HORIZONTAL FLOW WETLANDS

AUTHORS

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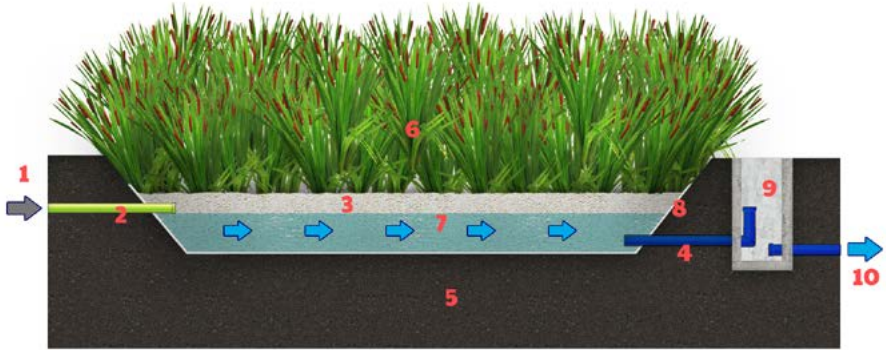

1 - Inlet
2 - Feeding system
3 - Porous media
4 - Drainage system
5 - Original soil
6 - Plants
7 - Saturated water level
8 - Waterproof liner
9 - Regulation manhole
10 - Outlet

Description

Horizontal flow (HF) wetlands consist of gravel beds planted with emergent wetland vegetation promoting horizontal flow through the filter media. The media are fully saturated with water which can create an anoxic environment, maintaining a subsurface flow. Particles are retained by straining or filtration; solubles are partly absorbed abiotically or biotically. Further transformation and degradation of the retained substances happen owing to chemical and mainly biological processes in the filter media. The root zone provides a highly active environment for biofilm attachment, oxygen exchange, and sustains the hydraulic flow.

Advantages

- No specific hazard with mosquito breeding
- Robust; can handle hydraulic fluctuations
- Low energy usage possible (feeding by gravity)
- Operation in separate and combined sewer systems possible
- Reuse potential at building scale (toilet flushing, irrigation)

Disadvantages

- No disadvantages additional to treatment performance and requirements

Co-benefits

High	Water reuse			
Medium	Biodiversity (fauna)	Biomass production		
Low	Biodiversity (flora)	Carbon sequestration	Aesthetic value	Recreation

Compatibilities with Other NBSs

Mainly combined with vertical flow (VF) wetlands to improve nitrogen removal, but also with free water surface (FWS) wetlands and ponds, depending on treatment goal.

Case Studies

In publication

- A horizontal subsurface flow system for Gorgona Penitentiary, Italy
- Horizontal treatment wetland in Karbinci, Republic of North Macedonia
- Horizontal-flow wetlands in Chelmná, Czech Republic

Operation and Maintenance

Regular

- Control efficiency of primary treatment and sludge removal

Extraordinary

- First growing season: weed harvesting
- Filter material at the inlet zone needs replacement every after at least every 10 years

Troubleshooting

- Odor: anaerobic conditions due to biological clogging

Literature

Dotro, G., Langergraber, G., Molle, P., Nivala, J., Puigagut, J., Stein, O. R., von Sperling, M. (2017). Treatment Wetlands. Biological Wastewater Treatment Series, Volume 7, IWA Publishing, London, UK, 172 pp.

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NBS Technical Details

Type of influent

- Primary treated wastewater
- Secondary treated wastewater
- Greywater

Treatment efficiency

• COD	60–80%
• BOD_5	~65%
• TN	30–50%
• NH_4-N	20–40%
• TP (long term)	10–50%
• TSS	>75%

Requirements

- Net area requirement: 3–10 m^2 per capita
- Electricity needs: can be operated by gravity flow, otherwise energy for pumps is required

Design criteria

- Fine gravel (5–15mm)

Secondary treatment
- HLR: up to 0.02–0.05 $m^3/m^2/day$
- OLR: up to 20 g $COD/m^2/day$
- TSS load: up to 10 g $TSS/m^2/d$

Tertiary treatment
- HLR: up to 0.4 $m^3/m^2/day$

Commonly implemented configurations

- VF – HF
- HF – VF
- HF – FWS
- FWS – HF

Climatic conditions

- Ideal for warm climates, but also suitable for temperate and cold climates
- Tested as suitable for tropical climates