Phosphate sorption on different filter materials

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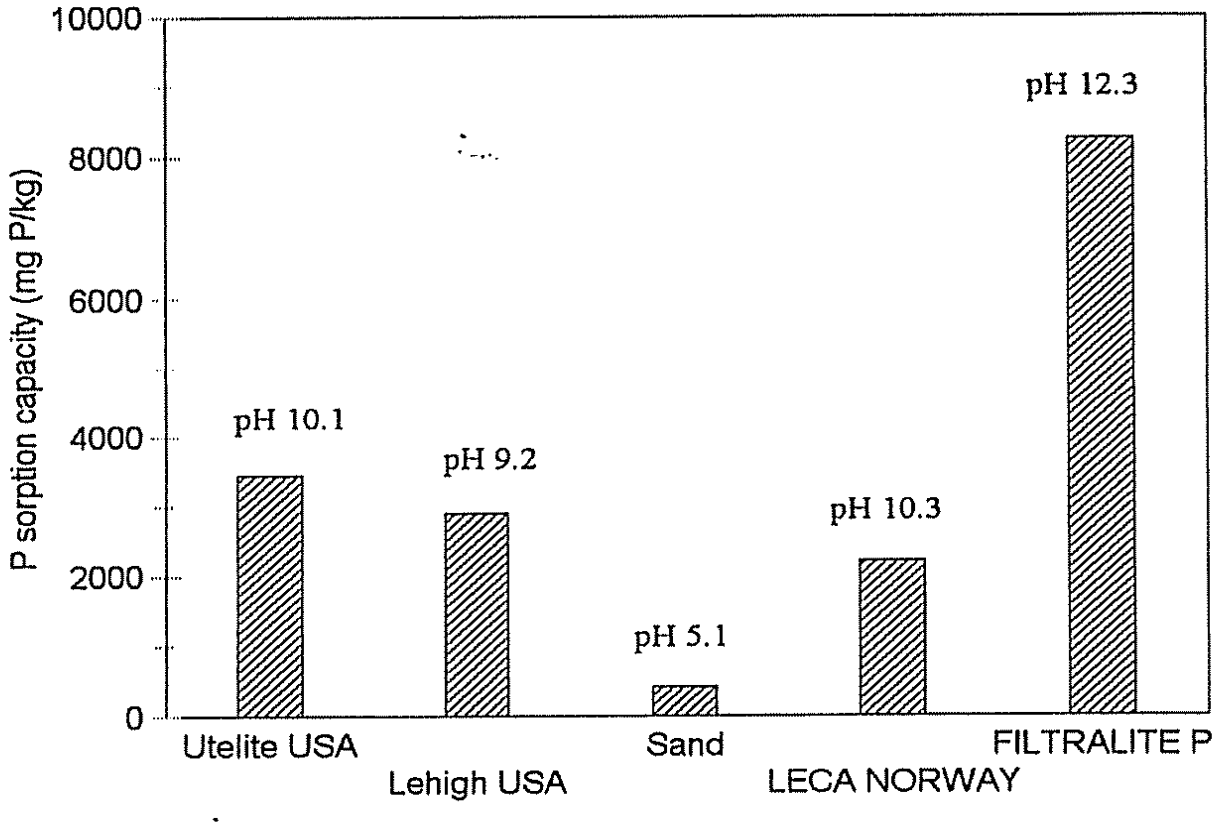
The history of the use of lightweight aggregates (LECA) as filter in Norway

In early 1990's testing of wastewater treatment with LECA was started.

LECA is porous, i.e. large surface for adsorption of pollutants.

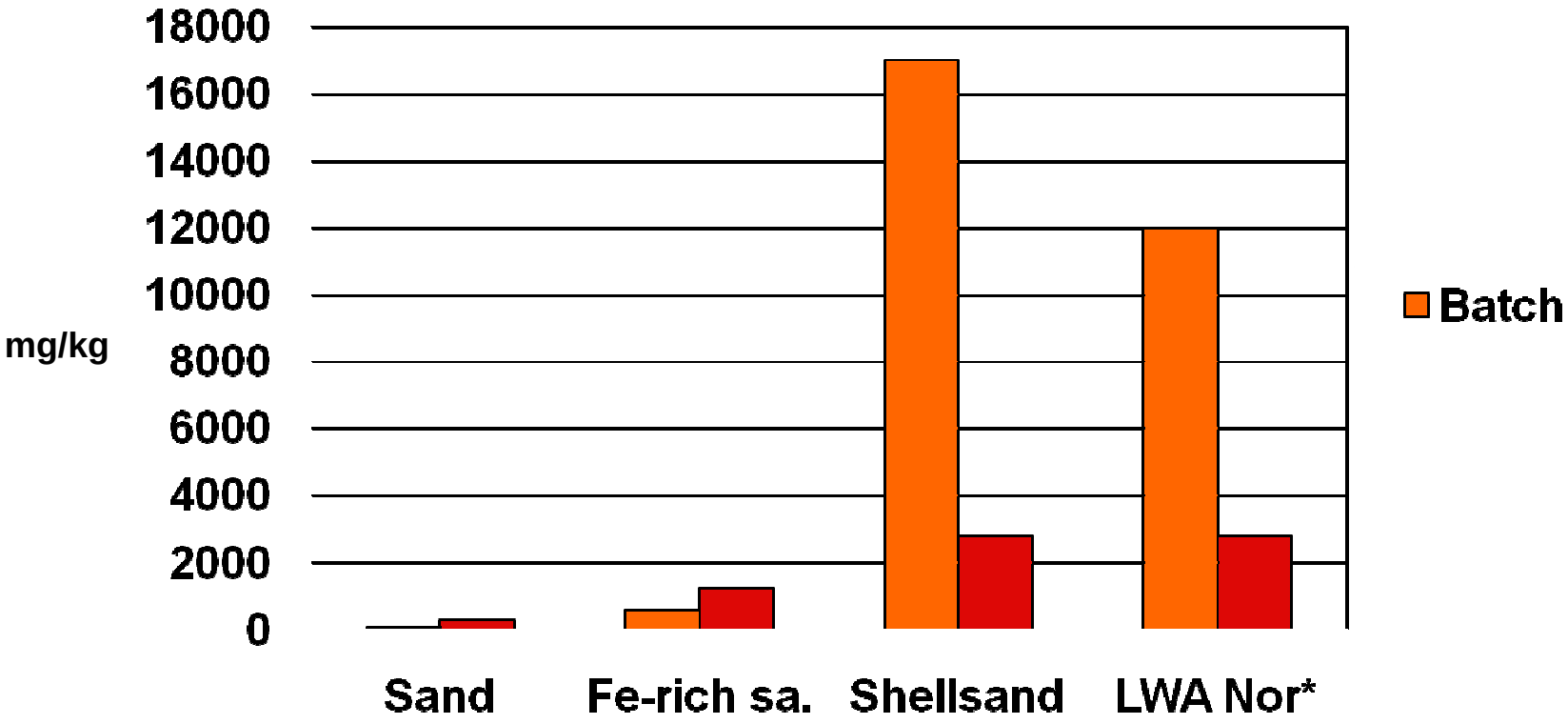
In middle of 1990's Filtralite P® with higher adsorption capacity was developed (LECA with lime included)

Filtralite as a phosphorus sorbent



From: Jenssen and Krogstad 2002

P-sorption in batch tests and fullscale natural systems for wastewater treatment



* FiltraliteP

Shellsand as filter

Adsorption capacity of different types of shellsand has been tested:

Some have higher and some lower adsorption capacity than Filtralite P®

Filters for runoff from agriculture

Waste water treatment:

- P in waste water 5-15 mg P/l
- Target: < 1 mg P/l

Runoff from agriculture

- Usually < 1 mg P/l, and high portion of particle bound P
- Target: ~ 50 µg P/l
- Adsorption capacity and ability to give low P concentration in outlet

Challenges

- High amount of water must pass the filter
- Soil particles may clog the filter

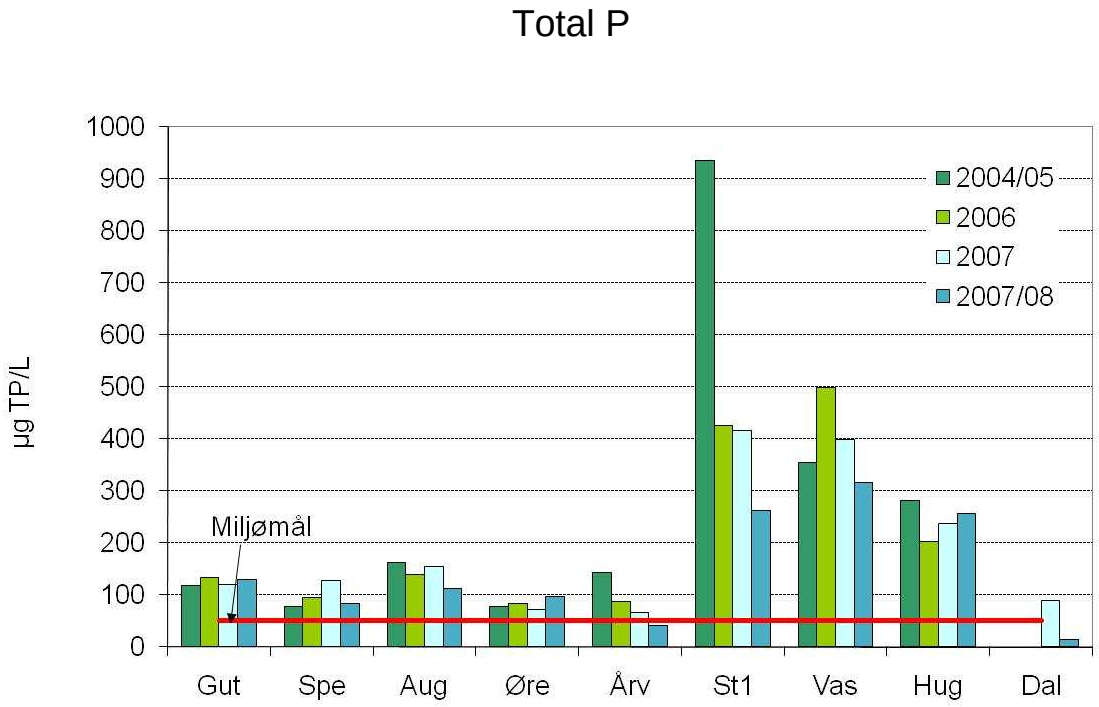
Small constructed wetlands

Small constructed wetlands without filter:

25-40 % of TP is retained

Need for improved P retention in catchments with high P loads and sensitive lakes

Phosphorus in streams to lake Vansjø



Areas with large production of vegetables and potatoes have high P concentration in the streams

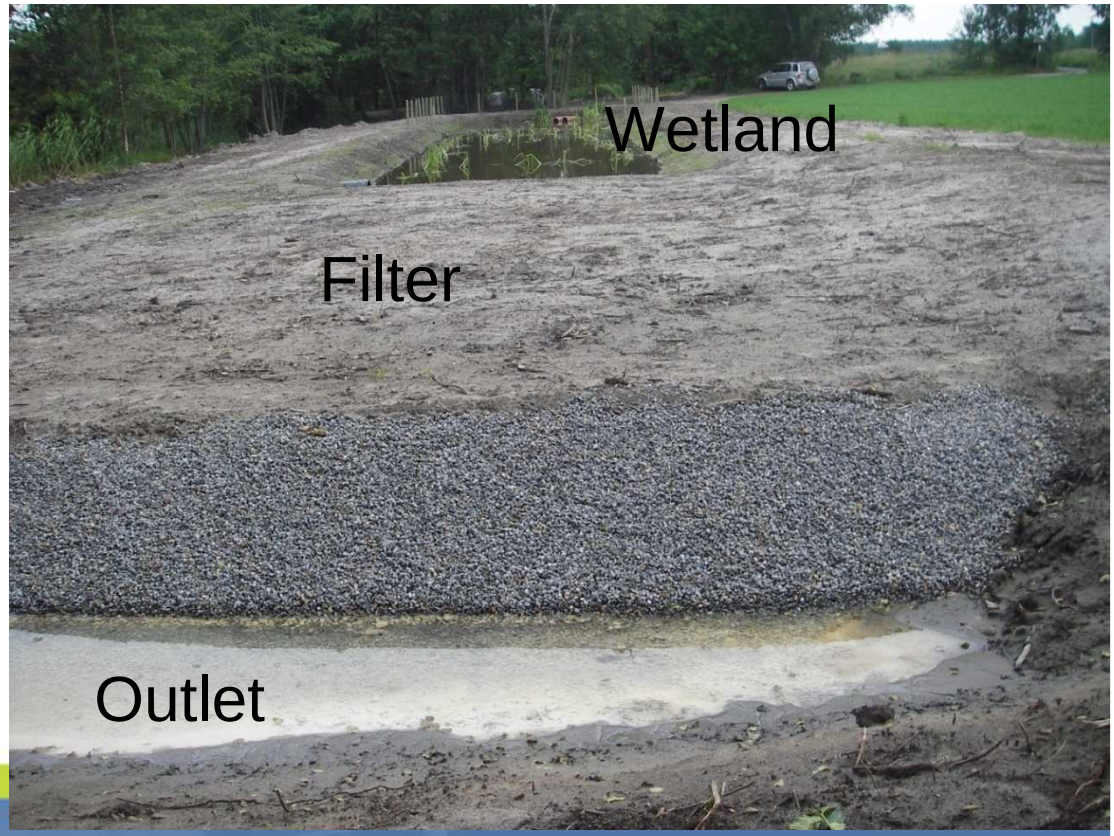
Marianne Bechmann

Annual water flow weighted concentrations of total P

Filtralite P® filter at the end of constructed wetlands

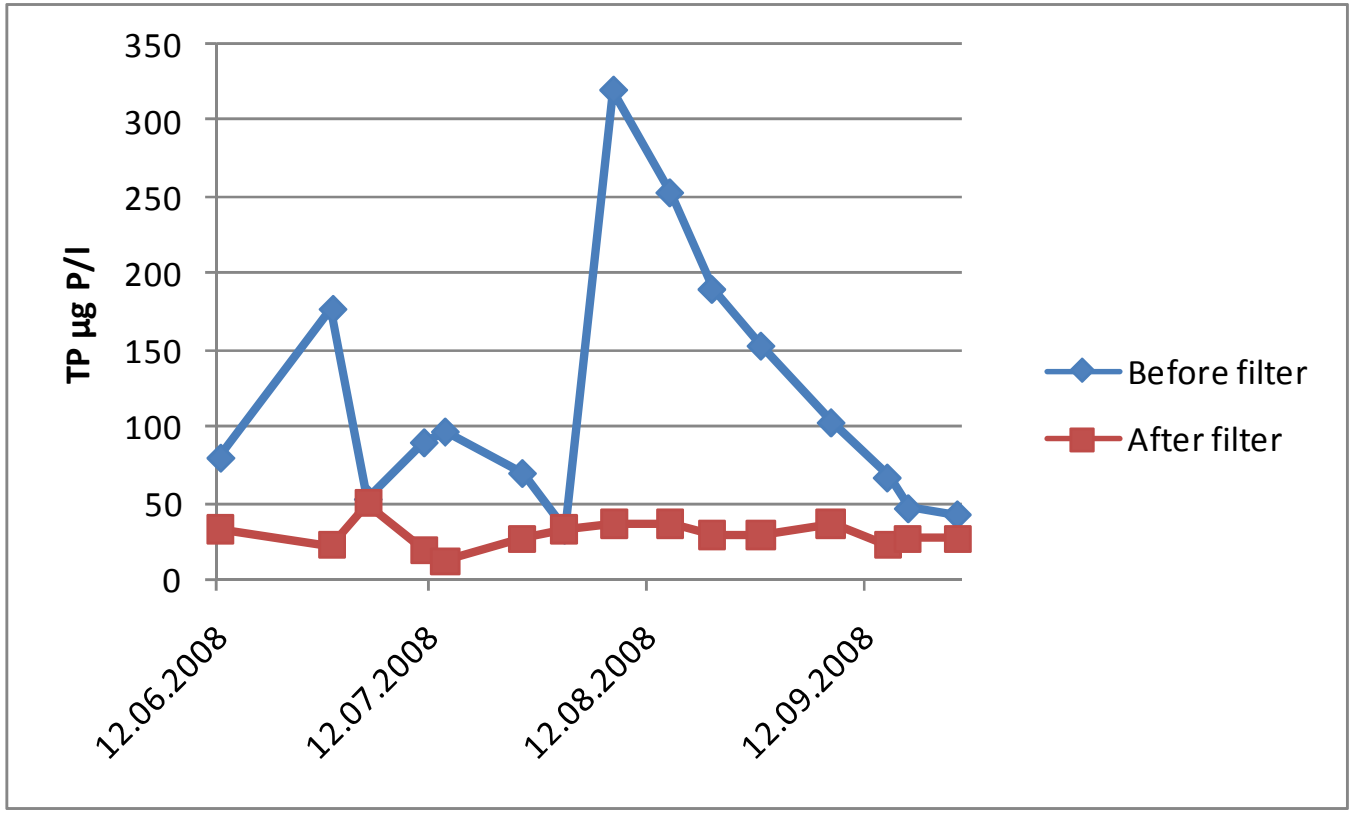
- 35 m^3 Filtralite P (0,5-4 mm)
- Cost of Filtralite P:

  65-90 € per m^3
- Designed for low-flow – flood overflow pipe
- Approx. 0,2 l/s
- 20 hours retention time



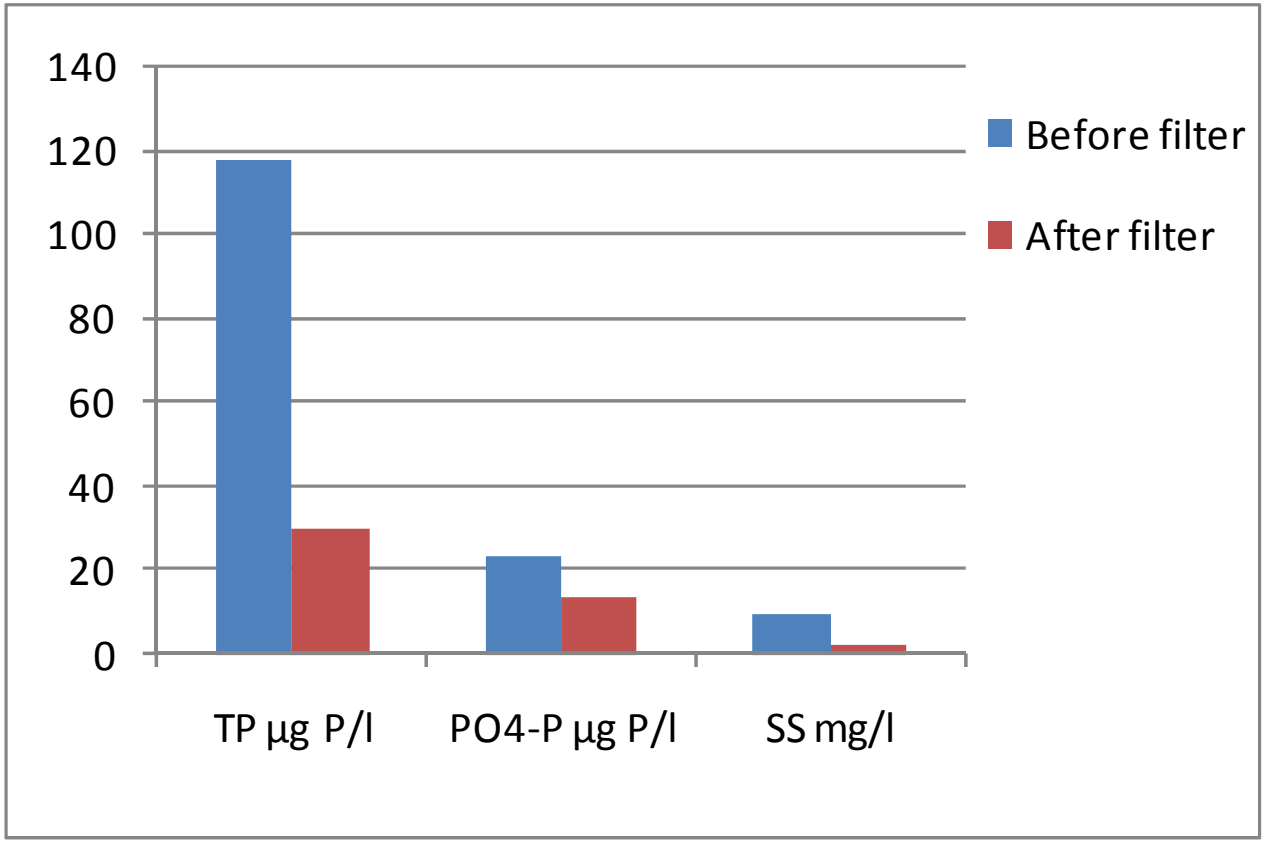
Filtralite P® filter at the end of constructed wetlands

P retention in the filter - one year after establishment



Data from E. Hougsrud 2009

Retention of P fractions



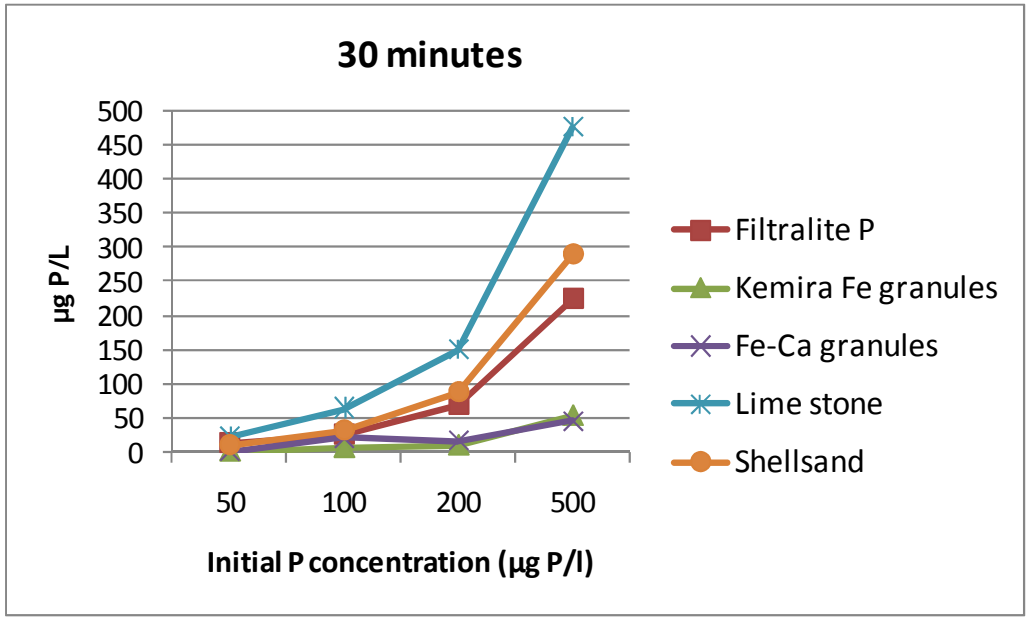
Required characteristics for filters for agricultural runoff

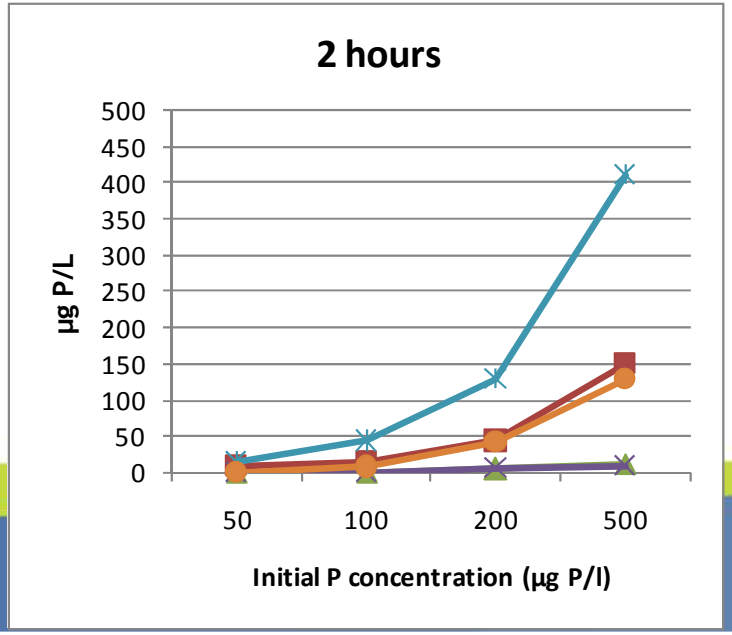
- High hydraulic conductivity

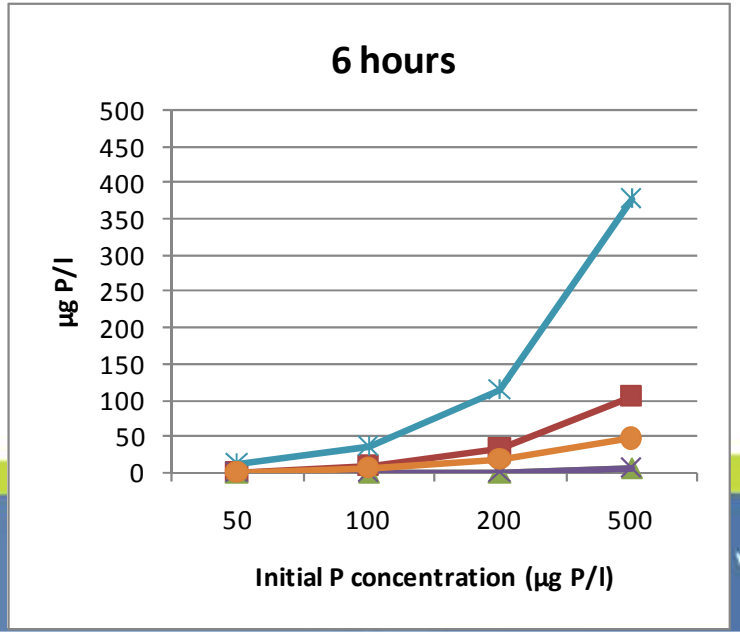
small contact surface

- High adsorption capacity and short reaction time
- Flocculation of clay particles

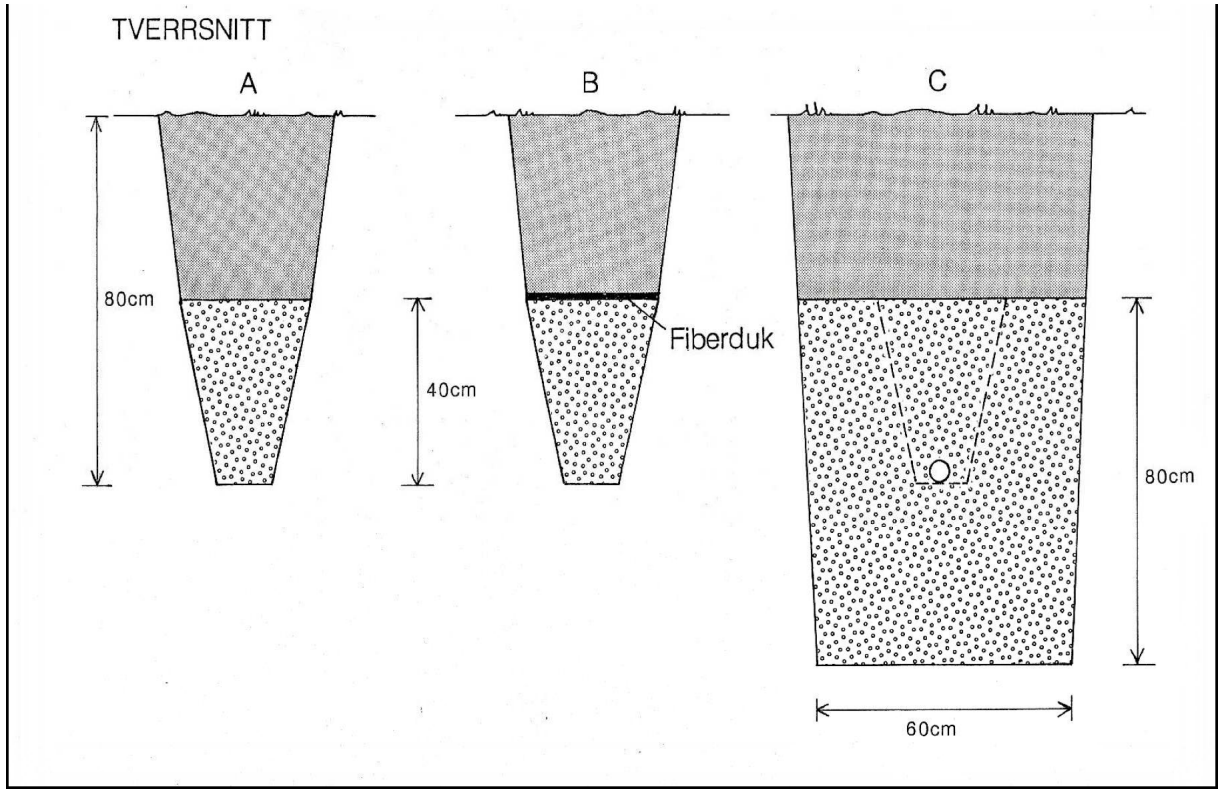
P sorption, batch experiment





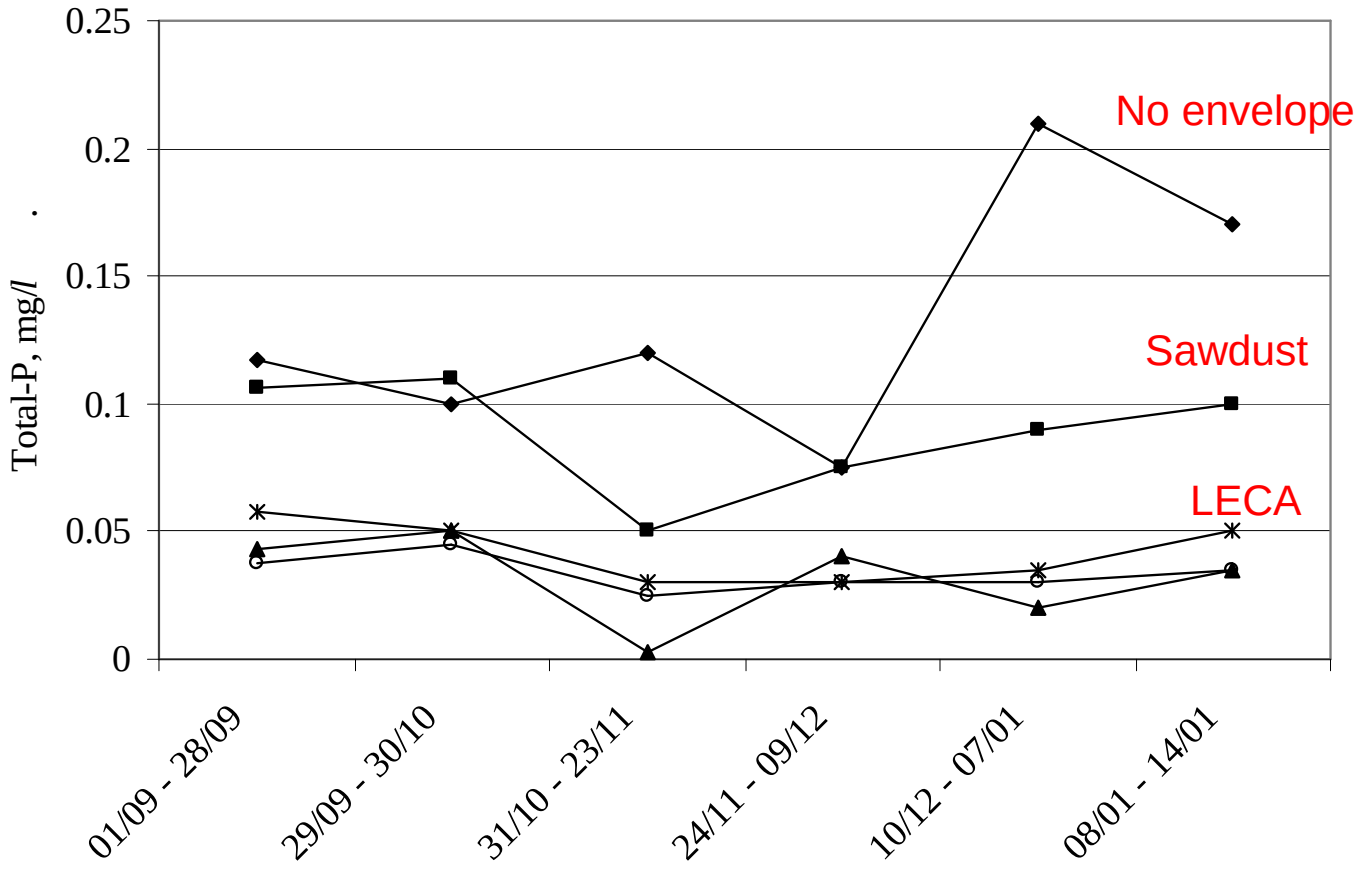


LECA in agricultural drainage systems: Trench design



From: Bjerkholt et al. 2004

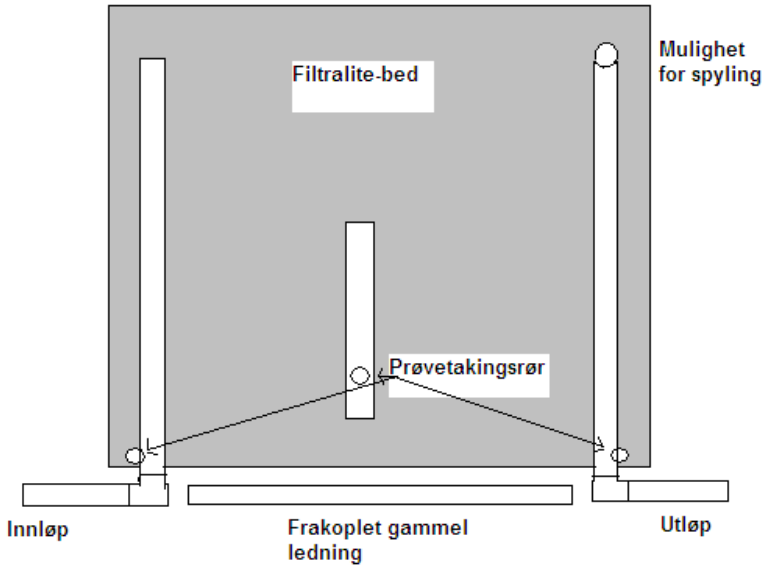
LECA in agricultural drainage systems: Phosphorus in drainage water

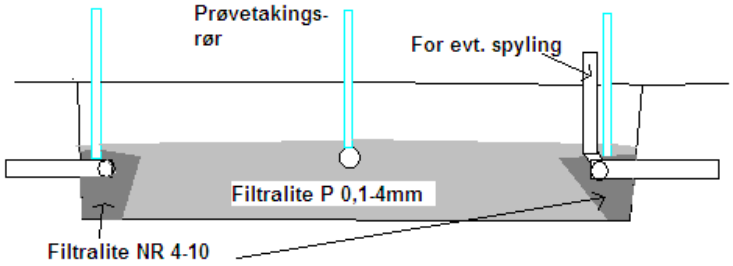


From: Bjerkholt et al. 2004

Drainage pipe filter with Filtralite P

Skisse av pilotanlegg for rensing av drensvann fra landbruket med Leca Filtralite P





Atle Hauge, Bioforsk

Drainage pipe filter with Filtralite P

Results – drainage pipe filter

- 7 m^3 for 0,3 ha
- 2 hours retention time
- Spot sampling during 6 rain episodes
- Never first-flush
- 57 % reduction of total P, (average from 785 µg/l at the inlet to 332 µg/l at the outlet) with a variation from 46-74 % (1010-530 at the inlet to 480-258 µg/l at the outlet).