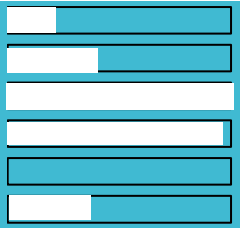
Zero-valent iron and zeolite filter

Phosphate and nitrate removal and nitrogen recycling



Price: € 3800
Flow: 1,5 m³/d
PO_4 removal
NO_3 removal
Plant Protection Product removal
OM removal

Benefits

- Nitrate can be completely removed, even at low concentrations and low temp.
- Ammonium can be recovered enabling nitrogen to be recycled
- Phosphate is fully removed
- Iron(II) formed during ZVI corrosion contributes to futher increase the reactivity of the system

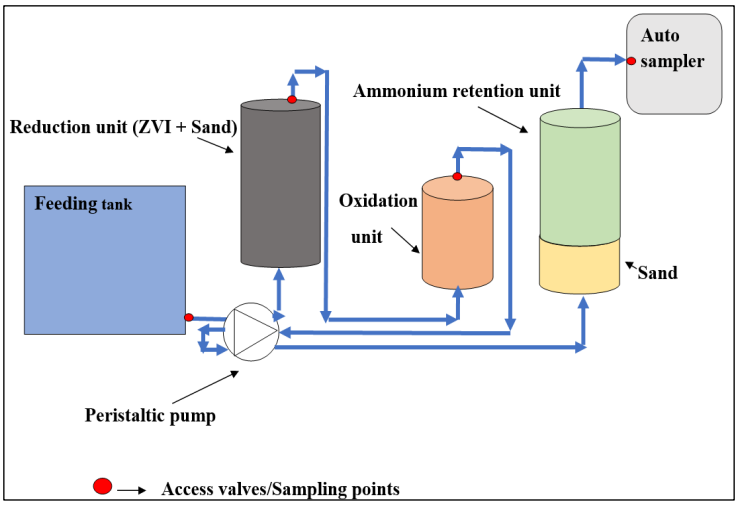
Limitations

- Nitrate removal efficiency decreased due to passivating ZVI corrosion layers
- Oxygen in drainage water will also consume ZVI
- Reduction of water consumes ZVI and generates H_2
- Maintenance: requires aeration (pump)

Working principle and installation

How is ZVI working with nitrate and phosphate?

- **Nitrate removal**: The ZVI reduces nitrate to gaseous nitrogen (N_2) and/or ammonium. Ammonium is capturee in another medium to enable recycling of nitrogen.
- **Phosphate removal**: When nitrate is reduced ZVI corrodes and "rust" is produced. Rust (iron oxide) is a super filter for phosphate



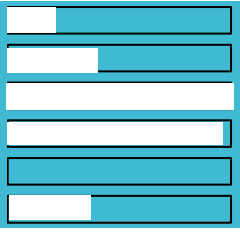
Schematic diagram of the filter system and field filter installation in Taastrup, Denmark

Contact details: Adrian Florea (aff@plen.ku.dk)
Hans Christian (haha@plen.ku.dk)

Interreg North Sea Region NuReDrain European Regional Development Fund
EUROPEAN UNION

Zero-valent iron and zeolite filter

Nitrate removal by biological denitrfication



Price: € 3800
Flow: 1,5 m³/d
PO_4 removal
NO_3 removal
Plant Protection Product removal
OM removal

Conditions for installation and application

Technological

- High NO_3^- removal efficiency regardless the initial nitrate concentration (3 to 8 mg/L nitrate).
- NO_3^- is converted to NH_4^+.
- Almost 100% NH_4^+ retained in zeolite over the entire running period.
- 100% of iron(II) removed through oxidation in the aeration section.
- Inlet phosphate concentration: 0.5 mg/L
- Phosphate sorbed to the "rust" formed and thus is fully retained.
- Green rust (GR), an unstable corrosion product that forms in the ZVI unit, facilitates reduction of nitrate to ammonium and reduces the mass of ZVI needed. GR may also contribute to phosphate sorption.

Practical

- The unit is advantageous for production facilities such as greenhouses .
- Flow rate up o 1,5 m³/day.
- Maintenance: requires aeration (pump).

Unused material

Used material

ZVI fast surface passivation could be a limittion factor for the filter system

Economical

Estimating the establishment, maintenance and materials costs of a filter system capable to filter the amount of drainage water that flows in 1 ha/year (approx. 2000 m³), having an average nitrate-N concentration of 10 mg/L, results in a total cost up to 35€/kg N reduced, over a projection/depreciation period of 10 years.

ZVI filter technology is also a perfect filter for trapping phosphorus. This could add to the cost-efficiency of the ZVI filter system.

Important

- The limiting factor of the ZVI filter system is related to formation of passivation layers and reduction in permeability.

Legal

- After efficient N and P removal, the drainage water have lower N and P concentration than EU minimum accepted standards values.