Woodchip Bioreactor

Nitrate removal by biological denitrification

Price: € 20,000 – 30,000 + € 350/y
Flow: 3-20 m³/d
PO4 removal
NO3 removal
Plant Protection Product removal
OM removal

Benefits

+ Edge-of-field and low-tech measure
+ Low maintenance
+ Effective nitrate remediation
+ Moderate temperature fluctuations favor microbial activity even in winter

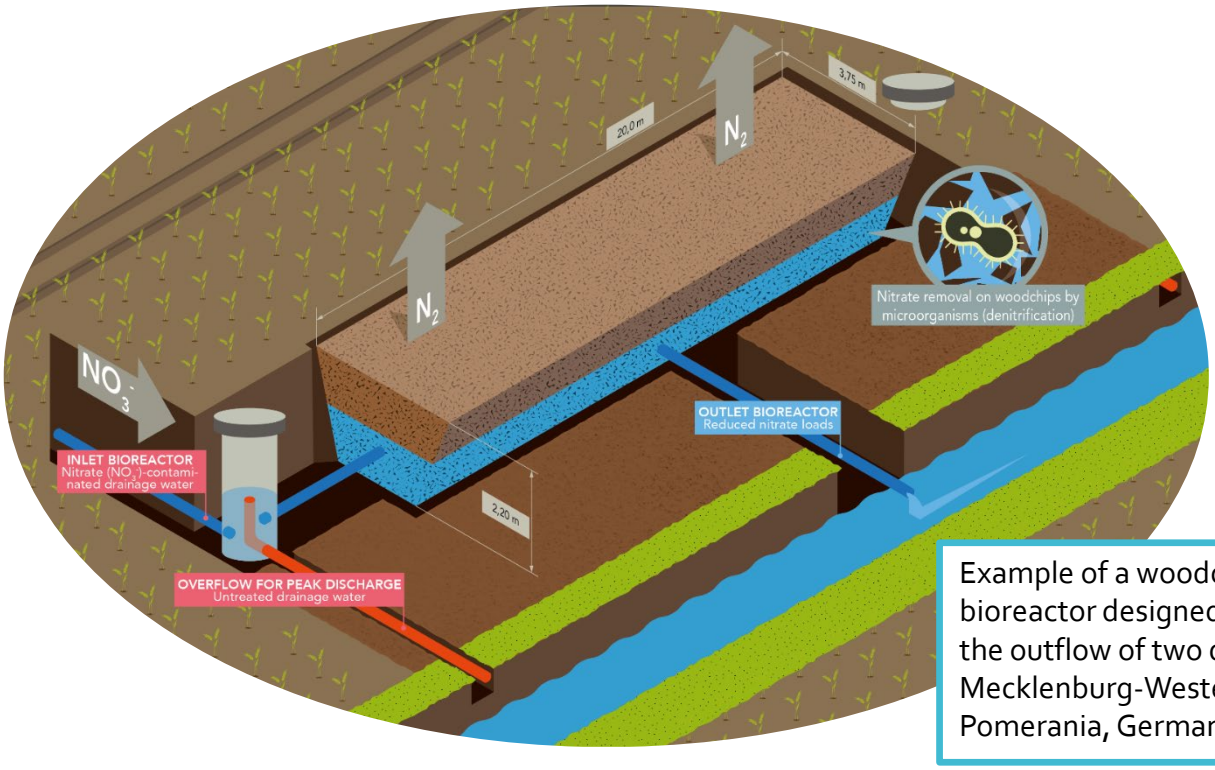
Limitations

- Construction work for excavation and diversion of drainage pipes necessary
- Substance release (e.g. TOC) from the woodchips, in particular in the beginning of drainage season

Working principle and installation

Mechanism

Nitrate-enriched drainage water is diverted through a bioreactor filled with woodchips, which provides anoxic and carbon-enriched conditions. Microorganisms in the bioreactor break down nitrate to nitrogen gas, which is released in the atmosphere. As nitrate represents the major form of nitrogen in drainage water, nitrogen loads to the aquatic ecosystems are significantly reduced.



Example of a woodchip bioreactor designed to treat the outflow of two drains in Mecklenburg-Western Pomerania, Germany

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Conditions for installation and application

Technological

- The denitrifying capacity of the woodchip bioreactor is determined by the hydraulic and chemical conditions in the reactor.
- The higher the hydraulic residence time (i.e. the larger the volume of the reactor or the lower the flow rate), the higher the nitrate removal.
  - → A hydraulic residence time of ≥ 12 hours is recommended.
  - → Avoidance of short-circuiting of the water is important.
- Hydraulic conditions for more than one connected drainage system are difficult to predict; thus the technology is particularly suitable for individual drainage systems with high runoff and high nitrate concentrations.

Practical

- Suitable for tile-drained areas with open receiving waters
- Hardly any maintenance needed and woodchips only need to be replaced every 10 to 20 years.

In the construction phase the arable land is most affected.

A foil can prevent a connection to ground water.

Woodchips turned out to be the most long-lasting filling substrate.

A cover with a geotextile helps to prevent the spreading of woodchips and to insulate the reactor to a certain degree.

Economical

- Costs depend on size of the bioreactor; the figures given here refer to a reactor with a volume of 100 m³ and collect drainage water of 1 to 5 ha.
- CAPEX cost: € 20 000 – 30 0000
- OPEX cost (replacing woodchips every 10 years): € 350/y

Important

- The hydraulic performance of the bioreactor plays a key role for the nitrate removal.

Legal

- The EU standard for discharge in surface water is 50 mg NO_3/L.