STØTTET AF

Promilleafgiftsfonden for landbrug

Phosphorus retention by compact filter systems treating agricultural drainage discharge

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Phosphorus (P) losses in subsurface runoff from artificially drained agricultural land can locally contribute to surface water eutrophication. These losses are a function of hydrological processes and long-term P accumulation in soils due fertilization practices, which is why agronomic mitigation options tend to be ineffective. However, as subsurface drainage systems concentrate water flow spatially, drainage filter technologies represent a potentially cost-effective end-of-pipe mitigation practice for P losses. The aim of this study was to test such a compact, full-scale P filter system under field conditions.

The system is located in the Fensholt catchment, Denmark, and has two main compartments: a sediment filter for retaining particulate P and a porous reactive filter consisting of iron-coated sand (ICS) for dissolved P. A pump feeds drainage water from an adjacent ditch into the filter system at flow rates of typically 1-1.5 l/s. Hydraulic loading of the system and drainage water composition were monitored continuously on a daily basis to evaluate system performance. Measurements of total P (TP), total dissolved P (TDP) and turbidity (NTU) were done. Suspended sediment was estimated in all water samples from turbidity measurements.

During the runoff season October 2020 to June 2021 the hydraulic load to the filter system was 18000 m^3 corresponding to an average hydraulic retention time (HRT) for the sediment filter of 92 minutes. Total P concentrations in drainage water at the system inlet varied substantially between 0.03 and 2.47 mg P/l, while TDP varied between 0.04 and 0.84 mg P/l. On average TDP represented 60% of TP. The sediment filter retained 71% and 64% of the estimated sediment and PP load, respectively. However, occasionally TDP was remobilized from the sediment filter in late spring due to chemical and biological processes. The TDP retention in the ICS filter averaged 51% for the drainage season. On a monthly basis TP retention in the filter system varied between -33% and 88% averaging 61% in 2020/21. This compares positively with other end-of-pipe solutions such as constructed wetlands which tend to have lower TP retention efficiencies under Danish conditions. However, the effective storage capacity of the compact P filter system has to be better understood including the mechanisms of potential P release processes and the required frequency of filter cleaning.