Greywater Treatment and Use

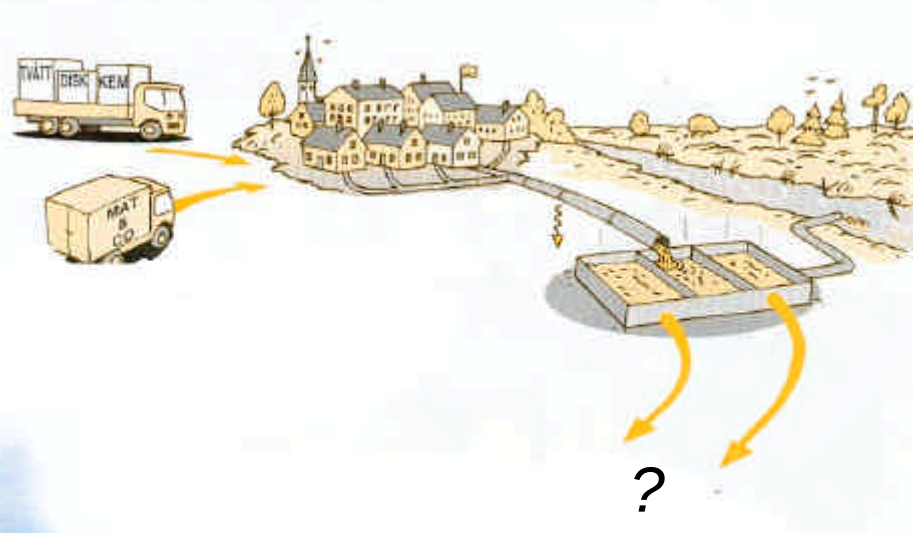
Håkan Jönsson & Peter Ridderstolpe

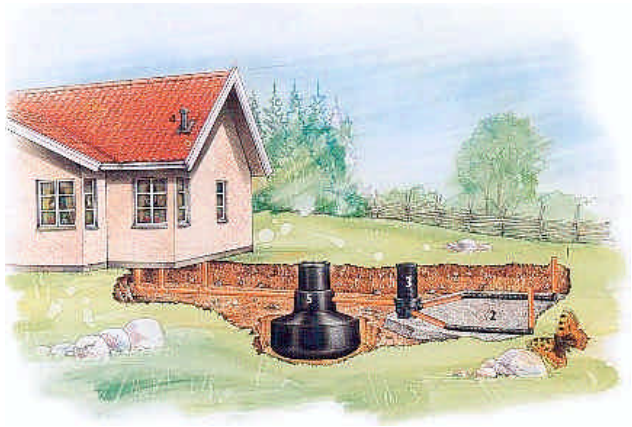
- Introduction
- What is greywater and what does it contain?
- Use and reason for treatment?
- Management and options for treatment
- Discussion “potential for greywater use”

The Swedish approach to wastewater treatment

Centralised systems

> 90 % of population





Onsite systems

5 % of population

Greywater management and techniques for treatment

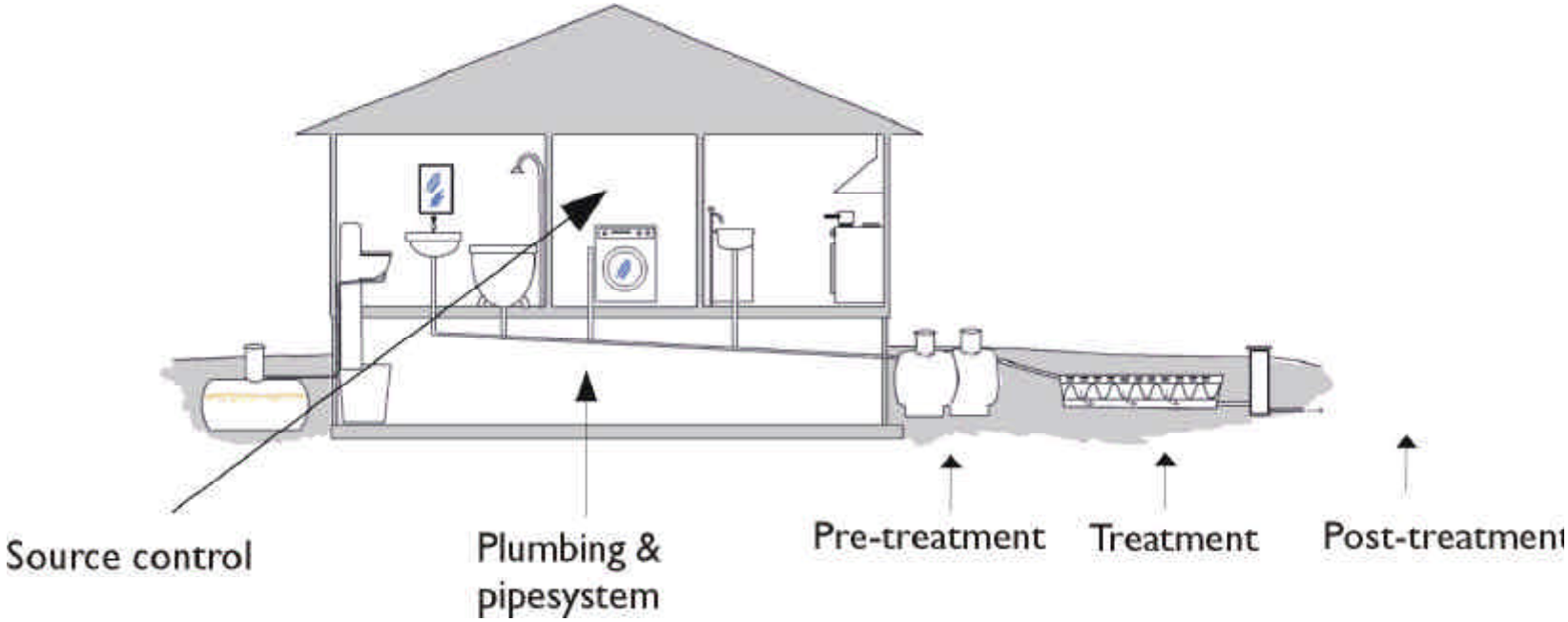
Successful wastewater management involve:

- appropriate design of all components in the technical system!

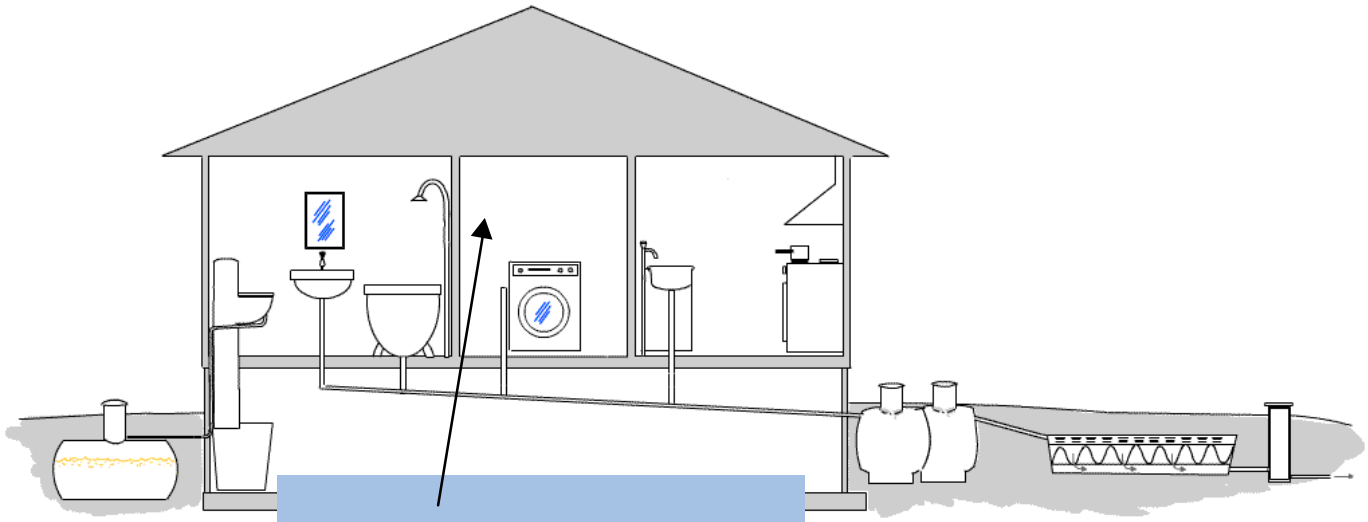
- appropriate use and operation!

This presentation discuss aspects on hardware and software for a successful greywater management

Consider all components of the system!

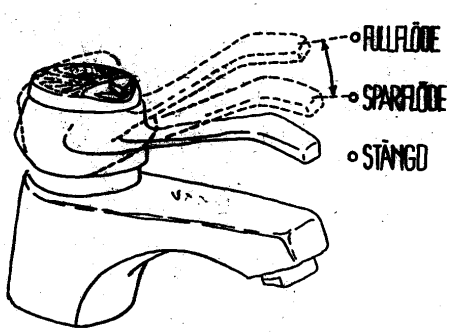


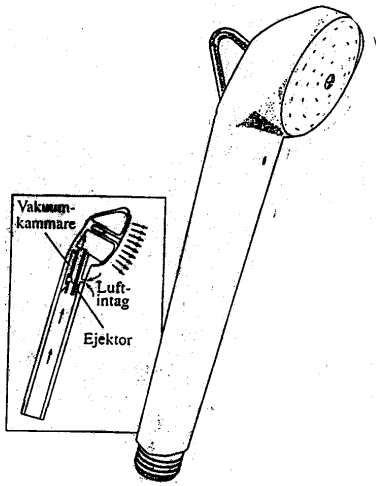
“SOURCE CONTROL”



- Water saving equipment's!
- Environmentally behaviour!

“Use Water saving techniques !”





Water consumption in Swedish households decrease due to the use of water saving equipment's

Water consumption in Sweden

1965 : 220 l/p d

Today : 180 l/p d (New houses c:a 150 l/d)

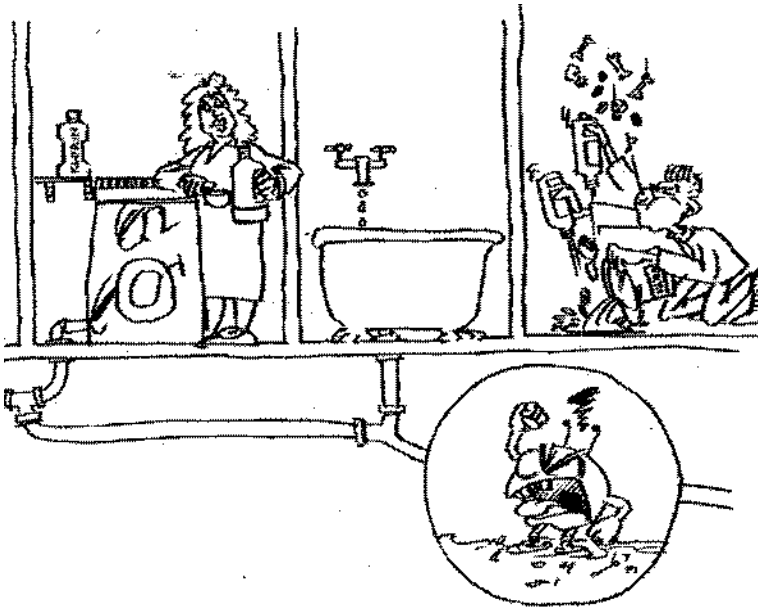
Greywater production:

Normal in Sweden: 140 l/pd

Eco-villages (in Germany) : 80 l/pd

“Use your wastewater system properly !”

Don’t do this!



Instead:

-Use water conservative

-Use only environmental friendly chemicals for cleaning washing etc (e.g don’t use chlorine)

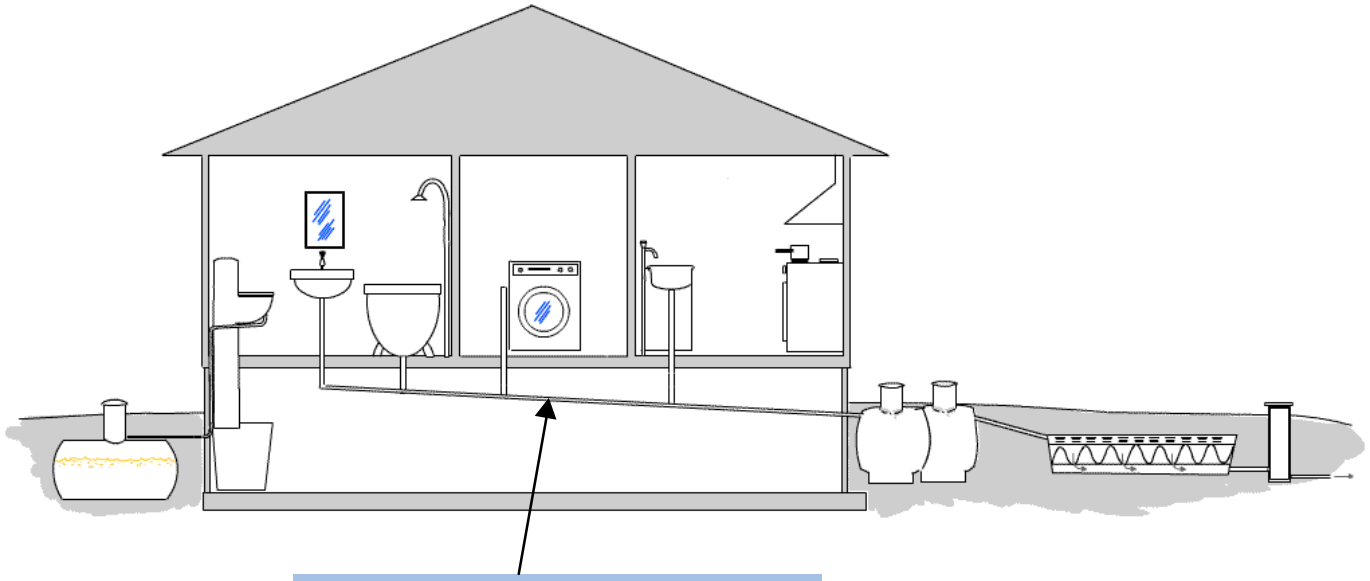
-Leave toxic liquids to safe collecting

-Use no P-enriched washing and dish-cleaning powders.

-Use liquid soap (containing K) before hard soaps (containing Na).

-etc

“THE PIPE SYSTEM”



Appropriate plumbing and piping

Plumbing and piping

- Sinks, shower, washing machines etc must be equipped with appropriate screens or seals for SS removal. Use water traps for prevent odour.

- Use non-flexible pipe before flexible pipe (no necks or depressions)

- Use appropriate dimension and material in pipes. Plastic pipes should be preferred (PE or PP, 50 -70 mm dimension for indoor plumbing.

- Pipe slope gradient should be around 1%

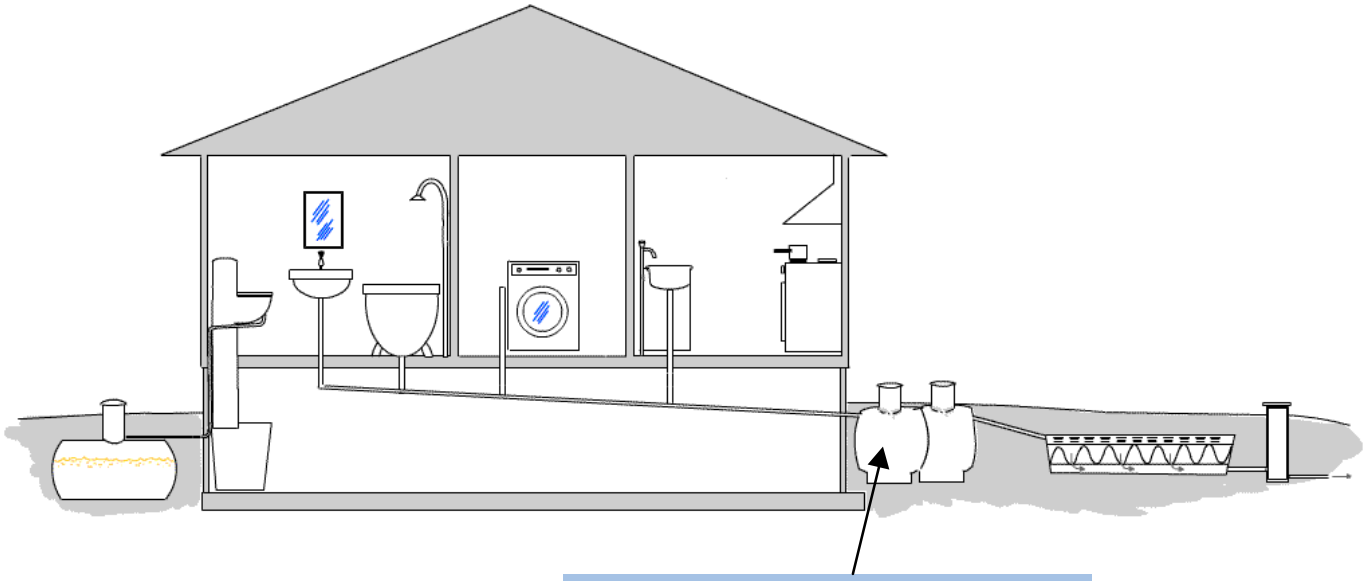
- Don't forget to ventilate pipe system (= chimney over roof)

- be careful when install (no back slope, water or air leakage!)

- Consider need of flushing pipe and inspection wells (outdoor)

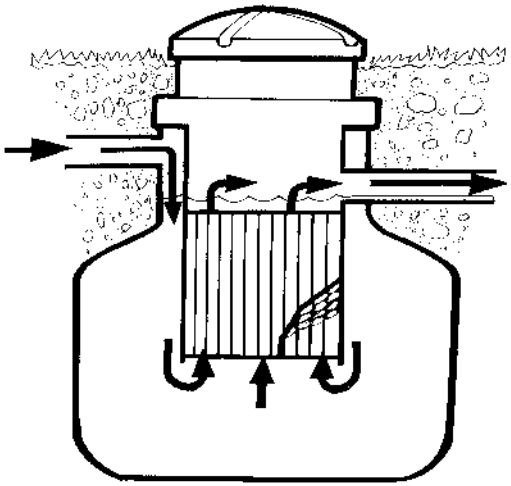
- no Storm Water connected

“PRE-TREATMENT”



Appropriate design, and dimension
- *grease traps*
-*septic tanks*
-*screens*
-*etc*

Pre-treatment - design and dimensioning



Ex. Septic tank for Greywater

WM ekologen/P. Riddertolpe

Swedish standard for dimensioning (mixed Wastewater)

1. Surface load: *less than 0,5 m3/m2 x h**

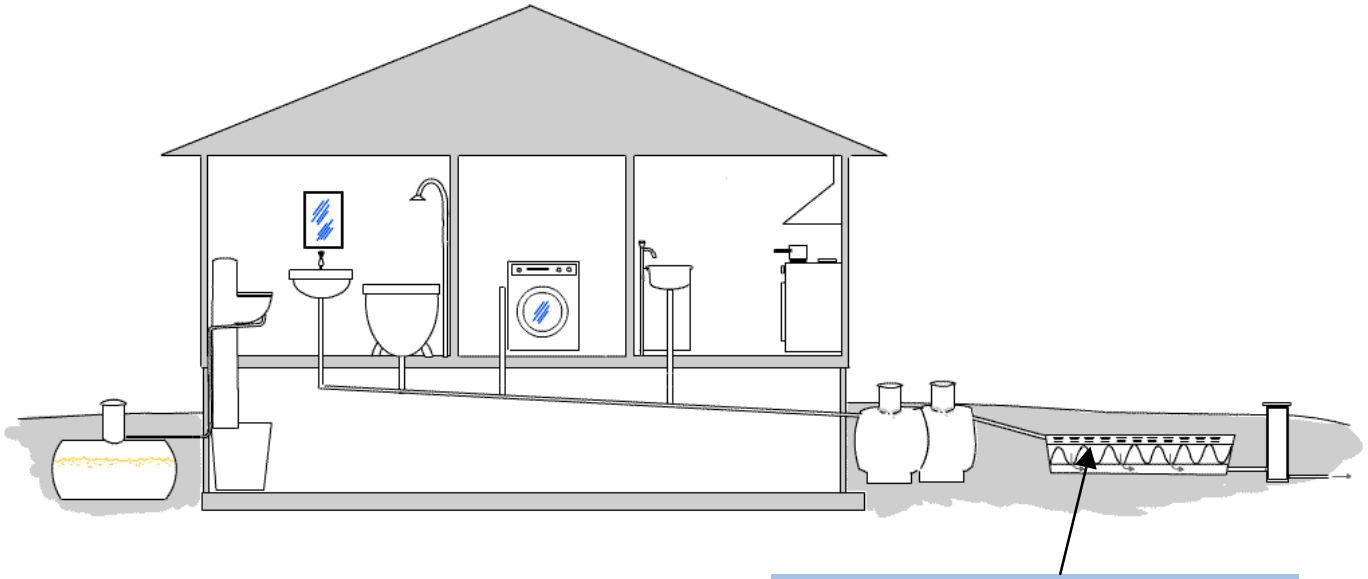
2. Detention time: *more than 6 hours**

3. Volume for sludge

* calculated from q dim

** normally for one year storage. Assumed sludge production 50 l/p x year

“TREATMENT”



Appropriate design and dimension

“Attached aerobic Biofilm techniques”

Sorption- and irrigation systems

- Dish pan dump
- Drain mulch basins
- Swales, resorption trenches
- Wetland irrigation (overland flow, impounding wetlands)
- Pressure pipe irrigation

Vertical soil filter systems

A. <u>Soil filters</u>

- Infiltration (open, covered, under ground)
- Sand filters (open, covered, under ground)

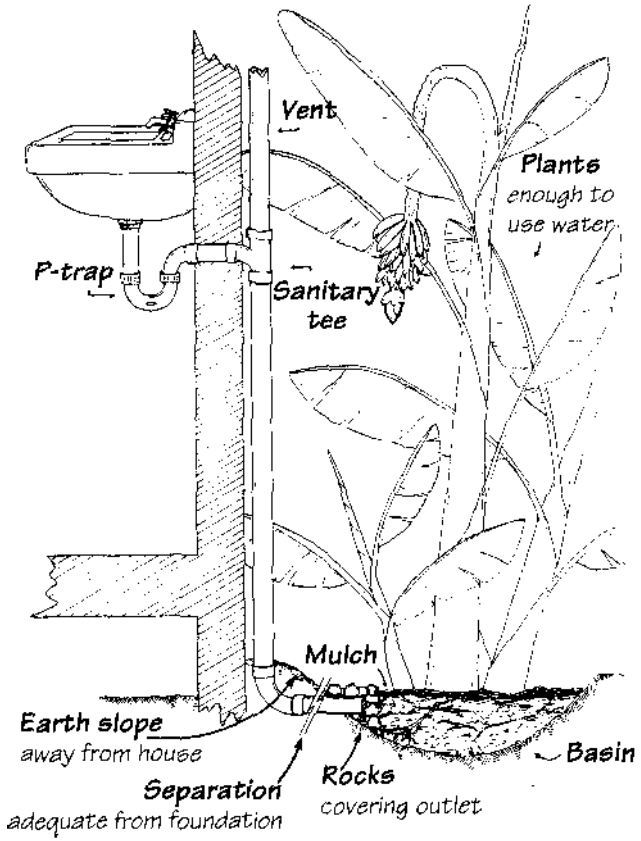
B. <u>Artificial filter media</u>

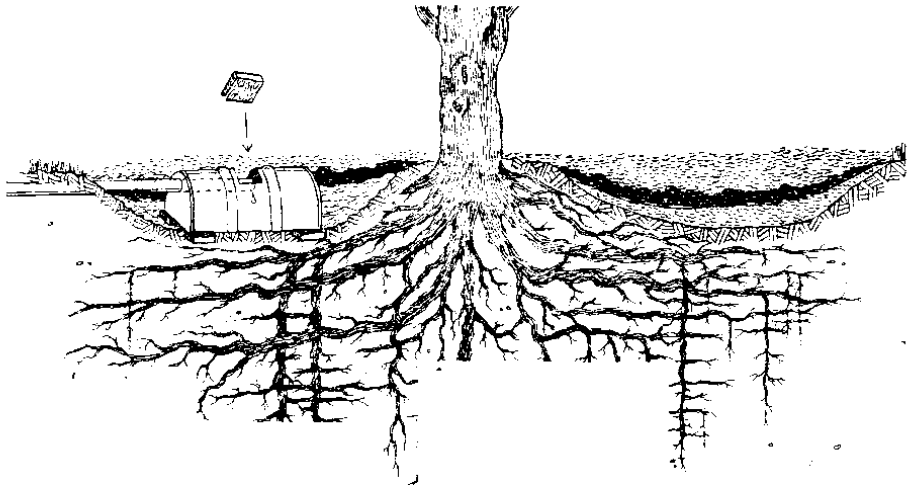
- InDrän, Infiltra etc

Biofilter reactors

- Trickling filters
- Bio-rotors

Direct use in “Mulch bed”

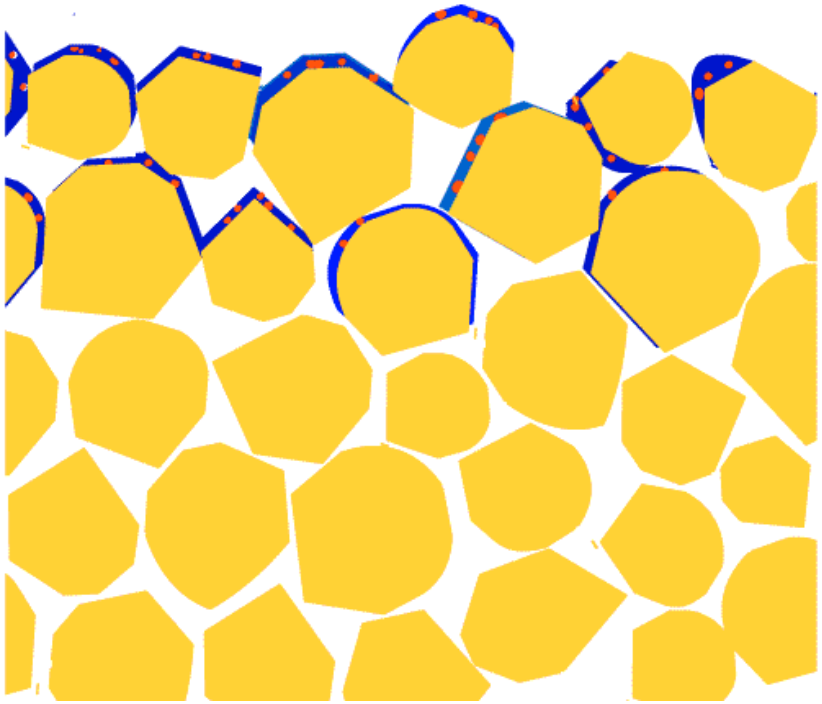


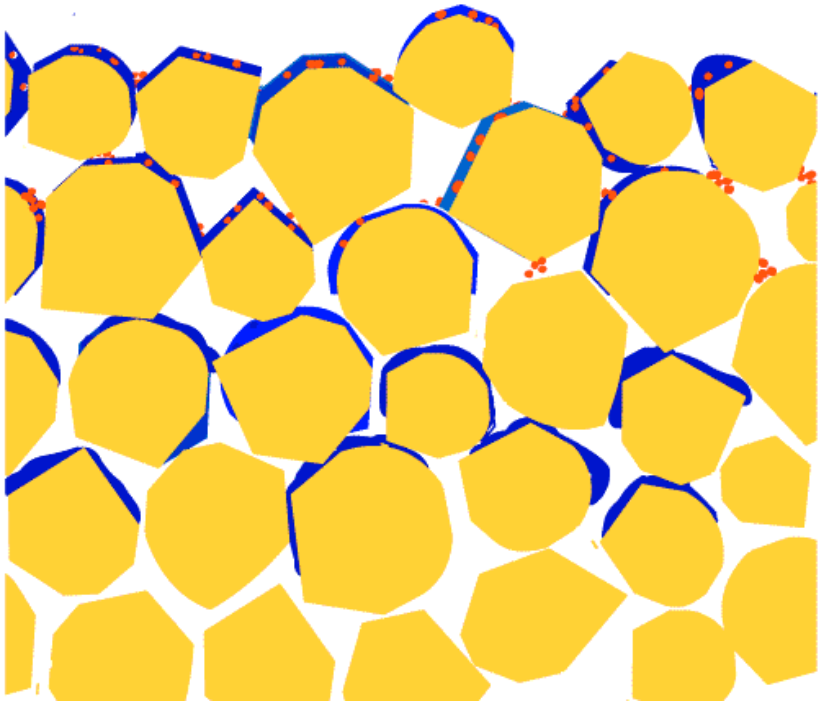


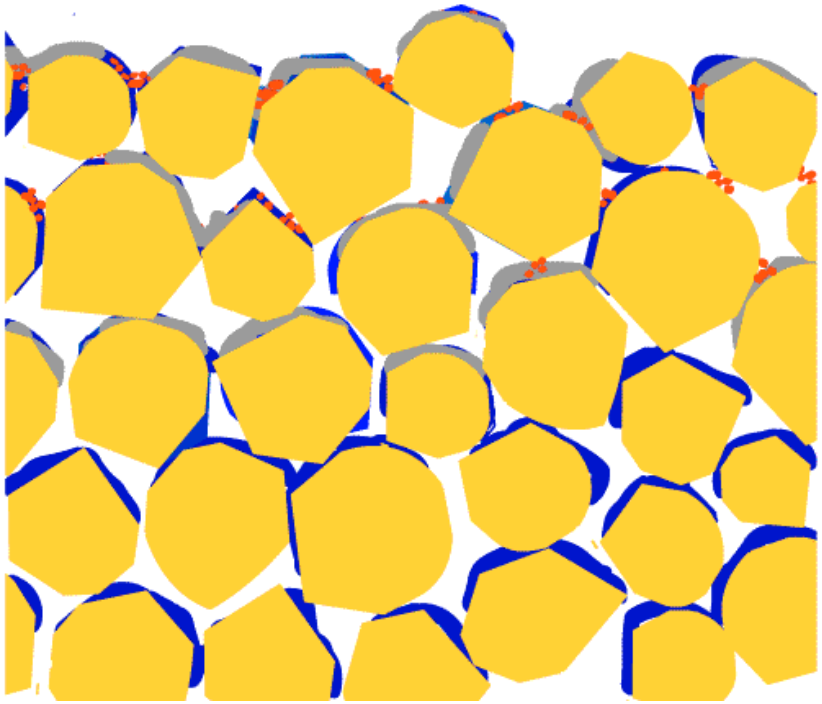
From Art Ludwig, “Create an oasis with greywater”

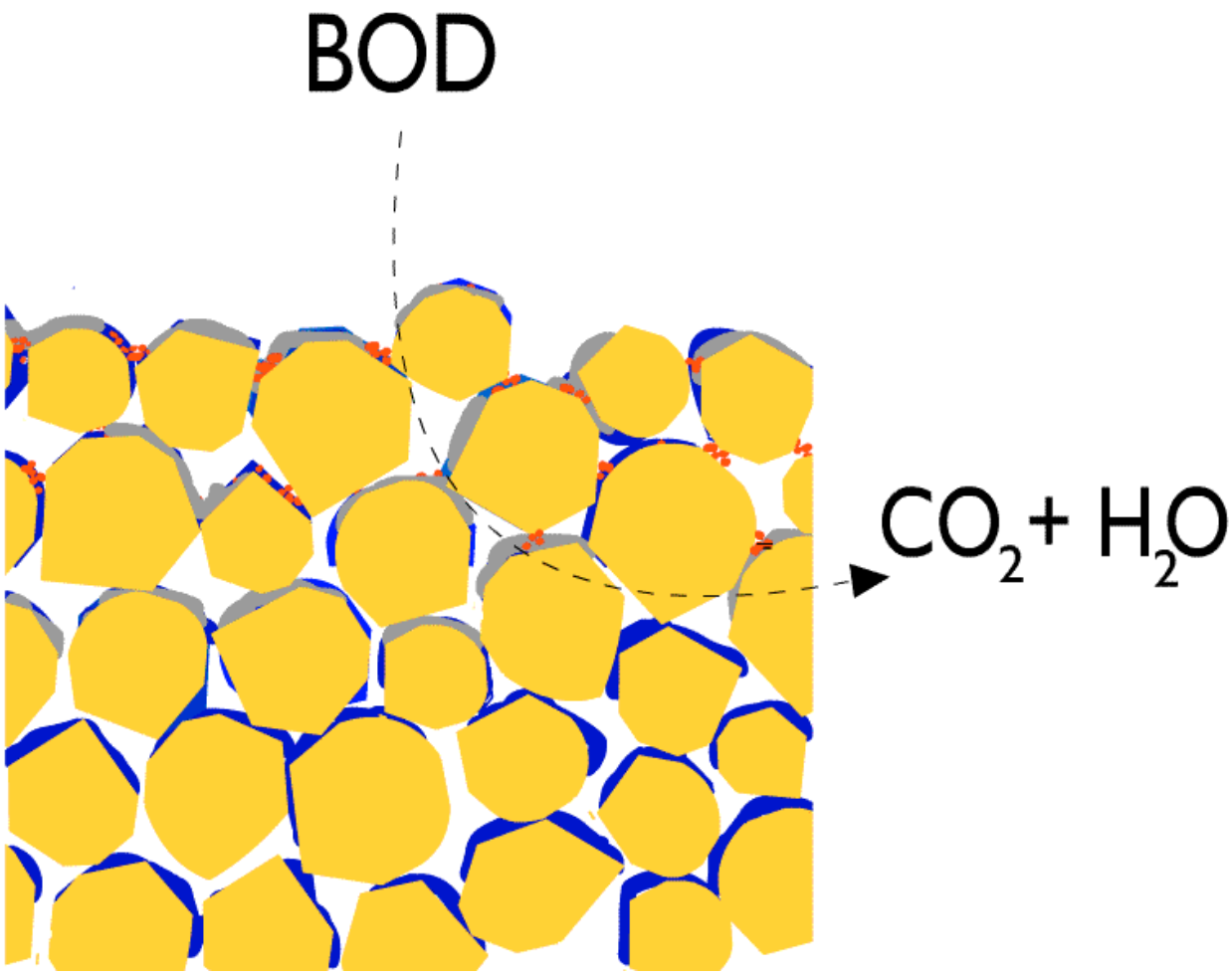
Treating mechanisms in vertical soil filters

Unsaturated or saturated flow?
= difference between success and failure

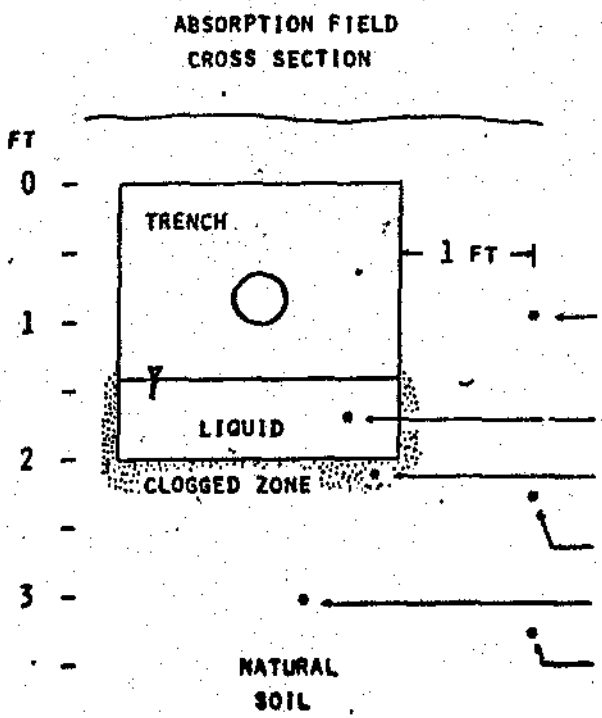








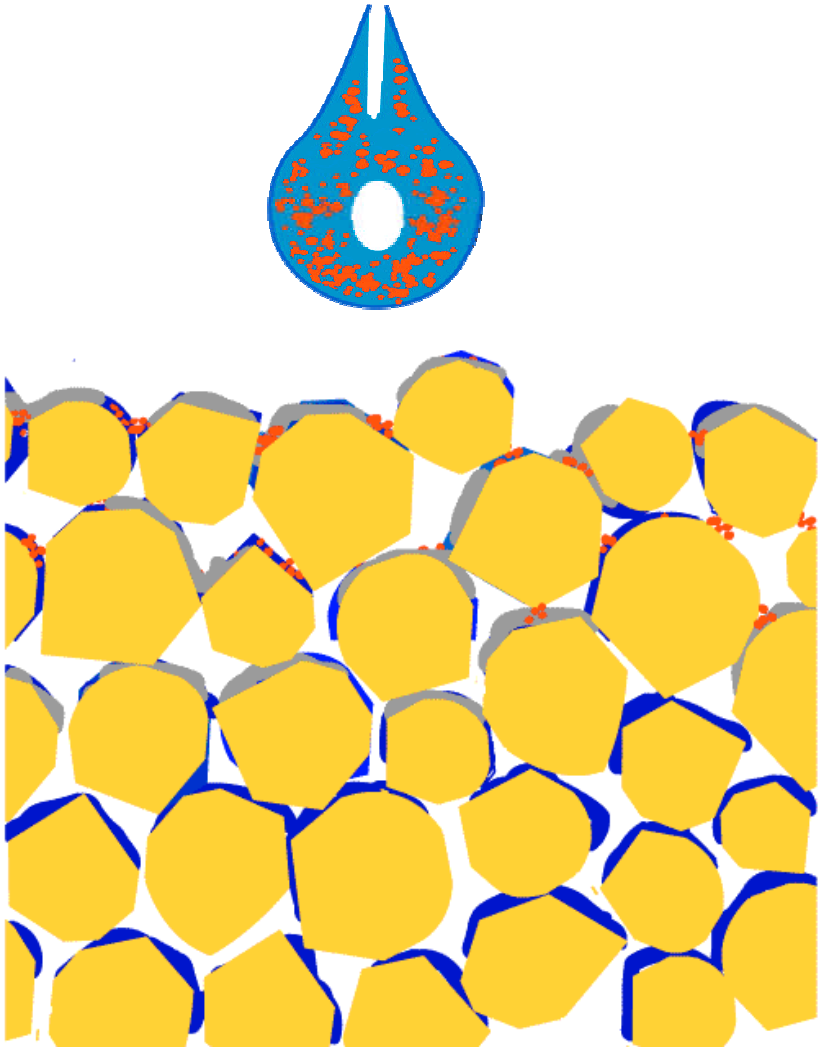
Bacteria removal in soil filter

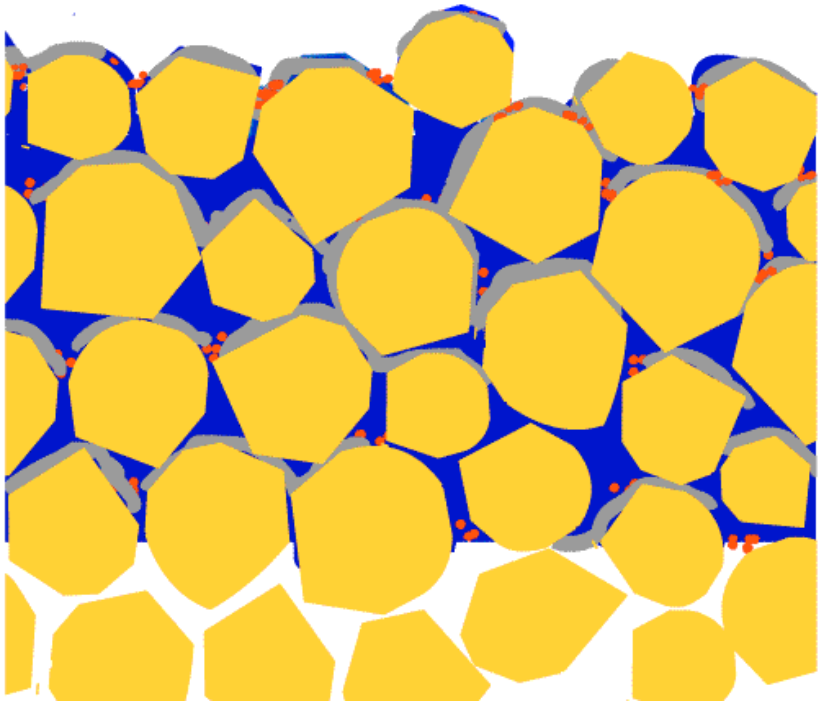


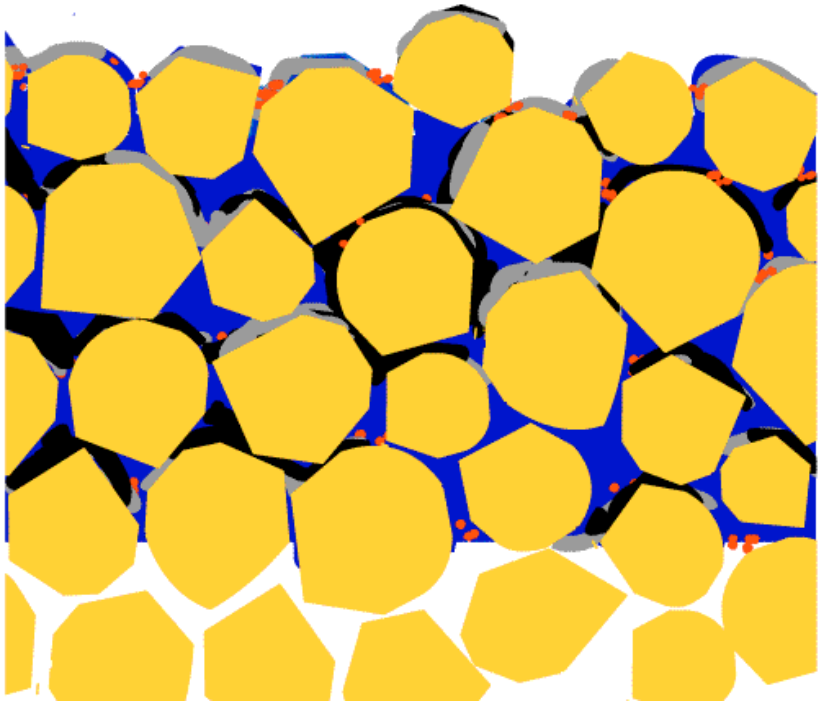
BACTERIA/100 MLS OR PER 100 G OF SOIL

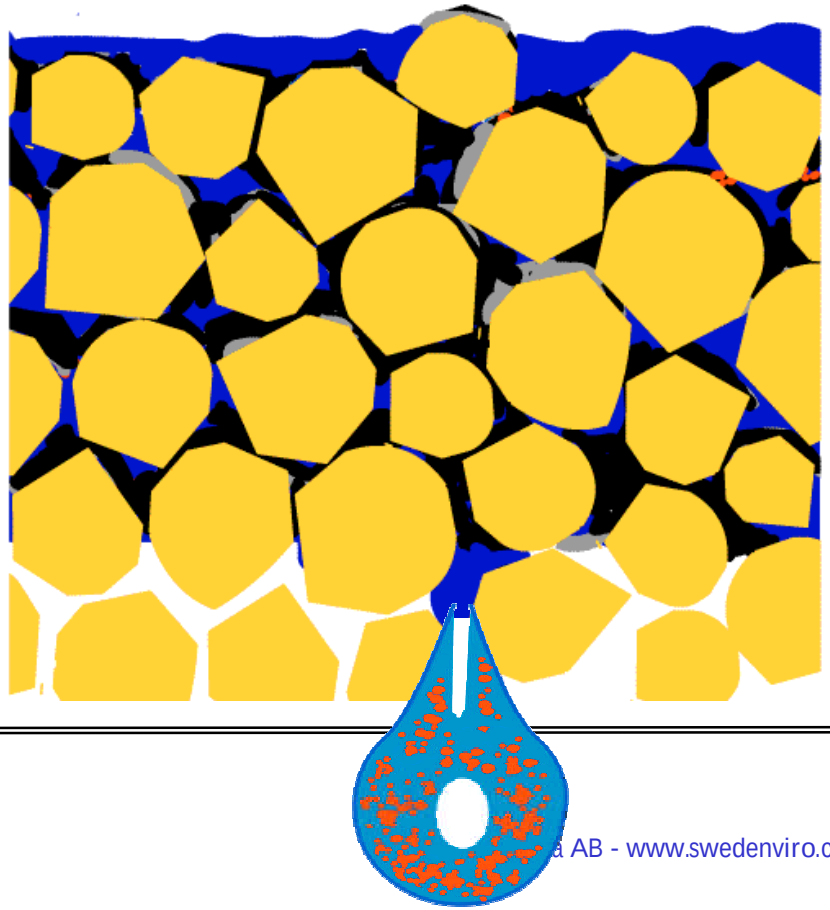
FECAL STREPTO-COCCI	FECAL COLIFORMS	TOTAL COLIFORMS	TOTAL BACTERIA x 10^7
< 200	< 200	< 600	0.6
160,000	1,900,000	5,700,000	3.0
54,000	4,000,000	23,000,000	4,400
< 200	17,000	23,000	6.7
< 200	< 200	< 600	3.7
< 200	700	1,800	2.8

Ziebell et al, 1975



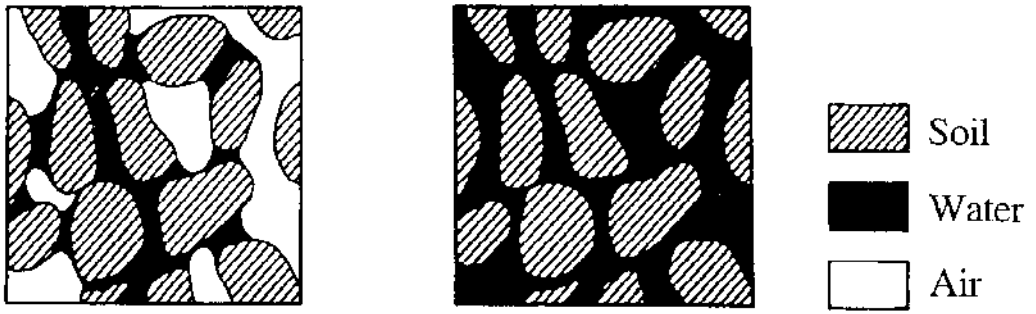




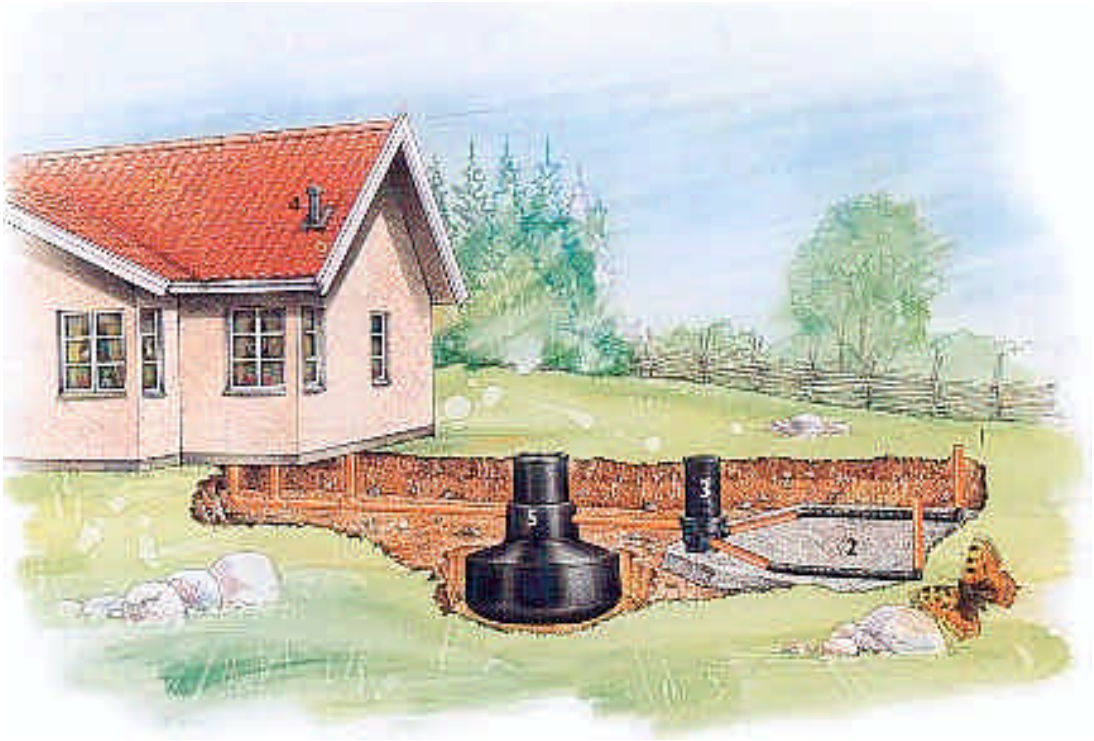


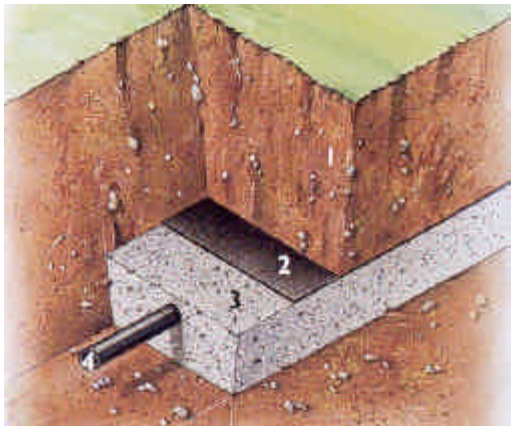
Unsaturated flow vs. saturated flow

- Better filtration!
- Better oxygenation!



Rapid Infiltration

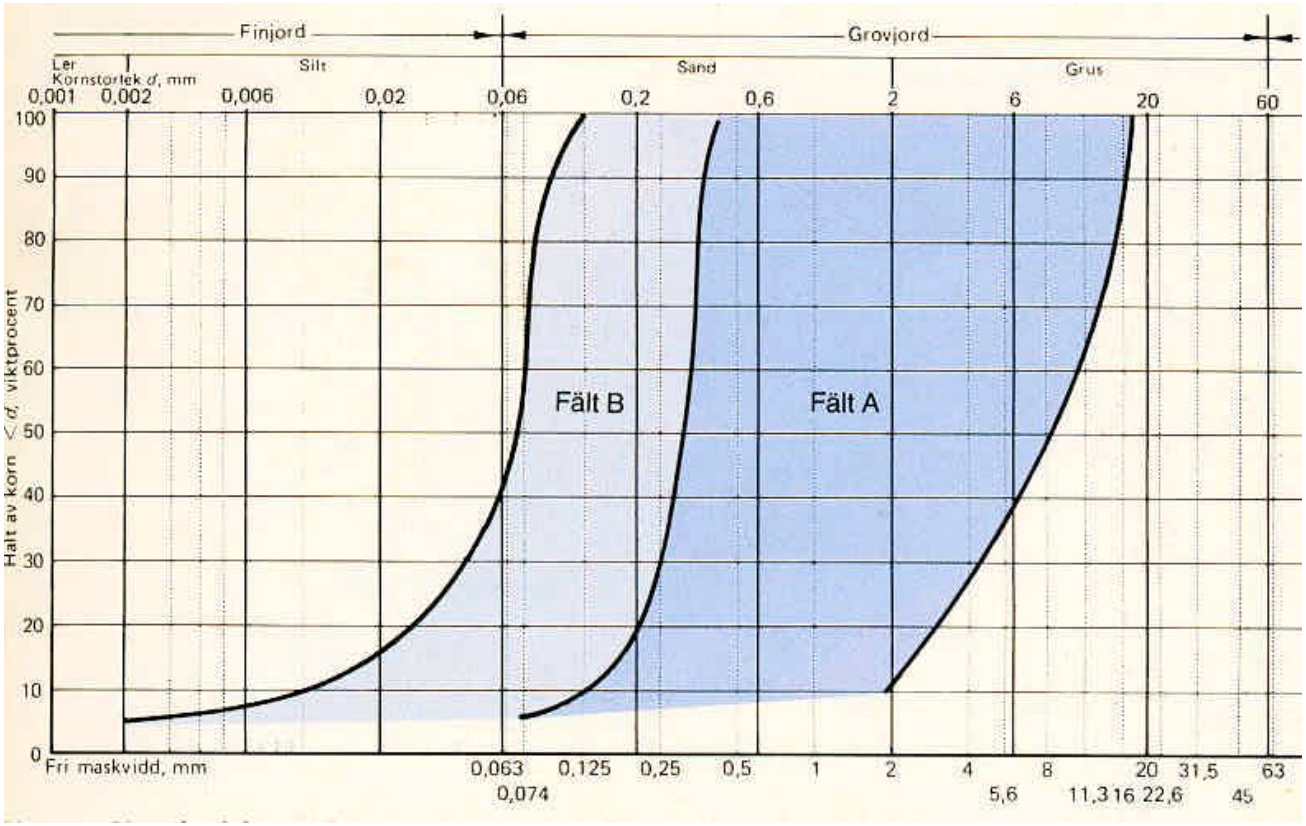




1. Refilling (with isolation)
2. Separating layer (geotextile)
3. Distribution layer
4. Distributing pipe

Soil property - soil texture

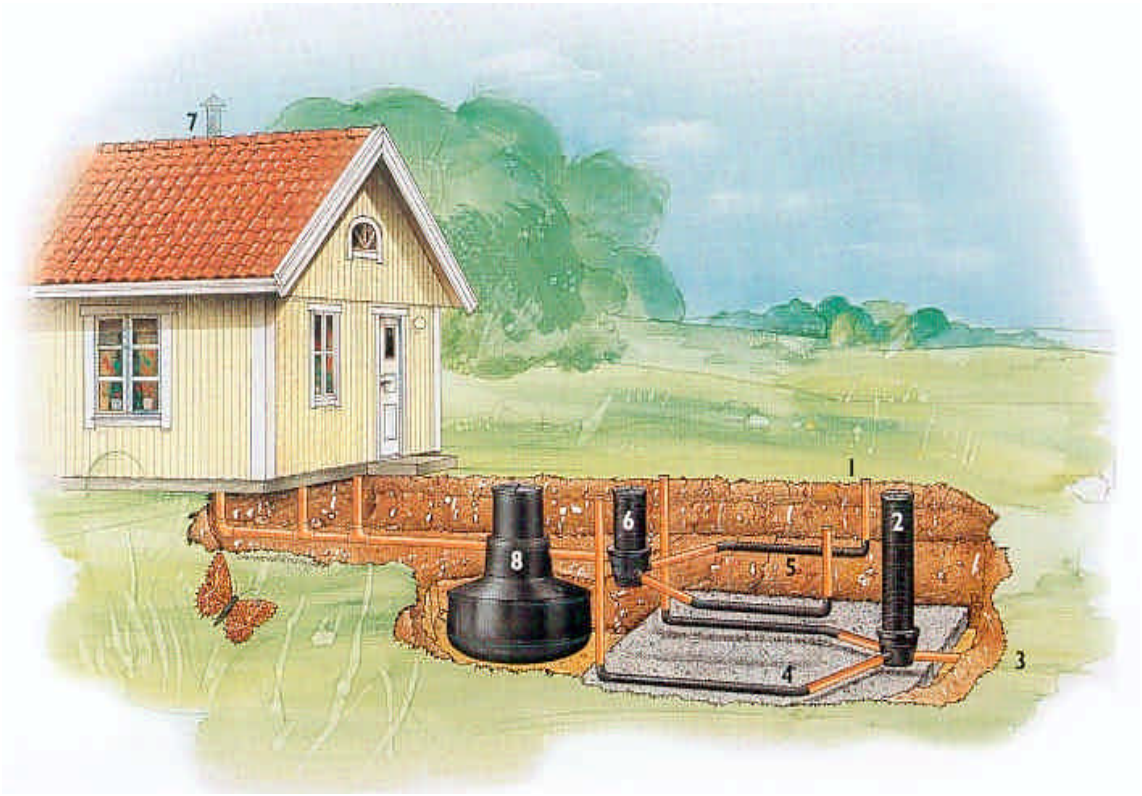
Recommendations according to Swedish EPA:

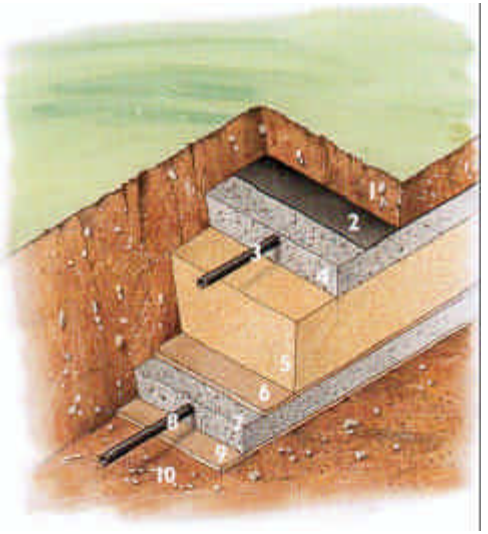


A= infiltration possible. Hydraulic load 40-60 l/m2 x d

B= Infiltration possible if it is strengthened. Sand filter bed recommended

Soil filter bed

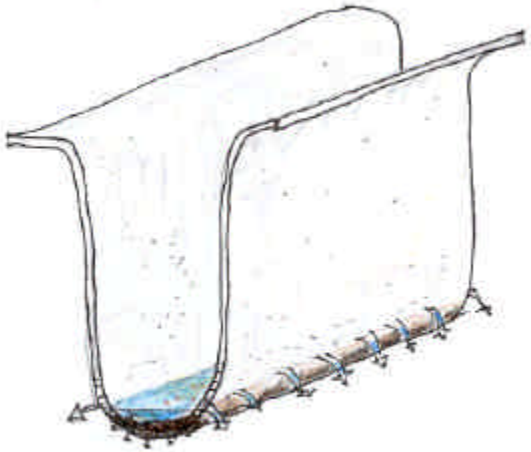




1. Refilling (with isolation)
2. Separating layer (geotextil)
3. Distribution layer
4. Distributing pipe
5. Filter sand
6. Separating sand layer
7. Drainage layer
8. Drainage pipe
9. Underlay (with Sealing)

Strengthening a soil filter by “controlled clogging” using an artificial filter media

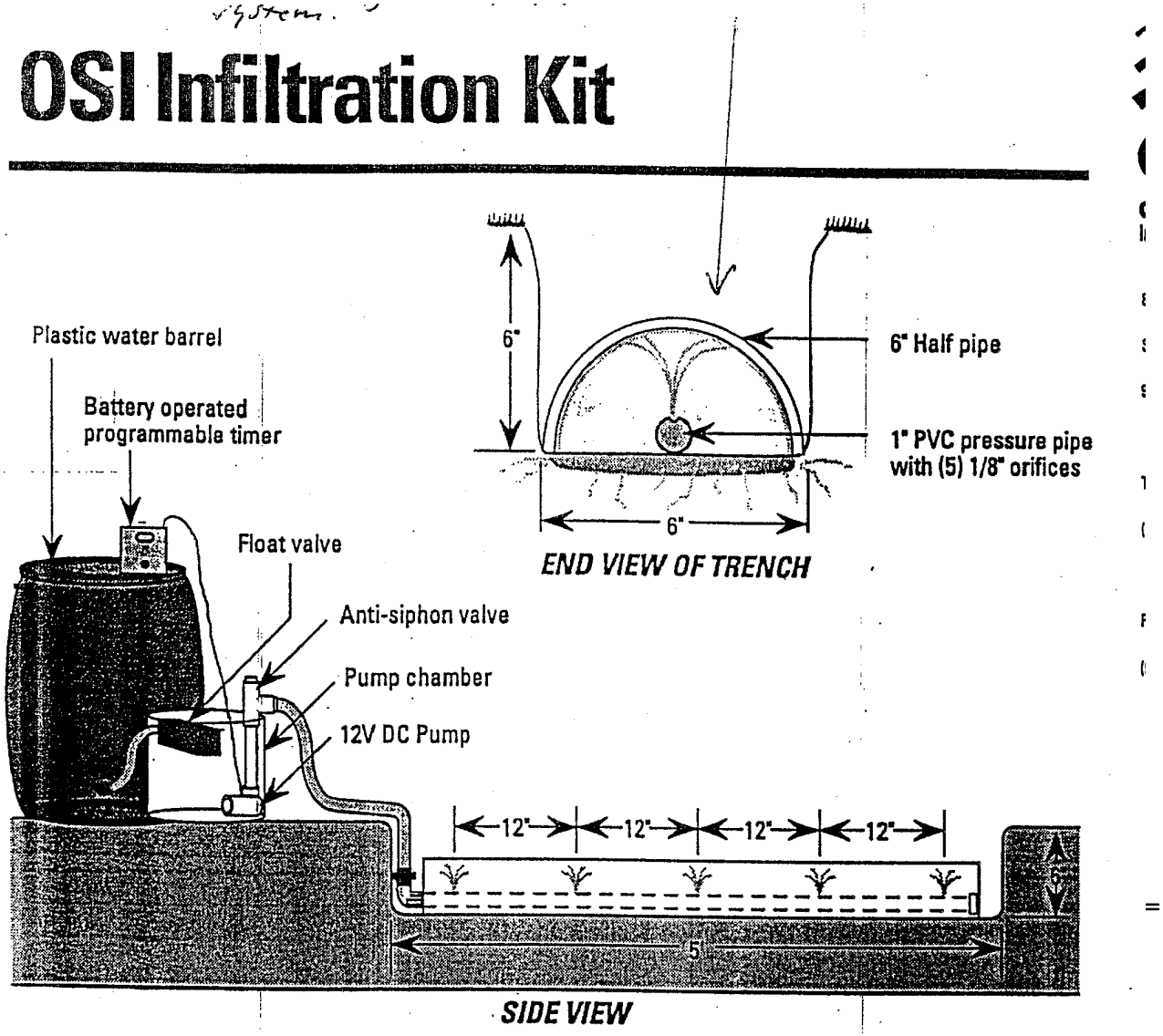
“Ekoporten”. Multifamily “Eco-house”, 20 flats. Urine diversion in double flush toilets, Wastewater treatment in a vertical/horizontal soil filter bed strengthen by Infiltra



Surface flooding

Open Sandfilter bed

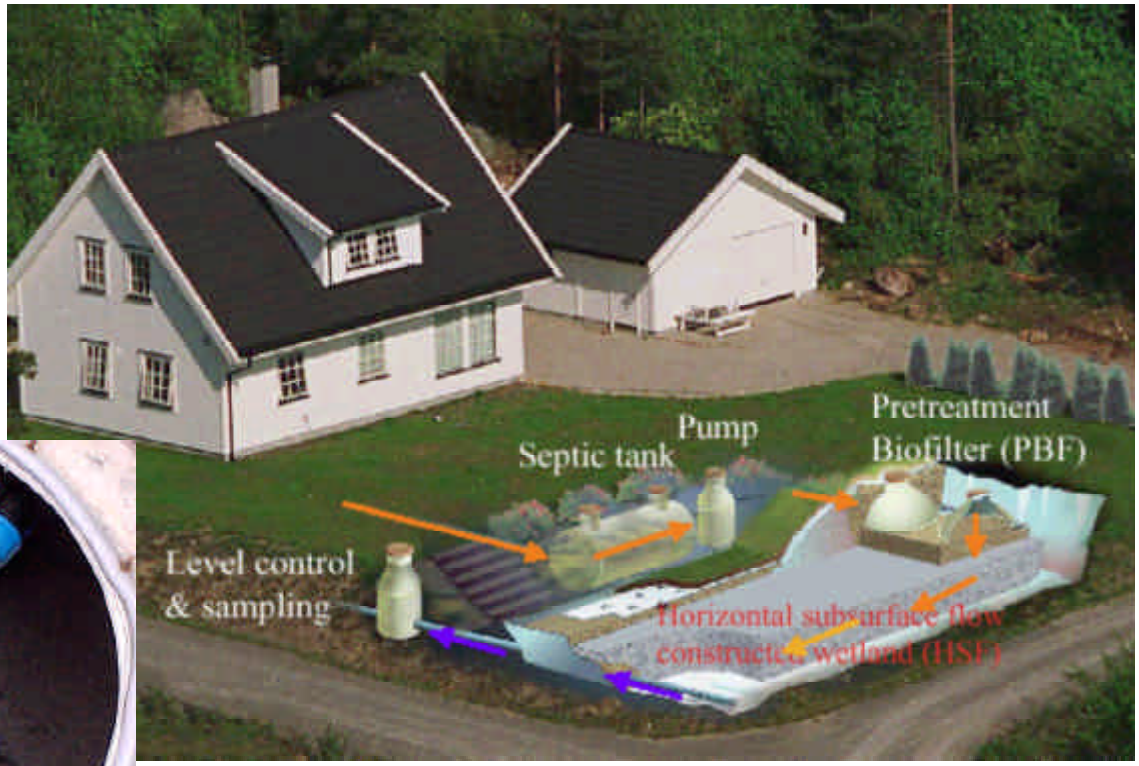
Application from horizontal perforated pipes



Planted vertical soil filter (“Constructed wetland”)

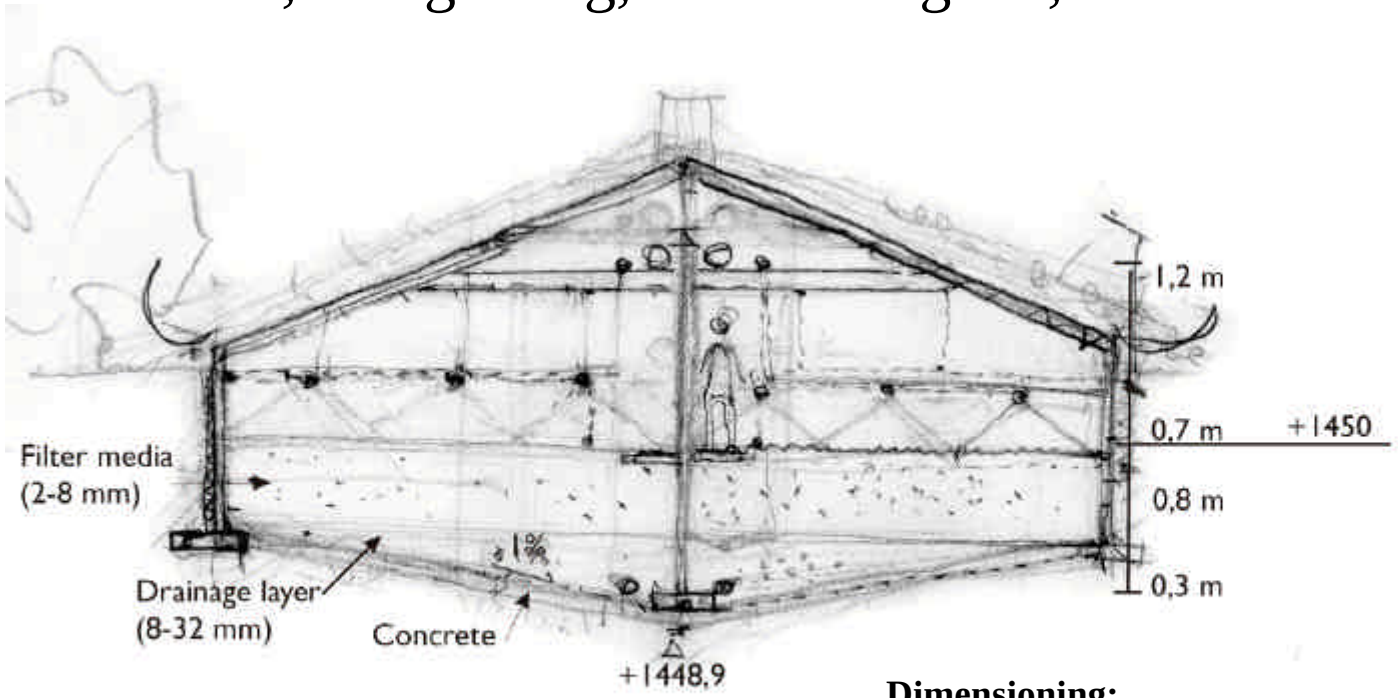
Hamburg, Germany

Spraying technique from Norway



Klosteregna Oslo. Greywater treatment in the central of Oslo by Norwegian filter (vertical/horizontal) for.

Spray technique for greywater treatment, proposal for HZK, DongSheng, Inner Mongolia, China



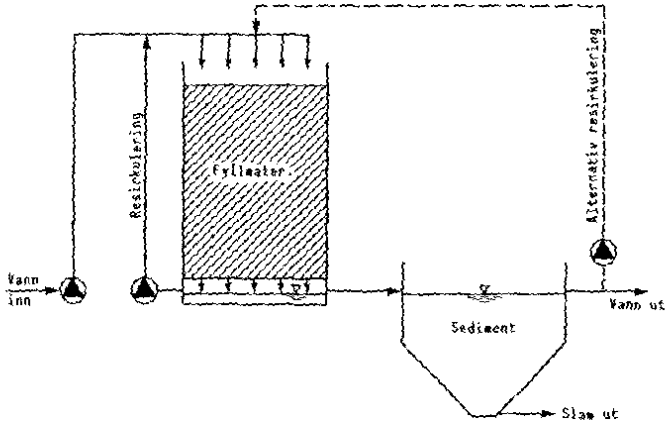
Dimensioning:

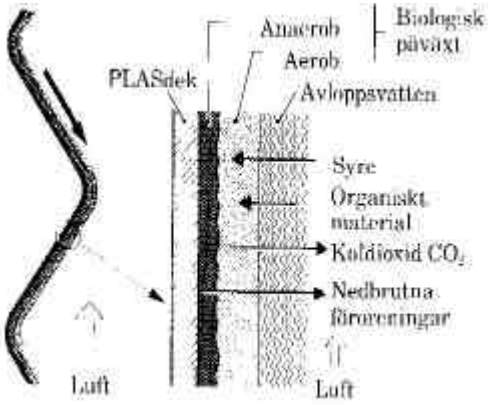
Q=80 /pers.d

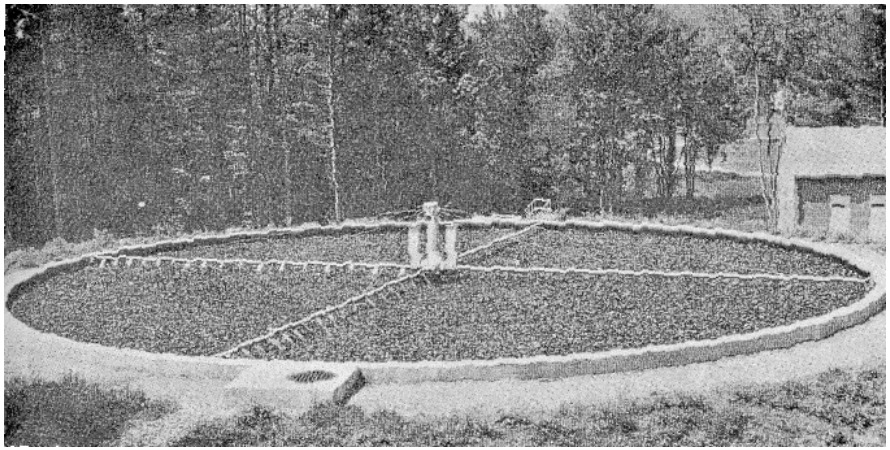
Qload= 300l/m2.d

1000 person > 300 m2 (10x30m)

Trickling filter







“Ponds and wetlands”

+ Simple to construct and operate

- uncertain treatment result (lack of oxygen for BOD reduction, production of toxic fermentation products)

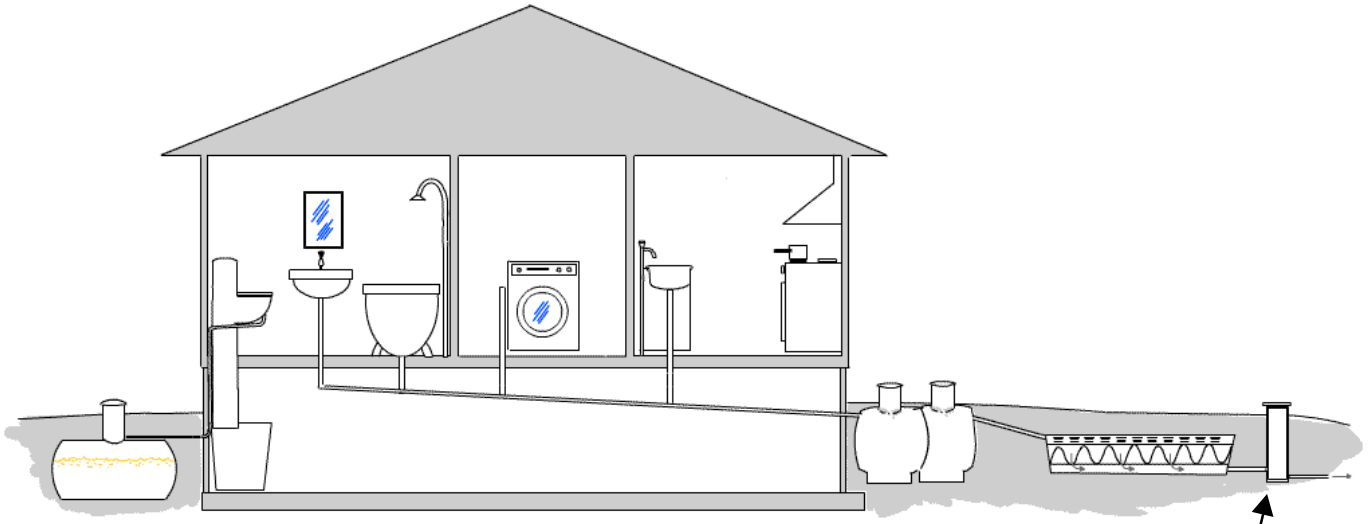
- emission of methane may be a concern

Feasible pond- and wetland techniques ?

- when valuable crops are produced (Wastewater Aquaculture)
- in warm climate, if environmental draw backs from oxygen depletion can be managed e.g ponds in serial (anaerobic/ facultative ponds and green ponds)
- Semi- wet wetlands system eg overland flow system

Vagnhärad teratment wetland, Trosa

“DISPOSAL SYSTEM”



- *to surface water*
- *to groundwater*
- *to crop production, gardening etc*

Potential for greywater use- Discussion

1. End use = surface water
2. End use = ground water
3. End use = irrigation for crop production

Conclusions and recommendations

- **Consider all parts of the technical system** (1) the sources, (2) plumbing and pipes, (3) the pre- treatment, (4) the treatment and and the (5) post- treatment
- **Consider the software** (the users! economical incentives for efficient water use, responsibility for operating etc)
- **Decide the requirement** for treatment from end use
- **Use as simple techniques as possible. Try to build them accessible**
- **Aerobic attached biofilm techniques are often feasible for treatment**
- **Consider and evaluate different possible solutions before decision**
- **Do ”pilots” for “trial and error”, demo and R&D.**