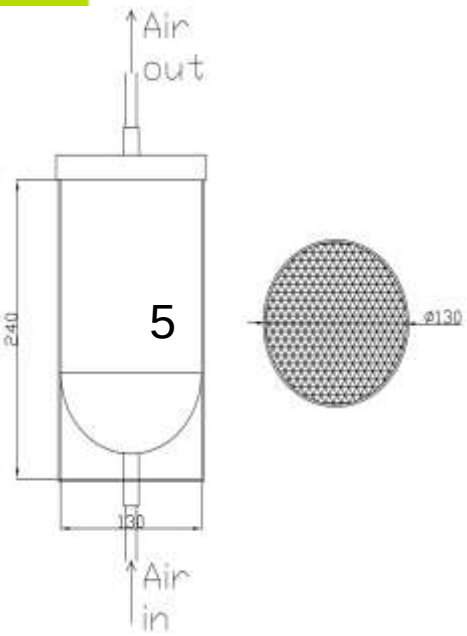
Filtering

- Odours can be removed by containment, chemical scrubbing, adsorption, oxidation, biological scrubbers, biotrickling filters and biofilters
- Activated carbon has been used as a biofilter material successfully for the removal of both ammonia and hydrogen sulphide
- Activated carbon has the advantage of absorbing contaminants also when the biological activity is somehow disturbed.

Biological

- Biological
  - Biofilters
  - Bioscrubbers
  - Membrane biofilters
  - Photochemical biofilters
  - Suspended cell biofilters

Schematic view of the experimental setup. M.Sc thesis Vesa Kolha

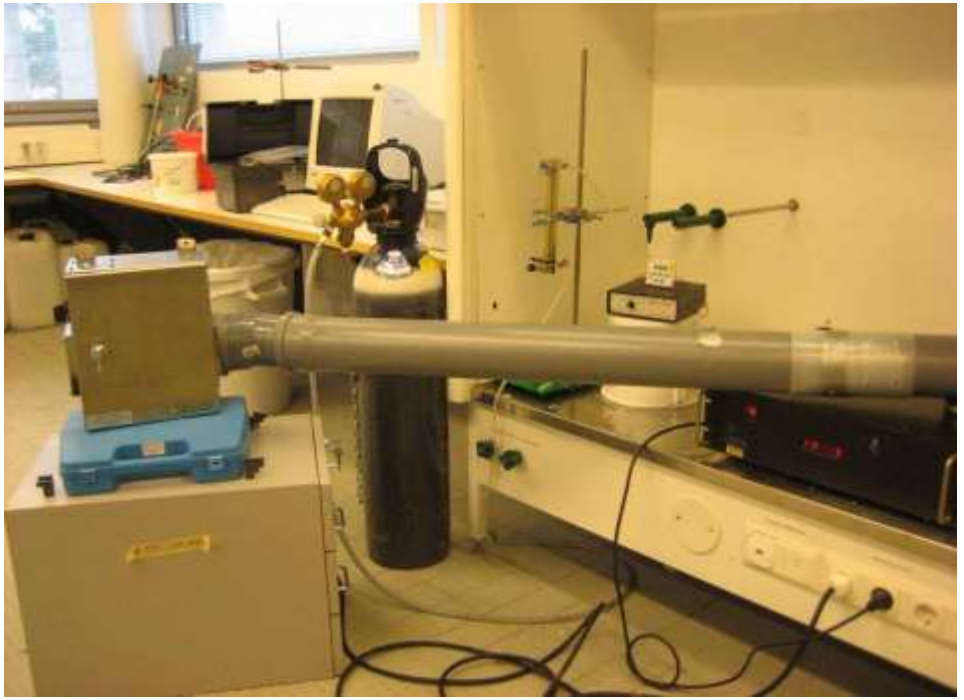


1. = rotameter, 2. = Woulff bottle used as a urine container, 3. = rotameter, 4. = gas washing bottle for inlet gas measurements, 5. = biofilter, 6. = gas washing bottle for outlet gas measurements.

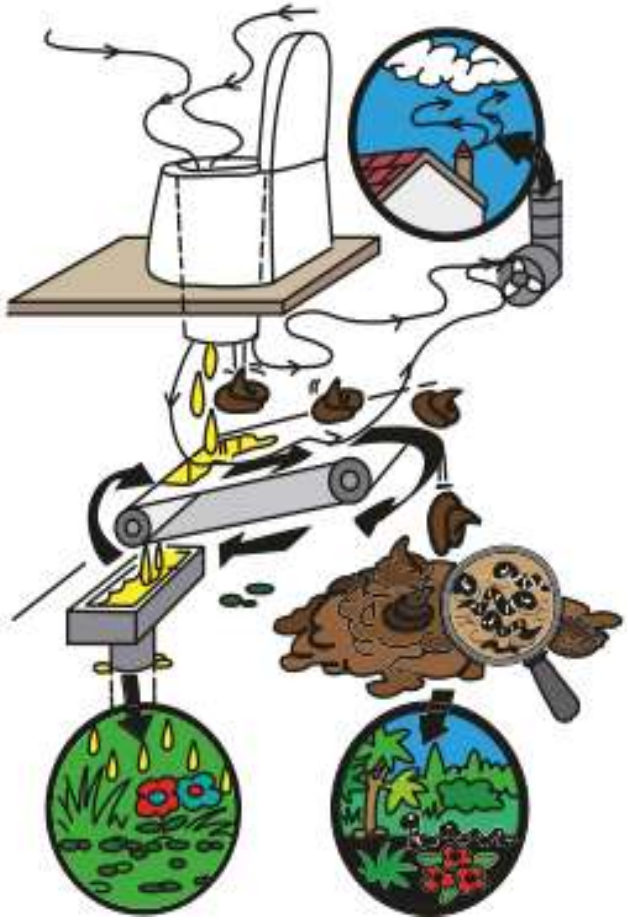
Chemical

- Chemical precipitation
- Chemical oxidation
  - Gas/liquid
  - Ozone, Hydrogen peroxide,
- Combustion
  - Fires
  - Thermal oxidation
  - Catalytic oxidation

Ozone for Hydrogen Sulfide removal; M.Sc thesis of Laura Aatola, TUT



Possibilities for odor prevention and control by separation of urine and feces



Dry(er) sanitation with urine and fecal separation is an promising approach that can offer solutions where also the aesthetic aspect such as stink-free in-door toilet is technically achievable with reasonable pricing and with manageable operation and maintenance and communal support services.

Ecosphère Technologies
Natural Public Toilets

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Thank you for your attention