Biological filtration of treated waste water by Daphnia

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STP Everstekooog

sewage treatment plant

presettling basin

9 ditches with reed/cattail and aquatic plants

discharge ditch

Research project 1995 - 1999

www.waterharmonica.nl
Biological filtration by Daphnia

Focus on ponds fed by well treated effluent from activated sludge plants

Daphnia

Empuriabrava

www.waterharmonica.nl
Daphnia – “engineering”

- Length: 0.3 - 5 mm
- Wet weight: 0.5 - 2 mg
- Filtration capability: 2 - 4 ml/ind.hour

(1000 Daphnia/l filtrates water 2 - 4 times per hour)

- Size of food particles between 1 - 40 µm

Protein: 60 %
Fat 10 %
Carbohydrates 6 %

C = 44 %
N = 8 %
P = 1.4 %

Daphnia food chains

Empuriabrava
Grou
Everstekoog

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Daphnia size distribution
new digital counting method

Size of Daphnia (mm)

- Daphnia > 5 mm
- Daphnia 3 - 4 mm: older ones grow
- Daphnia 2 - 3 mm
- Daphnia 1 - 2 mm
- Daphnia < 1 mm: stable birth rate

dag_2003
Feecal Coli removal
(nr / ml)
temperature < 10 °C

Hydraulich retention time (days)

28 – 2 – 2006
winter Daphnia magna, overgrown with algae, temp +2°C
What do the Daphnia eat?

Algae or/and Sludge ??

Hypothesis

theory:
ponds fed with treated wastewater will become green because of algae growth

light

temperature

Filtration of Algae

in practice:
ponds turned red with Daphnia, which feed on particles in the water (loose bacteria, small sludge flocs, every algae that appears is immediately consumed by the numerous Daphnia

suspended solids:
size of particles 
composition
nature of the particles

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Daphnia: Daphnia feces

Stickleback Spoonbill

Food chains (Eco)toxicity
Horstermeer experiments in effluent upgrading
2005 – 2008

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Biological filtration

Technical filtration

Research on m³ scale

4 x 4 mesocosms:
- 2 x 4: effluent
- 2 x 4: filtrated effluent

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Equal experiments on three STP’s

Horstermeer
Netherlands
Effluent
Filtrated effluent

Grou
Netherlands
Parallel to ponds

Empuriabrava
Spain
Parallel to ponds

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Not only Daphnia:

Suspended material and benthic algae:
• biological filtration by Daphnia
  • mainly Daphnia magna, but also other Cladocera

Attached algae and settled sludge:
• grazing by snails
  • Holland: mainly Great pond snail Lymnaea stagnalis

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