Witteveen Bos

Some results from Dutch practice with constructed wetlands for effluent polishing

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I. Purpose of application

Why?

To improve the quality of the effluent to meet the surface water standards for nature and agriculture

How?

- **reduce the oxygen consuming components**
- **regenerate oxygen day-night rithm**
- **decrease N, P and bacterial loads**
- **turn “bacterial” Suspended Solids in i.e algae**

II. Examples and experiences

3. Large scale constructed wetlands

two examples:

- **WWTP Everstekoog (Texel)**
- **WWTP Land van Cuijk**

WWTP Everstekoog

photo: Waterboard Hollands Noorderkwartier

WWTP Everstekoog

- WWTP mainly recreational pollution (Isle of Texel)
- major goal: turn effluent into water with a natural oxygen concentration, limited oxygen demand and better hygienic condition
- constructed wetland built in 1994
- horizontal system: retention basin, reedzone and submerged water plants

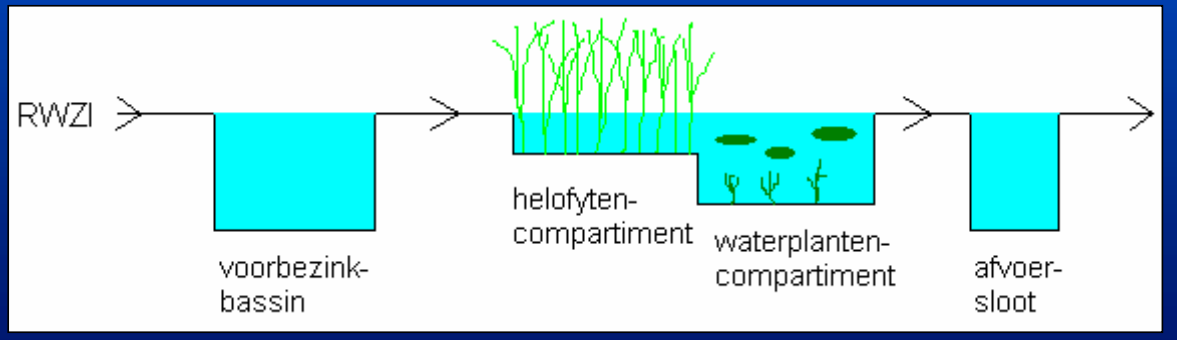
WWTP

retention basin

reed zone

submerged waterplants

discharge ditch



WWTP Everstekoog

some characteristics:

- **wet area = 1,3 ha**
- **volume = 7.150 m^3**
- **hydraulic load = 4.000 m^3/day**
- **residence time = approx. 2 days (paralel ditches from 7 hours to 10 days)**
- **4 years research / monitoring (1995 - 1999)**

WWTP Everstekoog

some results:

- **effective regeneration of oxygen day-night rithm (natural surface water)**
- **reduction P (8 - 11%, residence time 2-10 days)**
- **reduction N (26 - 67%, residence time 2–10 days)**
- **good desinfection (residence time 2- 3 days)**

WWTP Land van Cuijk

photo: Waterboard Aa en Maas

WWTP Land van Cuijk

- constructed wetland built in 2000
- major goal: turn effluent into natural water for use in agricultural and nature area and further reduction of P and N
- horizontal system: retention basin, reedzone and submerged water plants

reed zone

retention basins

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submerged water plants

out

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WWTP Land van Cuijk

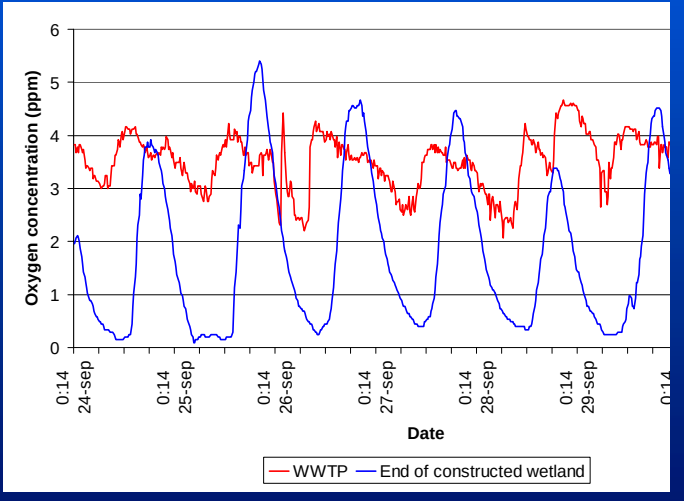
some characteristics:

- **wet area = 3,9 ha**
- **volume = 35.000 m^3**
- **hydraulic load = 8.500 m^3/day**
- **residence time = approx. 4 days**
- **3 years research, monitoring (2001 - 2003)**

WWTP Land van Cuijk

some results:

- effective regeneration of oxygen day-night rithm (natural surface water)



WWTP Land van Cuijk

some results:

- **reduction P (20-40%)**
- **reduction N (10-30%)**

through filtering of the reed roots / accumulation

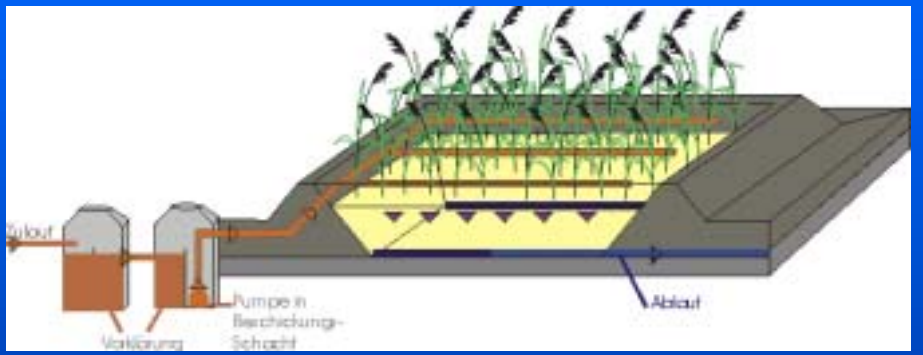
II. Examples and experiences

4. reed systems for small scale applications:

i.e. two agricultural farms:

- 3 mushroom farms
- poultry farm

Three mushroom farms



graphic: Waterboard De Aa and Waterboard Limburg

some characteristics:

- **reed area's = 80, 135 and 260 m²**
- **hydraulic loads = 40-55 mm/day (max. 140)**
- **vertical flow**

Three mushroom farms

some results:

- **reduction Suspended Solids = 89 - 99%**
- **reduction BZV = 88 - 97%, CZV = 43 - 83%**
- **reduction P = 0 - 57%, N = 0 - 69%**
- **effluent is non-toxic, influent was.**

Poultry farms

some characteristics:

- **reed area = 75 m^2 on 75 m^3 vertical sand bed**
- **reed area = 70 m^2 on 2 horizontal ditches**
- **hydraulic load = 45 mm/day**

some results:

- **reduction BZV = 75 - 99%, CZV = 21 - 95%**
- **reduction P = 41 - 99%, N = 9 - 91%**

III. Lessons learned

1. Large scale horizontal systems:

- good reduction of bacteria and Suspended Solids (res.time = min. 2 days)
- moderate P reduction (10 - 40%, max 60 kg/ha/y at res.time = 5 days)
- moderate N reduction (10 - 60%, max 1.250 kg/ha/y at res.time = 10 days)
- best reduction in summer, less in winter

III. Lessons learned

1. Large scale horizontal systems:

- combination of retention basin (sedimentation), reedzone (filtration) and a zone with submerged waterplants (oxygen regeneration) is optimal
- total residence time: min. 2 days, better 5 days
- good combination with nature and recreation is possible

III. Lessons learned

1. Large scale horizontal systems:

- need for a bypass? => constant hydraulic load for optimal treatment results
- remove duckweed at max. 80% coverage
- yearly mowing of reed to keep it in good condition (very limited reduction of nutrients with removal)

III. Lessons learned

1. Large scale horizontal systems:

- need for a maintenance plan (mowing of the reed, removal of duckweed, boundaries of hydraulic load, removal of sludge)

- constructed wetlands = natural system => seasonal changes, not a constant output quality

III. Lessons learned

2. Small scale vertical systems:

- good reduction of bateria and Suspended Solids (due to vertical filtering)
- moderate fosfor reduction (40-60%)
- moderate nitrogen reduction (10-70%)
- reed plants mostly effective for nitrogen reduction
- hydraulic load: 30-50 mm/d

Constructed wetlands for effluent polishing?

- moderate treatment efficiency, large landuse
- attractive combination with nature and recreation