Nutrient recovery from black water from a Dutch perspective

ROYAL HASKONING

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Sanitation Challenge 2008

Wageningen

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Objectives sanitation

Source: Schrader, 2006

Main objectives:

1. Protection public health

2. Protection natural environment

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Dutch Sanitation system

Central collection and treatment:

- Extensive sewer system
- Wastewater treatment systems

Energy consumption:
- 1 – 2 W/person

Costs:
- € 50 / person.year

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Why change ?

Limiting resources:

- Water
- Phosphorus
- Energy

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New objective sanitation: ‘Sustainability’

Reuse of resources:

- Water reuse
- Nutrient recovery

Minimize use of resources:

- Save energy

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New sanitation system

Decentral collection and treatment:

- Separation domestic wastewater
- Black water → Nutrient recovery ?
- Grey water → Water reuse ?

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Research question

Is it possible to recover nutrients from black water in the Netherlands ?

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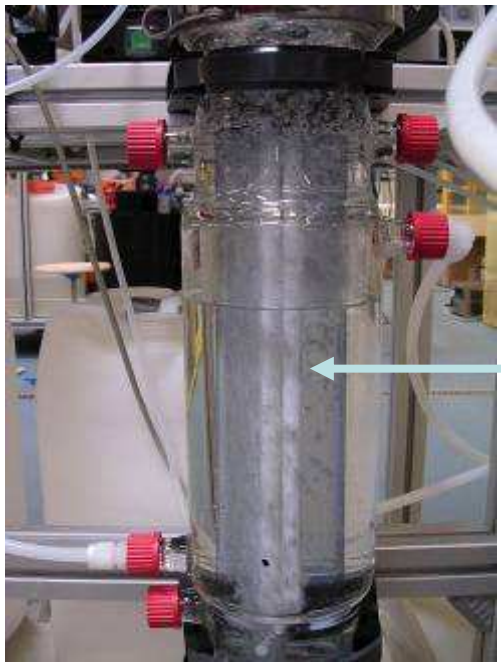
Research approach I

- **No direct recovery possible**

→ Biological treatment of black water

- → Anaerobic MBR
- → UASB + Effluent filtration
- → Aerobic MBR



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Research approach II

- **Independent from central sewer system**

→ Achieve wastewater discharge standards
  - → Nitrogen: 10 mg/l
  - → Phosphorus: 1 mg/l

→ Advanced technologies required!

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Advanced technologies

Nutrient recovery and clean water production in ONE step:

- Electrodialysis
- Reversed osmosis
- Ion exchange

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Evaluation technologies

- Concentrate quality
- Water quality
- General system performance

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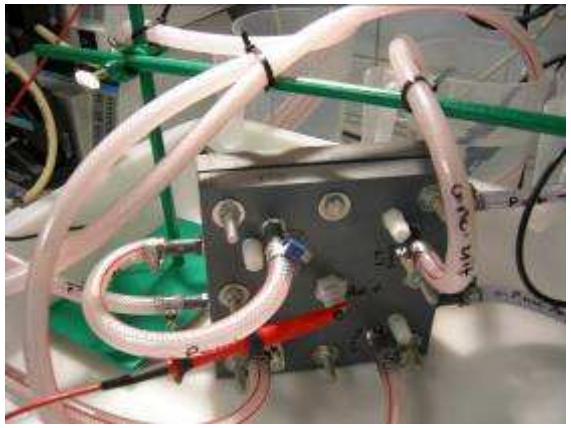
Electrodialysis (ED)

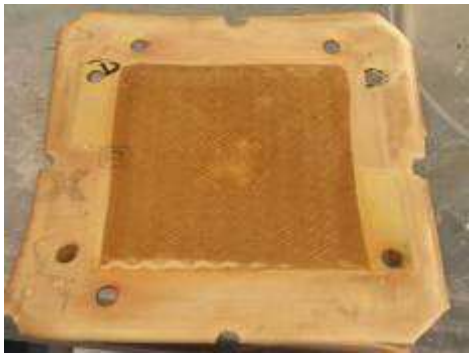
Set - up



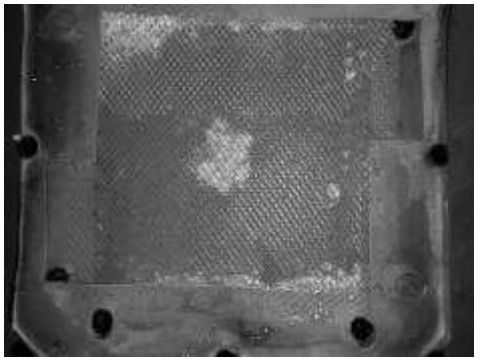
- 2 cell pairs
- Electric potential 4V
- 24 – 30 hours

Results

- Water quality ✗
- Concentrate quality ✗



Organic fouling



Scaling

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Reversed osmosis

Set - up

- Stirred cell
- Pressure 5 bar
- 15 hours

Results

- Water quality ✗
- Concentrate quality ✗

- Rejection of N and P too low at a recovery of 50% (Conc.factor:2)

Organic fouling

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Ion exchange

Set - up

- Synthetic material
  - Cation: NH_4-N
  - Anion: NO_3-N ; PO_4-P
- Natural material
  - Clinoptilolite
- Column experiment

Results

- Water quality ✔
- Concentrate quality ✘

- High chemical consumption
- Low exchange capacity

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Answer on research question..

Is it possible to recover nutrients from black water in the Netherlands ?

No, because:

- Black water is too diluted:

→ Concentration of nutrients difficult

- Discharge standards for wastewater are difficult to achieve

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Recommendations

- Focus on more concentrated streams
- Focus on **phosphorus** recovery only
- Separate treatment of black water or urine for:
  - Removal of hormones
  - Removal of medicine residues

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Final thoughts….

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Sanitation should always focus on:

Protection public health!

Type of system depends on:

- Local needs
  - Water
  - Nutrients
  - …….
- Local circumstances
  - Economic
  - Population density
  - Geographic situation
  - Social aspects / Culture
  -

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