SupremeTech

Sustainable Phosphorus Remediation and Recycling Technologies in the Landscape

C. Kjaergaard, G. Heckrath, C.C. Hoffmann, B.V. Iversen (Aarhus University)
H.C.B. Hansen, B. Strobel, P. Holm, S. Marcussen (University of Copenhagen)

Background

• The goals of the European Water Framework Directive (WFD) for the aquatic environment require a substatial reduction of diffuse phosphorus (P) loads from farmland in Denmark.
• Mitigation agricultural P losses is a challenge, as critical losses of ~0.5 kg P ha^{-1} are only a small fraction of actual soil P content.
• Tile drains and ditches connect fields to receiving waters and act as subsurface highways for both soluble and particulate P and nitrogen.
• P-load from drainage ~33% (400 t), DK

Drainage filter solutions are targeted and potentially cost-efficient mitigation options to reduce nutrient losses in drainage water.

Objective of SUPREME-TECH

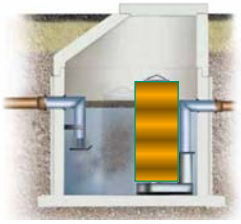
- Explore industrial high-affinity P filter substrates
- Explore innovative filter technologies targeting drainage losses
- Increase the filter denitrification capacity
- Analyse the recycling of P-saturated filter substrates to soil
- Assess contamination risk and filter function regarding pollutants
- Model filter systems to optimize design and filter function
- Analyse the cost-effectiveness of filter technologies in the landscape

Drainage filter technologies

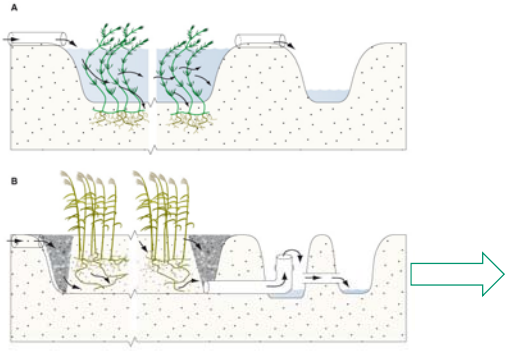
1. Drainage well filters

Sedimentation well

Phosphorus filter



2. Constructed wetlands

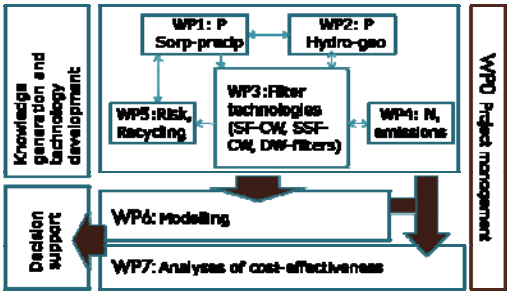


Project methodology

Supreme-Tech provides the scientific basis for developing cost-efficient filter technologies for P-retention and N-removal in agricultural drainage water by:

I. Identifying the best performing filter substrates for nutrient retention under highly variable flow regimes and nutrient loads
II. Explore technical solutions for field scale implementations of the filter technologies

The project is structured in seven closely linked workpackages:

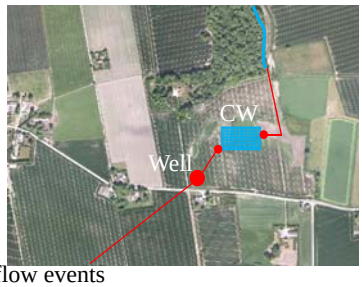


Filter substrates: LECA (Filtralite/Filtralite-P), lime/limestone, shells, CFH, crushed concrete, Damolin, iron sludge, others

Implementation of drainage filter technologies

Case-study area 1:

• Drainage catchment: 140 ha, Constructed wetland: 1 ha (0.7%)
• Estimated hydraulic load ~4.000.000 m^3/year
• Peak load: 504-1008 m^3/hour
• Sediment transport: ~10-40 t/y
• P-load: 70 kg/year
• N-load: 7350 kg N /year
• HRT_CW: 8-16 hours



Scientific challenges

• Variable hydraulic load / peak flow events
• Variable nutrient load – nutrient mass correlates with hydrograph
• Handling sediment load
• Reducing P concentrations to biological threshold (<0.05 mg/L)
• Enhancing denitrification – high load during winter

SUPREME-TECH

Danish Strategic Research Project, 2010-2015 (www.supremetech.dk)

Project partners

Aarhus University, University of Copenhagen, BOKU-Vienna, Alterra, Wageningen, Linköping University, Oklahoma State University, ART-Zurich, Bioforsk, DAAS, Orbicon

Supporting partners

Maxit, KemiraWater, Damolin, Faxe Kalk, Aalborg Portland, DanShells, Yara, TRE-FOR, KWHpipe, IBF, Byggros, Vejle, LMØ

Aarhus University
Faculty of Agricultural Sciences

Charlotte Kjaergaard (*c.kjaergaard@agrsci.dk*)
Department of Agroecology and Environment