REACTIVE BED FILTERS FOR REMOVAL OF P IN AGRICULTURAL RUNOFF – BINDING EFFICIENCY AT LOW CONCENTRATIONS INVESTIGATED IN LABORATORY AND FIELD EXPERIMENTS

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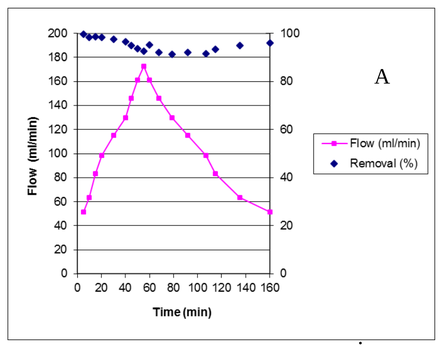
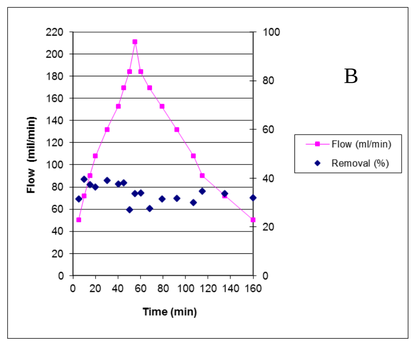
Objectives

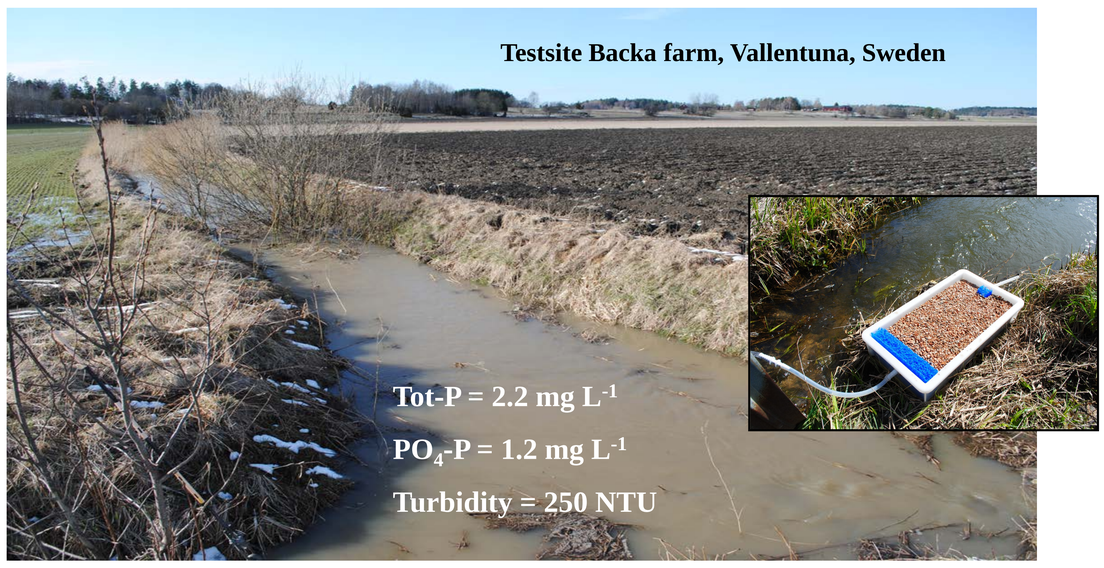
We performed bench-scale laboratory and pilot-scale field experiments to evaluate the long-term removal efficiency of two filter media under dynamic conditions.

The engineered materials are used in constructions adapted for tile drains and ditches.





Dual filter box experiment – Polonite and Sorbulite, total weight/volume = 3 kg/6 L. Test showing the effect of increased flow through the filter; Fig. A, virgin filter media, Fig. B, exhausted filter media.



Filter media

Applied filter media are developed at KTH and aimed for sustainable recycling of P to agriculture.

- Polonite® : A porous calcium-silicate material prepared from natural bedrock opoka. Particle size 2-6 mm.
- Sorbulite® : A porous hydrated calcium-silicate prepared from autoclaved aerated concrete. Particle size 2-4, 5-30 mm.

Methods

The laboratory experiment with a dual filter used tap water and KH_2PO_4 to a final influent PO_4-P concentration of 0.5 mg L^{-1} . A total volume of 14 000 L was pumped with an average flow of 50 ml min^{-1} , i.e. hydraulic retention time (HRT) of 60 min. Kaolin was added to tap water to receive a turbidity of about 150 NTU and used in a second trial to simulate presence of clay. Here 7000 L was pumped.

The horizontal flow-through systems at testsites Backa and Nybble, HRT of 20 and 40 minutes respectively. The HRT of the up-flow column filters at Miedzna, Poland, was 150 minutes. The experiments at Nybble and Miedzna are still under operation.

Results

The field experiments demonstrated good removal efficiencies at low PO_4-P concentrations from 25 to 600 µg L^{-1}. The PO_4-P removal of the ditch water discharged to the filters was as high as 60-96%. However the total P removal efficiency ranged between 15 to 37%.

The laboratory experiments clearly showed the negative influence of clay on the sorption capacity of the studied filter media. The filter life was almost halved when the water with a turbidity of 150 NTU was discharged to the filter. Filter behavior was investigated during peak flow events. The filter media had surprisingly high capacity to withstand the increasing flow and remain high in phosphorus sorption capacity. The rejuvenation ability by the filters during periods of no water flow was clearly demonstrated.

Conclusions

It is concluded that Polonite and Sorbulite are promising filter media for efficient removal of P from agricultural runoff and farm wastewater although further development has to be undertaken on the technical filter design and ditch water pre-treatment measures

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KTH Filtering for life

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