# Hva er gjort av forsøk/undersøkelser på hygienesiden i fht. de ulike parametere? Hva planlegges videre?

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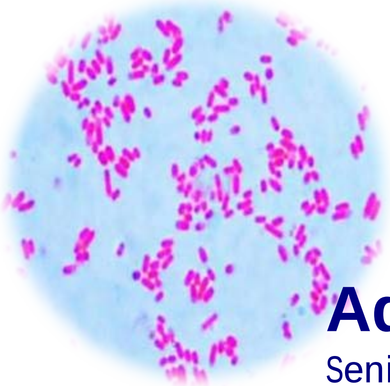

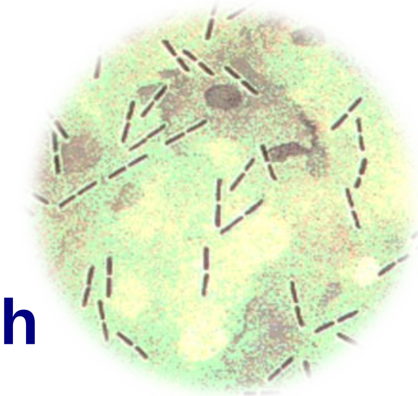

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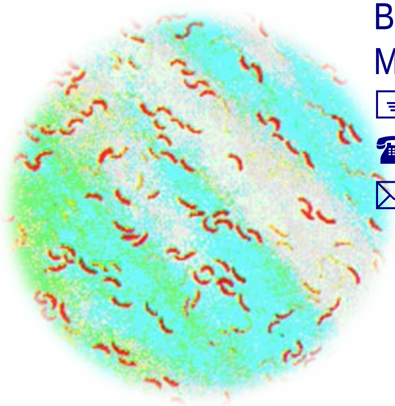

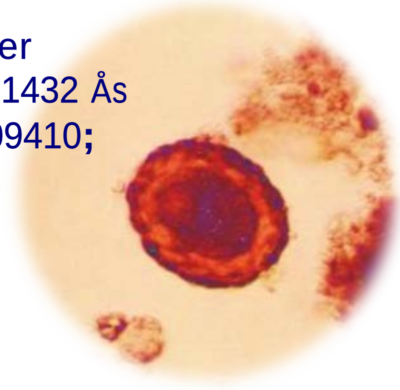

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**Hygieia** (also **Hygiea** or **Hygeia)**, the Greek goddess of good health, cleanliness and sanitation

The term **"hygiene"** is derived from her name

**Hygiene –** prevention to exposure to infectious agents

# Health and sanitation

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Hygienic refers to practices for the preservation of health and healthy living.

Sanitation is the hygienic means of promoting health through prevention of human contact with the hazards of waste materials.

Hazards can be either physical, microbiological, biological or chemical agents of disease.

Wastes that can cause health problems are human and animal faces, domestic/industrial/agricultural wastes/wastewater/runoff.

Hygienic means of prevention can be by using engineering solutions (e.g. wastewater treatment), simple technologies (e.g. latrines), or by personal hygiene practices (e.g. soaping and washing hands).

# **Hygiene** – prevention to exposure to infectious agents

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| Group | Examples of infectious agents | Symptoms and diseases |
|---|---|---|
| **Bacteria** | | |
| | *Escherichia coli* | Urinary Tract Infection (UTI), Haemolytic Uremic Syndrome (HUS), haemorrhagic colitis with diarrhoea |
| | *Salmonella* Typhi | Typhoid – fever, malaise, aches, abdominal pain, diarrhoea or constipation, delirium |
| | *Campylobacter jejuni* | Campylobacteriosis - diarrhoea, occasionally bloody and severe. Cramping abdominal pain, fever, malaise |
| | *Helicobacter pylori* | Acute gastritis leading to gastric mucosal atrophy, intestinal metaplasia and gastric cancer |
| | *Enterococcus faecalis* | Endocarditis and bacteraemia, urinary tract infections (UTI), meningitis |
| | *Clostridium perfringens* | Symptoms typically include abdominal cramping and diarrhoea |
| **Viruses** | | |
| | Hepatitis viruses | Hepatitis - cytological damage, necrosis and inflammation of the liver (HAV). Fever, nausea, abdominal pain, anorexia and malaise, associated with mild diarrhoea, arthralgias, scleral icterus. |
| | Enteroviruses | Aseptic meningitis, herpangina, paralysis, exanthema, hand, foot and mouth disease, common cold, hepatitis, infantile diarrhoea, acute haemorrhagic conjunctivitis |
| | Rotaviruses | Vomiting, abdominal distress, diarrhoea, dehydration, fever |

*(Mara and Horan, eds., The Handbook of Water and Wastewater Microbiology, 2003; Pond , Water Recreation and Disease Plausibility of Associated Infections: Acute Effects, Sequelae and Mortality, 2005; WHO, Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Excreta and Greywater Use in Agriculture, 2006.)*

# **Hygiene** – prevention to exposure to infectious agents

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| Group | Examples of infectious agents | Symptoms and diseases |
|---|---|---|
| **Protozoa** | | |
| | *Cryptosporidium parvum* | Cryptosporidiosis - water diarrhoea, abdominal cramps and pain, mild fever |
| | *Giardia lamblia* | Giardiasis - acute onset of diarrhoea, abdominal cramps, bloating and flatulence, malaise, weight loss |
| **Helminths** | | |
| | *Ascaris lumbricoides* (Nematodes – Roundworms) | Ascariasis - lung inflammation and fluid retention, infiltration of the larvae into sensitive tissues, such as the brain, migration of the adult worms into various body structures where they produce abscesses and toxic manifestations. Wheezing, coughing, fever, diarrhoea |
| | *Diphyllobothrium Latum* (Cestodes- Tapeworms) | Diphyllobothriasis - diarrhoea, abdominal discomfort and pain, flatulence, vomiting, nausea, and weakness, anaemia |
| | *Fasciolopsis buski* (Trematodes - Flatworms) | Fasciolopsiasis - abdominal pain, as well as diarrhoea and nausea alternating with constipation, general body weakness and fluid retention |

*(Mara and Horan, eds., The Handbook of Water and Wastewater Microbiology, 2003; Pond , Water Recreation and Disease Plausibility of Associated Infections: Acute Effects, Sequelae and Mortality, 2005; WHO, Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Excreta and Greywater Use in Agriculture, 2006.)*

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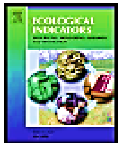

Short communication

# Specific features of *Escherichia coli* that distinguish it from coliform and thermotolerant coliform bacteria and define it as the most accurate indicator of faecal contamination in the environment

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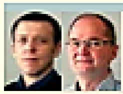
*"E. coli has historically been used as an indicator of faecal contamination since it is the only member of CB and TCB that is found exclusively in faeces and does not multiply appreciably in the environment (Edberg et al., 2000), while other members of these bacteria are also found naturally in water, soil and vegetation…*

*E. coli is the only member of the coliform group that satisfies most of the criteria for an ideal bacterial indicator of faecal pollution (Environment Agency, 2002). Thus E. coli is regarded as the most sensitive indicator and the most appropriate measure of faecal contamination in the natural environment of water, soils and plants (Edberg et al., 2000; Haller et al., 2009; Stevens et al., 2003)."*

## Fekale indikatorbakterier

Koliforme, termotolerante koliforme eller E.coli bakterier – hvilke er relevant indikator av fekal forurensing?



Av Adam M. Paruch, seniorforsker Bioforsk

Trond Mæhlum, forskningssjef Bioforsk

Vi har nylig sett eksempler på alvorlige sykdommer og dødstall i Tyskland som per dato antas skyldes forurenset vann, grønnsaker eller frø (for eksempel bukkehornkløver – *Trigonella foenum-graecum*). Ettersom det tar tid å finne ut den egentlige kilden til forurensning er dette fortsatt usikkert og ukjent.

Visse typer tarmbakterier i varmblodige dyr og mennesker kan være årsak til disse og andre sykdommer. Det er generelt økende fokus på å overvåke mat, drikkevann, badevann og vanningsvann for å unngå alvorlige sykdommer.

### Indikatororganismer

Det er viktig å benytte gode indikatororganismer som kan benyttes i slik overvåkning. Vårt inntrykk er at det er en viss mangel på kunnskap om grupperinger innen koliforme bakterier og hva analysedata kan fortelle om forurensningsrisiko.

Dette gjelder ikke minst de som er ansvarlige for overvåkningsprogram av vann og vassdrag.

Artikkelen gir en kort innføring i dette tema og kan også være interessant for alle som ser spøkelser når *E.coli* omtales i media.

### Kolibakterier

Det er både fellestrekk og karakteristiske egenskaper av koliforme bakterier (KB), termotolerante koliforme bakterier (TKB) og *Escherichia coli* (*E. coli*). Egenskapene gjer det mulig å definere en fekal forurensning basert på bakterielle indikatorer. Koliforme bakterier beskriver en stor gruppe av gram-negative, stavformede bakterier som ikke danner sporer. Disse tilhører en enkelt taksonomisk familie *Enterobacteriaceae* som omfatter mange slekter og arter.

*Salmonella* og *Shigella* er også slekter i denne familien, men de er ikke regnet som KB. Opprinnelig var KB-gruppen definert som de bakterier som er i stand til å vokse og produsere syre og gass fra laktose innen 24 – 48 timer ved 36 – 37 ºC.

Denne biokjemiske definisjonen fungerte i lang tid, men ble endret nesten to tiår tilbake og kan ikke benyttes til å gi en omfattende karakte-



## E.coli i avføring – er det farlig?

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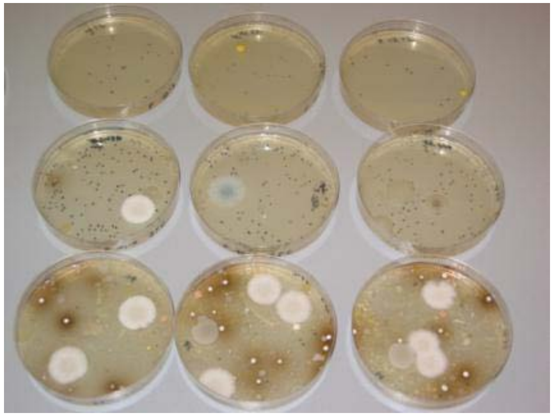

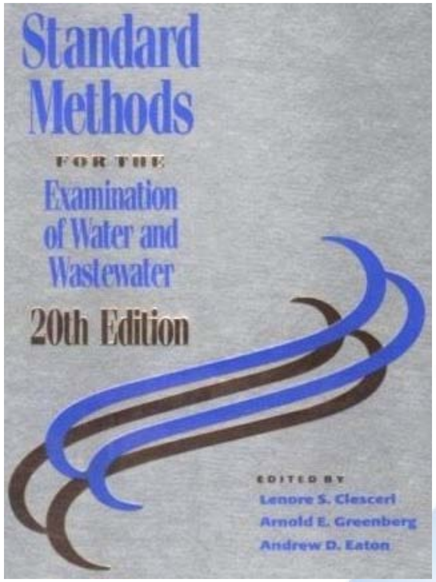

**Enteric viruses** generally pose a higher risk than bacterial pathogens (WHO, 2004). Viruses are smaller and have a lower infective dose.

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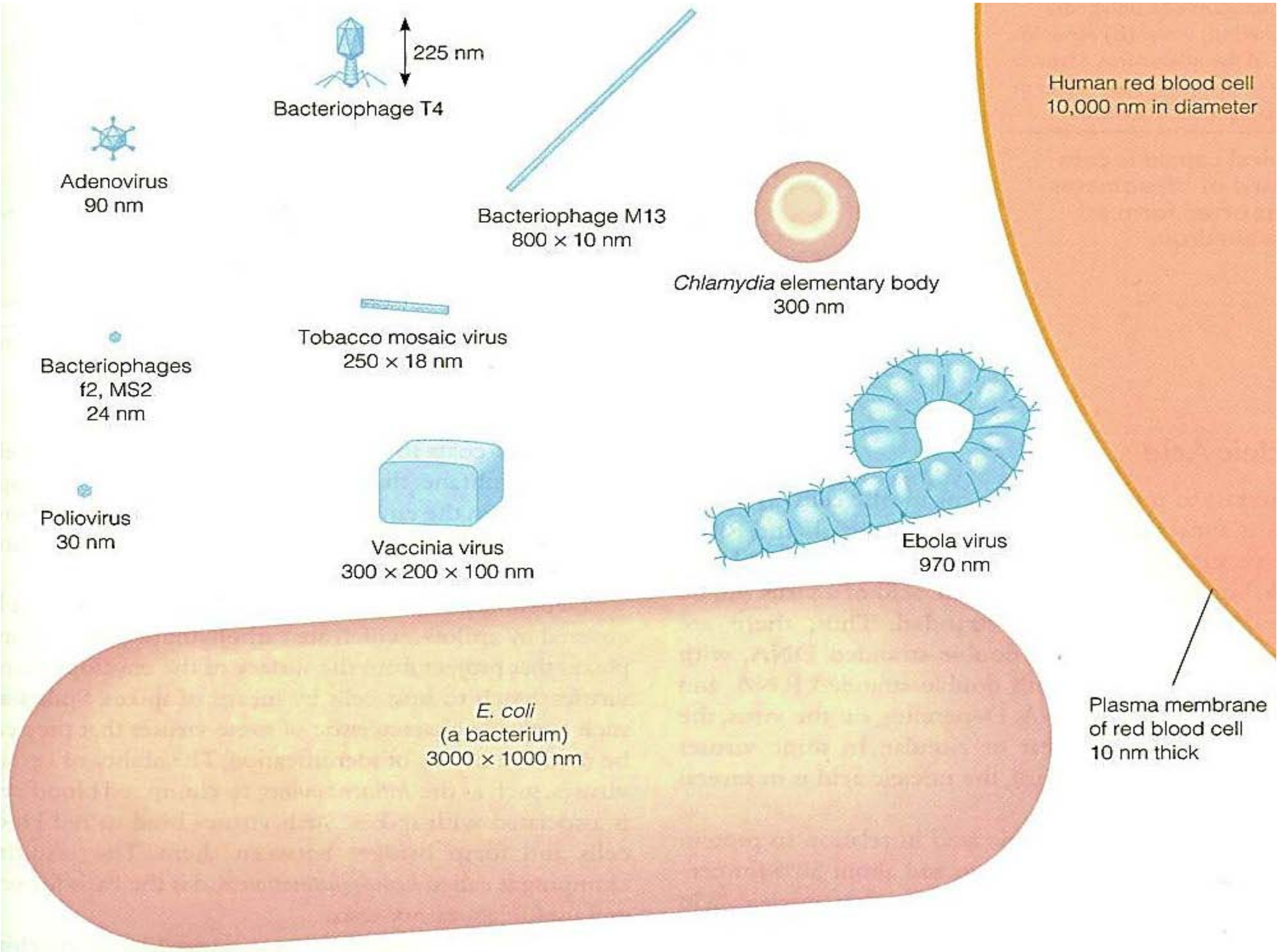
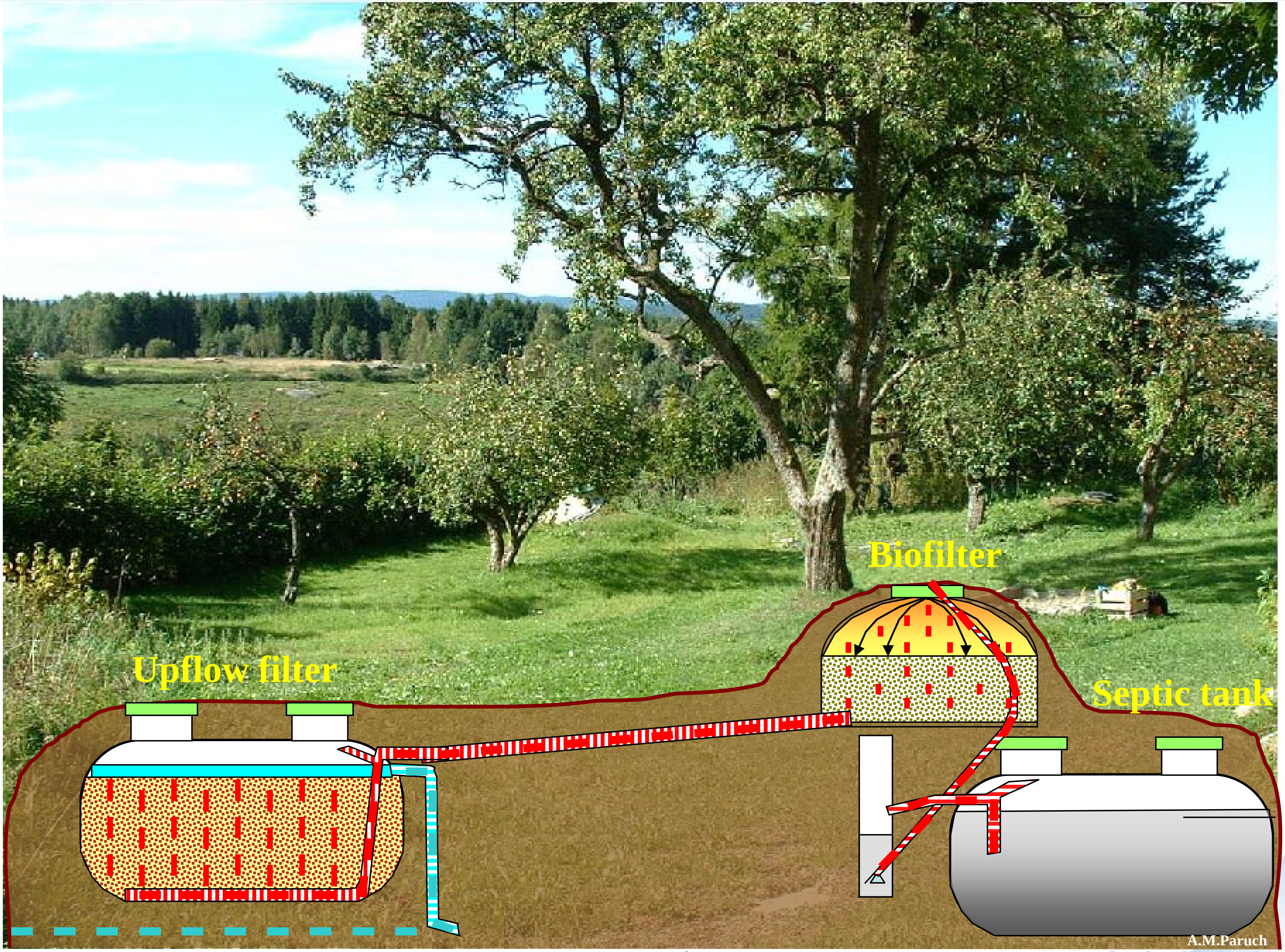



(*Tortora, Funke and Case, Microbiology: an introduction media update, 7th edition, 2002.*)

**Bacteriophages** serve as an indicator of enteric viruses


Biofilter
Upflow filter
Septic tank
A.M.Paruch

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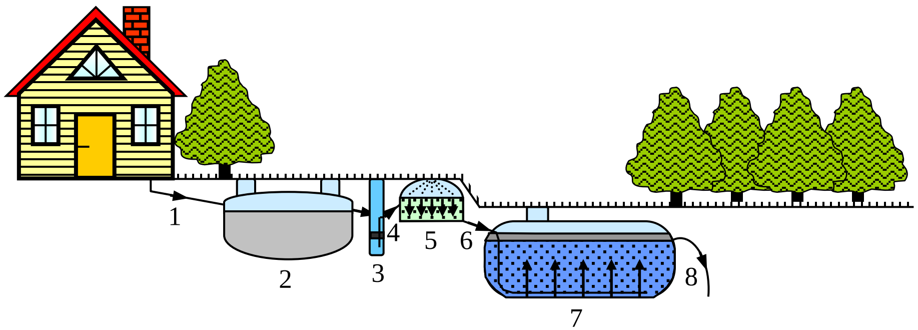


*Figure. Layout of the Norwegian wastewater treatment compact filter system: 1 – inlet (domestic wastewater), 2 – septic tank, 3 – pump well, 4 – effluent from the septic tank, 5 – aerobic pre-filter (biofilter), 6 – effluent from the biofilter, 7 – upflow saturated filter tank , 8 – outlet (effluent from the whole system).*


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**A high-performance compact filter system treating domestic wastewater**


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**Table 1 – Indicator bacteria and bacteriophage removal** *(Heistad et al., Eco. Eng., 2006.)*

| Effluents | April 2003 | June 2003 | November 2003 | May 2004 | |
|---|---|---|---|---|---|
| | (E. coli/100 ml)[a] | (TCB/100 ml)[b] | (E. coli/100 ml)[a] | (E. coli/100 ml)[a] | S.c.[c] |
| Septic tank | 2.0E+05 | –[d] | 7.9E+05 | 2.0E+05 | – |
| Biofilter | 8.8E+02 | – | 1.7E+04 | 1.0E+04 | – |
| Upflow filter | n.d.[e] | n.d. | n.d. | n.d. | n.d. |

[a] Filter membrane method.
[b] TCB, thermotolerant coliform bacteria (MPN, most probable number method).
[c] Somatic coliphages (presence/absence test).
[d] (no sample).
[e] n.d., Not detected.

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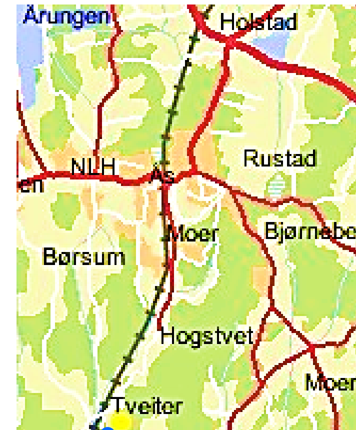
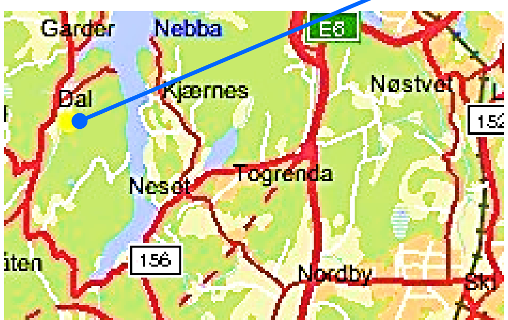
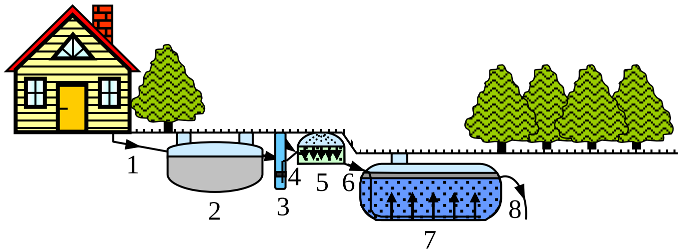
| Constructed wetlands | I-inlet O-outlet | E. coli (MPN/100 ml) |
|---|---|---|
| Holt | I | 3,50E+04 |
| | O | <1,80E+02 |
| Dal | I | 4,50E+01 |
| | O | <1,80E+01 |
| Tveter | I | 2,00E+01 |
| | O | 2,00E+01 |
| Haugstein | I | 4,00E+02 |
| | O | <1,80E+02 |




**Long-term Hygienic Barrier Efficiency of a Compact On-site Wastewater Treatment System**

Arve Heistad,* Razak Seidu, and Andreas Flø Norwegian University of Life Sciences
Adam M. Paruch Bioforsk Soil and Environment
Jon F. Hanssen Norwegian University of Life Sciences
ThorAxel Stenström Norwegian University of Life Sciences, Stockholm Environment Institute

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Table 1. Average concentrations of bacteriophages ($\log_{10}$ pfu mL$^{-1}$) and *Escherichia coli* ($\log_{10}$ MPN per 100 mL) ± SD in samples taken from different stages of the treatment and the corresponding fractional retention values.

| Pathogen indicator | Septic tank effluent | Biofilter effluent | Biofilter fractional retention† | Up-flow filter effluent | Up-flow filter fractional retention† |
|---|---|---|---|---|---|
| S.t.28B‡ | 6.3 ± 5.8 | 4.9 ± 4.4 | 0.9614 | 2.7 ± 1.0 | 0.0383 |
| φX 174§ | 5.3 ± 4.6 | 3.6 ± 2.0 | 0.9805 | 1.5 ± 0.8 | 0.0194 |
| E. coli¶ | 5.4 ± 4.0 | 3.3 ± 3.2 | 0.9912 | 2.9 ± 3.0 | 0.0060 |

† Relative to septic tank effluent concentration.

‡ Septic tank, *n* = 4; biofilter, *n* = 7; up-flow filter, *n* = 4.

§ Septic tank, *n* = 4; biofilter, *n* = 6; up-flow filter, *n* = 4.

¶ Without spiking. Septic tank, *n* = 2; biofilter, *n* = 3; up-flow filter, *n* = 3.

*(Heistad et al., J.Environ.Qual.., 2009.)*

*Escherichia coli* was used as an indicator organism for faecal bacteria removal, whereas bacteriophages ϕX174 and *Salmonella typhimurium* phage 28B (S.t. 28B) were used to model enteric virus removal.

An overall decrease in *E. coli* removal occurred from a complete (approximately 5.6 log10) reduction during the first 3 yr of operation to 2.6 log10 reduction. The removal amounts of the bacteriophages ϕX174 and S.t. 28B were 3.9 and 3.7 log10, respectively.

From an operational point of view, the biofilter with unsaturated flow regime serves as the most consistent hygienic barrier in this treatment system because it removes a larger fraction of *E. coli*, S.t. 28B, and ϕX174 entering from the septic tank.

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Filter bed systems treating domestic wastewater in the Nordic countries – Performance and reuse of filter media

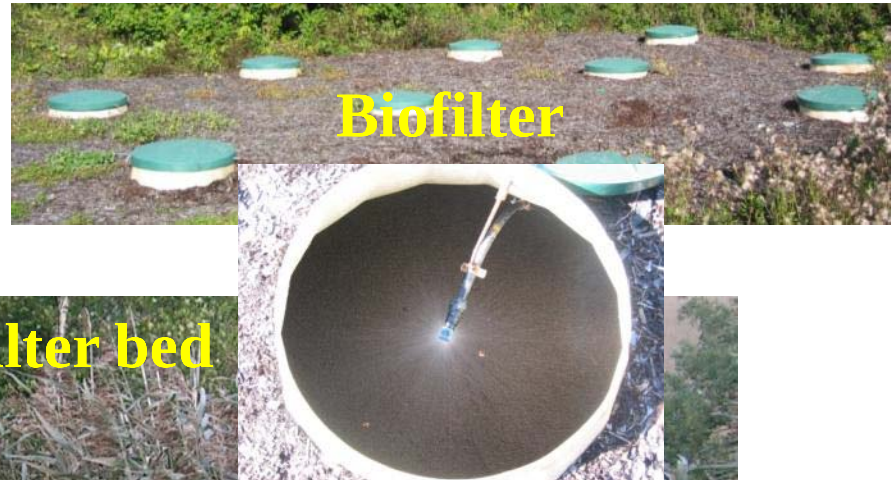
Petter D. Jenssen[a,*], Tore Krogstad[a], Adam M. Paruch[b], Trond Mæhlum[b], Kinga Adam[c], Carlos A. Arias[d], Arve Heistad[c], Lena Jonsson[e], Daniel Hellström[e], Hans Brix[d], Markku Yli-Halla[f], Lasse Vråle[c], Matti Valve[g]

**Table 2**
Concentrations in the inlet and effluent from the pre-treatment and saturated filter beds and total removal (%). Standard deviations are expressed in the parentheses. Number of samples evaluated – *n*.

| Specification | Norway | | | Denmark | | Finland | | Sweden | |
|---|---|---|---|---|---|---|---|---|---|
| | N1 | N2 | N3 | D1 | D2 | F1 | F2 | S1 | S2 |
| BOD ($mg\,O\,l^{-1}$) | | | | | | | | | |
| Inlet* | 360.0 (95.4) $n=4$ | 174.0 (59.6) $n=20$ | 174.0 (59.6) $n=20$ | 316.0 (55.4) $n=10$ | 405.0 (91.5) $n=4$ | 211.9 (135.3) $n=12$ | 203.1 (65.8) $n=10$ | 55.5 (32.4) $n=12$ | 234.7 (74.8) $n=15$ |
| Pre-filter effluent | 73.2 (60.2) $n=10$ | 7.9 (5.4) $n=20$ | 22.9 (20.9) $n=7$ | 48.0 (57) $n=10$ | 65.0 (63.6) $n=2$ | 21.3 (8.4) $n=10$ | 10.7 (9) $n=10$ | 18.3 (18.2) $n=30$ | 37.2 (36.2) $n=17$ |
| Filter bed effluent | 69.2 (13.7) $n=11$ | 5.4 (6.3) $n=20$ | 7.1 (6.2) $n=15$ | 3.3 (2.9) $n=10$ | 1.3 (0.6) $n=3$ | 19.1 (34) $n=14$ | 7.0 (8.3) $n=10$ | 11.4 (6.7) $n=11$ | 32.7 (20.6) $n=15$ |
| % removal | 80.8 | 96.9 | 95.9 | 99.0 | 99.7 | 91.0 | 96.5 | 80.0 | 86.1 |
| TP ($mg\,l^{-1}$) | | | | | | | | | |
| Inlet* | 13.3 (1.5) $n=11$ | 6.6 (2.5) $n=25$ | 6.6 (2.5) $n=25$ | 26.8 (9.2) $n=10$ | 21.2 (5.4) $n=5$ | 18.2 (7.6) $n=18$ | 11.7 (1.8) $n=14$ | 8.0 (5.3) $n=63$ | 9.5 (2.7) $n=74$ |
| Pre-filter effluent | 7.07 (3.73) $n=6$ | 4.6 (1.7) $n=25$ | 5.5 (2.1) $n=9$ | 24.0 (8.8) $n=10$ | 2.5 (0.9) $n=5$ | 14.0 (6.7) $n=16$ | 10.6 (2.4) $n=14$ | 6.9 (4.9) $n=63$ | 7.8 (2.8) $n=73$ |
| Filter bed effluent | 0.22 (0.02) $n=11$ | 0.18 (0.5) $n=28$ | 0.04 (0.03) $n=20$ | 1.22 (1.32) $n=10$ | 0.09 (0) $n=5$ | 0.02 (0.01) $n=20$ | 0.64 (0.79) $n=14$ | 0.02 (0.03) $n=107$ | 0.05 (0.07) $n=48$ |
| % removal | 98.3 | 97.3 | 99.4 | 95.4 | 99.6 | 99.9 | 94.5 | 99.7 | 99.5 |
| Fecal indicator bacteria/100 ml | | | | | | | | | |
| Bacteria type | a | b | – | a | a | c | c | b | b |
| Filter bed effluent | 0 | 0 | – | <3 | 0 | <10 | <300 | 0 | 0 |

* Septic tank effluent; [a]Thermotolerant coliform bacteria (fecal coliforms); [b]*E. coli*; [c]*Enterococcus*.

*(Jenssen et al., Eco.Eng., 2010.)*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**Long-term survival of *Escherichia coli* in lightweight aggregate filter media of constructed wastewater treatment wetlands**

A. M. Paruch

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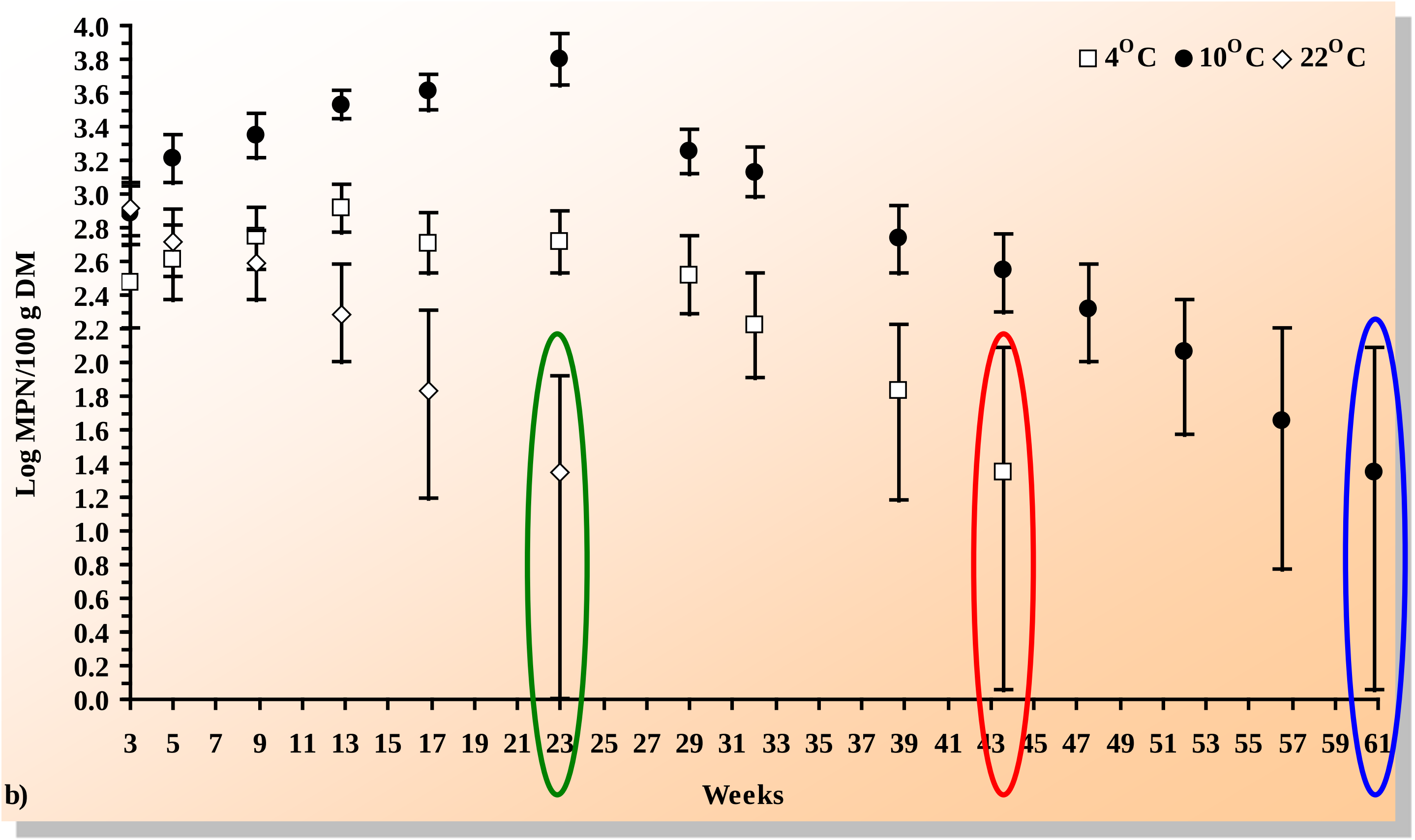


The length of the survival periods differed among temperature regimes from 23, 44 and 61 weeks in material stored at 22°C, 4°C and 10°C, respectively.

Rev Environ Sci Biotechnol (2010) 9:51–58
DOI 10.1007/s11157-009-9181-z

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MINI REVIEW

# Possible scenarios of environmental transport, occurrence and fate of helminth eggs in light weight aggregate wastewater treatment systems

**Adam M. Paruch**

Published online: 18 November 2009


**Abstract** This work discusses the potential routes of transport, possible occurrence and predicted fate of parasite eggs corresponding to human pathogens in on-site wastewater treatment systems with Light Weight Aggregates (LWA) media. The discussion is mainly based on scientific evidences supported by practical outcomes derived from a survey of helminth eggs in the specific LWA materials—typical filter media of constructed wetlands (CWs) treating domestic wastewater in Norway. The scientific evidences showed that the greatest reduction in the egg concentrations occurs in septic tanks. The eggs that could pass through the tank trap can be accumulated and effectively eliminated in the filter media of CWs. The practical outcomes did not show any accumulation and the consequent contamination of the LWA media with helminth eggs. Because the outcomes characterised a survey that was carried out for the first time ever on the above-specified filter media and was not replicated, the absence of parasite eggs in the CW filters cannot be definitely stated. However, it could be theoretically assumed that the possibility of finding human parasite eggs originated from domestic wastewater in the LWA filters should be negligible.

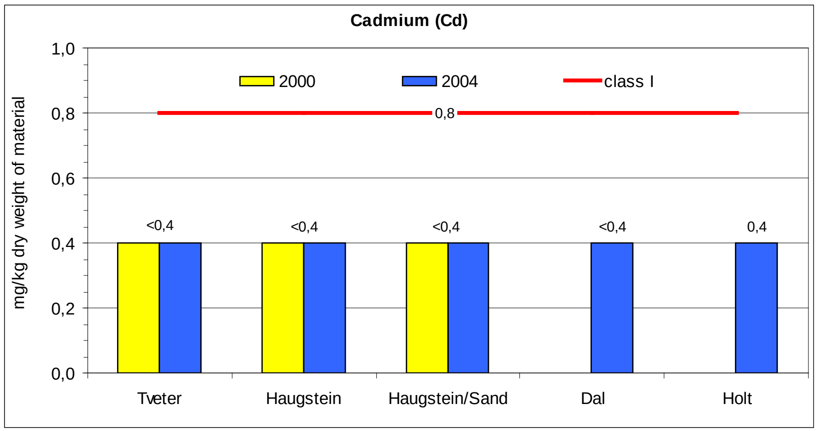
ECOHYDROLOGY & HYDROBIOLOGY
Vol. 7
No 3-4, 243-253
2007

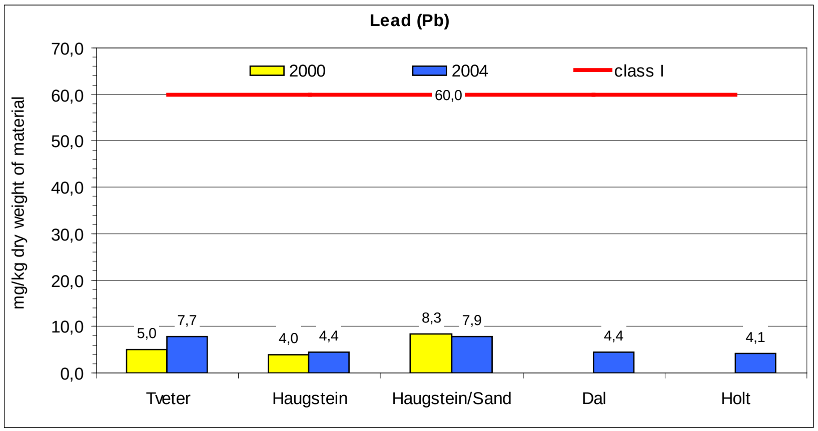
**Application of used wetland filter media in agriculture – control of heavy metal contents and faecal contamination**

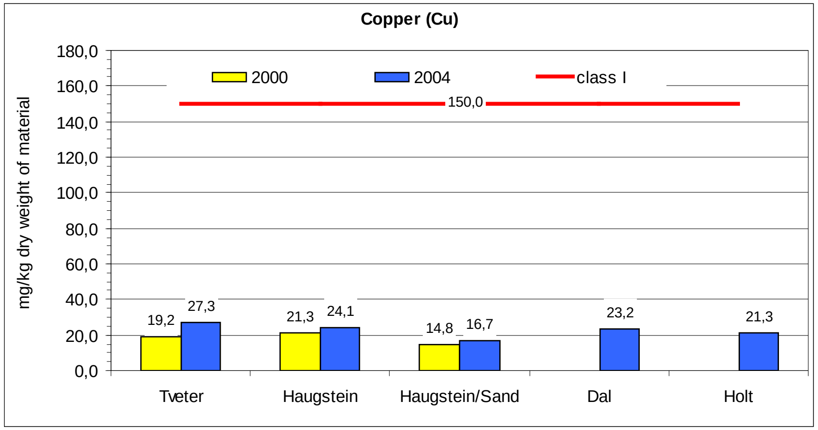
Adam M. Paruch[1], Tore Krogstad[2], Petter D. Jenssen[2]

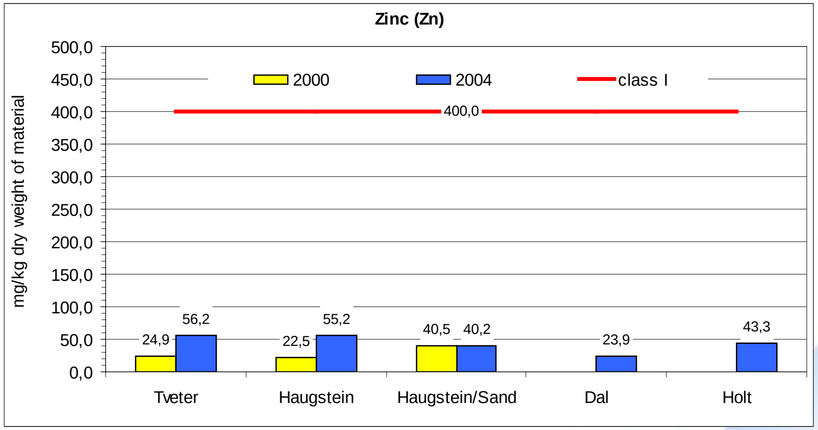
www.bioforsk.no

Average contents of heavy metals in examined filter media were compared to the maximum allowable concentration of these elements in materials used on cultivated areas (40 and 20 t/ha/10years for class 1 and class 2 respectively), in accordance to the Norwegian standards (Regulation F-1029).



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# Application of used wetland filter media in agriculture – control of heavy metal contents and faecal contamination

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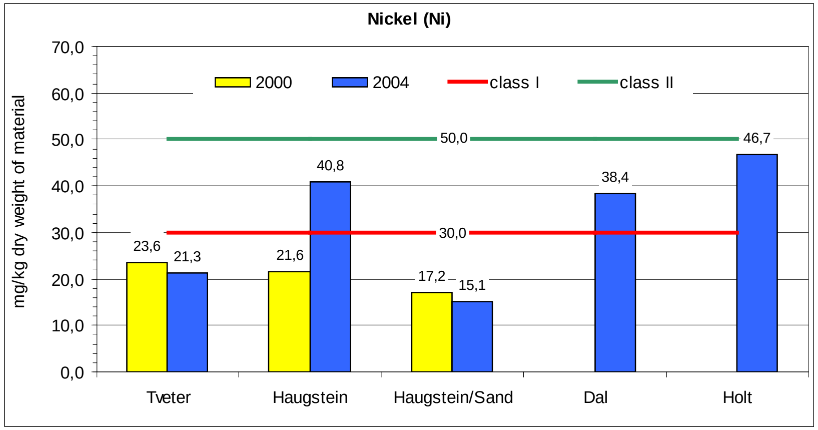
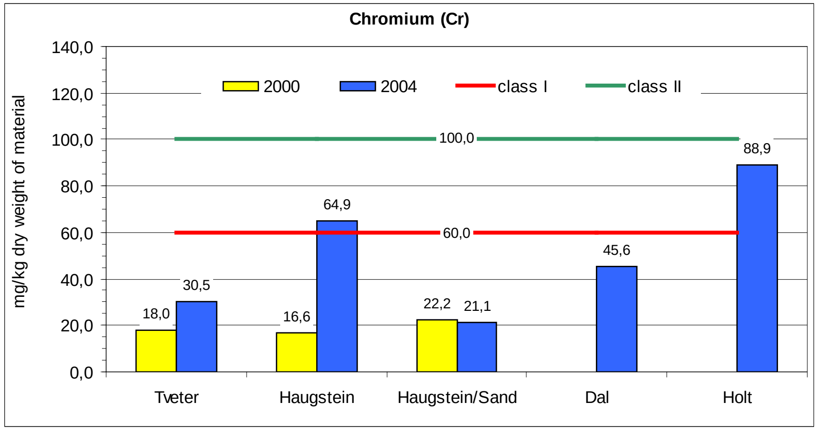
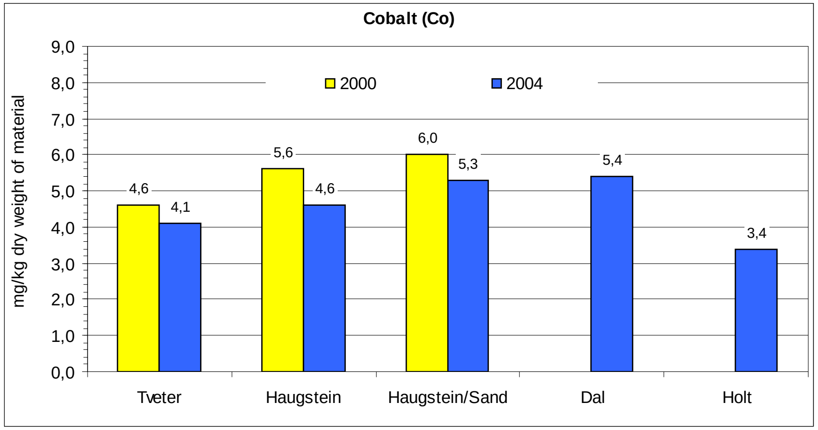
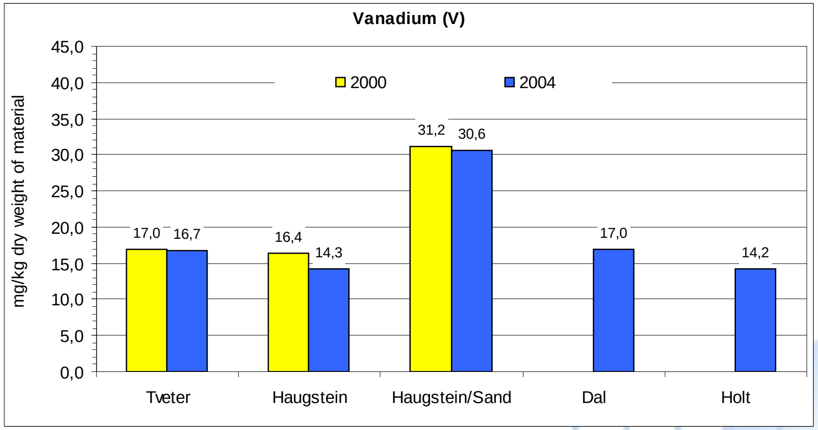
Average contents of heavy metals in examined filter media were compared to the maximum allowable concentration of these elements in materials used on cultivated areas (40 and 20 t/ha/10years for class 1 and class 2 respectively), in accordance to the Norwegian standards (Regulation F-1029).



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# Application of used wetland filter media in agriculture – control of heavy metal contents and faecal contamination

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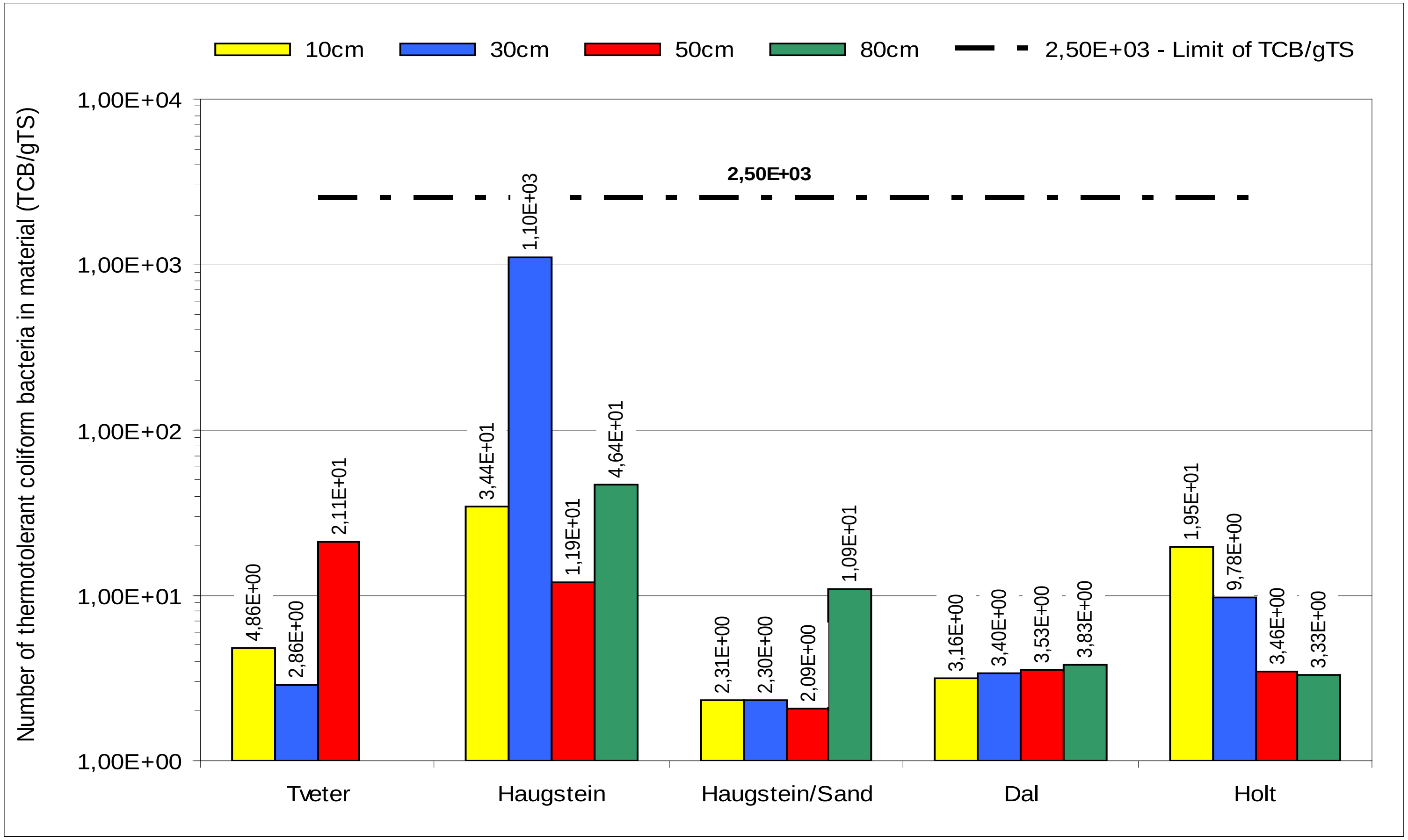


The results obtained from analyses of LWA filter media collected from selected horizontal subsurface flow constructed wetlands did not show any contamination with TCB, in accordance to the Norwegian standards (Regulation F-1029, 2003).

# Source separation of domestic wastewater

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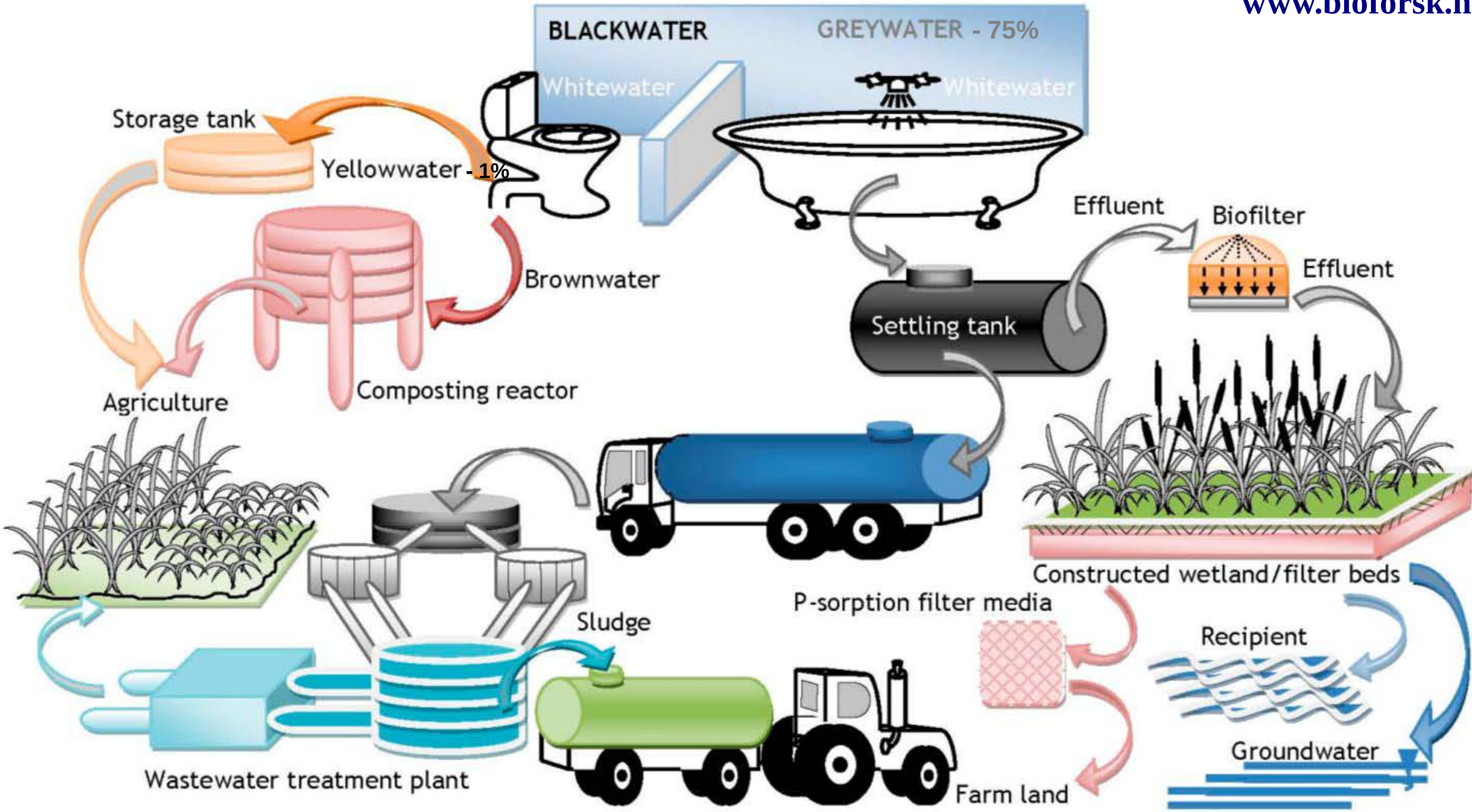

# Thank you
# for your attention !

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