Interreg
North Sea Region
NuReDrain
European Regional Development Fund

EUROPEAN UNION

FILTER SYSTEMS FOR A SUSTAINABLE AGRICULTURE

FIELD CASE DESCRIPTION

Phosphorus filter box
for drainage water at Anzegem

inagro
ONDERZOEK & ADVIES IN LAND- & TUINBOUW

GHENT UNIVERSITY

Location

Country: Belgium
City: Anzegem
Coordinates: 50.84572, 3.49098

Figure 1 Driving route to site Anzegem

Problem description

P concentrations in the drainage water are too high (on average 0.47 mg TP/l and 0.37 mg DRP/l) to meet the EU standard in the receiving surface water. The basic concept to reduce these P losses is installing a filter box containing a P sorbing material (PSM) at the end of the drainage tubes. This forces the water through the filter material and allows the removal of P from it before entering the ditch (Figure 2).

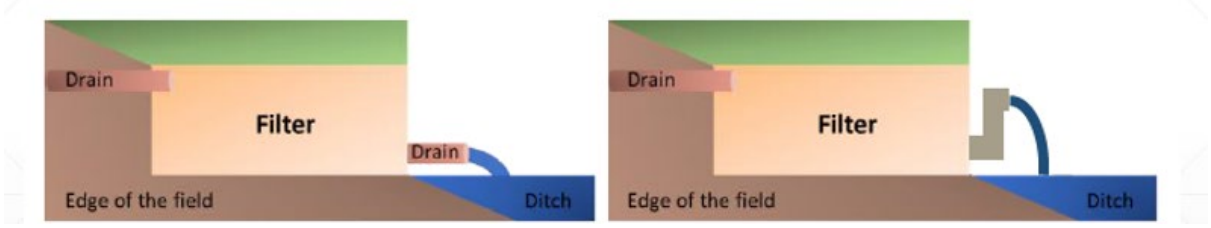

Figure 2. Schematic overview of the installation of P filters in the field

Filter description

Season of 2017-2018

One cylindric custom-made filter ton was installed in December 2017 (Figure 3) filled with iron coated sand (ICS). Filter materials were filled a layer of no more than 20 cm (approximately 32 l). A layer of wire mesh of 0.75 mm was placed on the bottom to stop big particles. Water enters the filter directly from the top of the ton and the height difference between the outlet tube and the top was 5 cm.

Season of 2018-2019

The same filter ton was used but the ICS was renewed as there was a lot of sediment/soil/algae in the filter. The filter box was cleaned and refilled with fresh sieved ICS.

Season of 2019-2020

The new prototype filter (cylindric shape, Figure 4) was installed in December 2019 with sieved filter materials (ICS>2mm). A layer of 24 cm with approximately 35 l of ICS was filled in the filters.

Season of 2020-2021

The prototype from season 2019-2020 was kept until March 2021 to check the long-term performance of the filter. From January 2021, overflow was observed and the filter was gradually clogged by sediment as shown in Figure 4, not only at the bottom but also at the top of the filter.

Photo filter

Figure 3 the custom-made filter ton in the season of 2017-2018 and 2018-2019

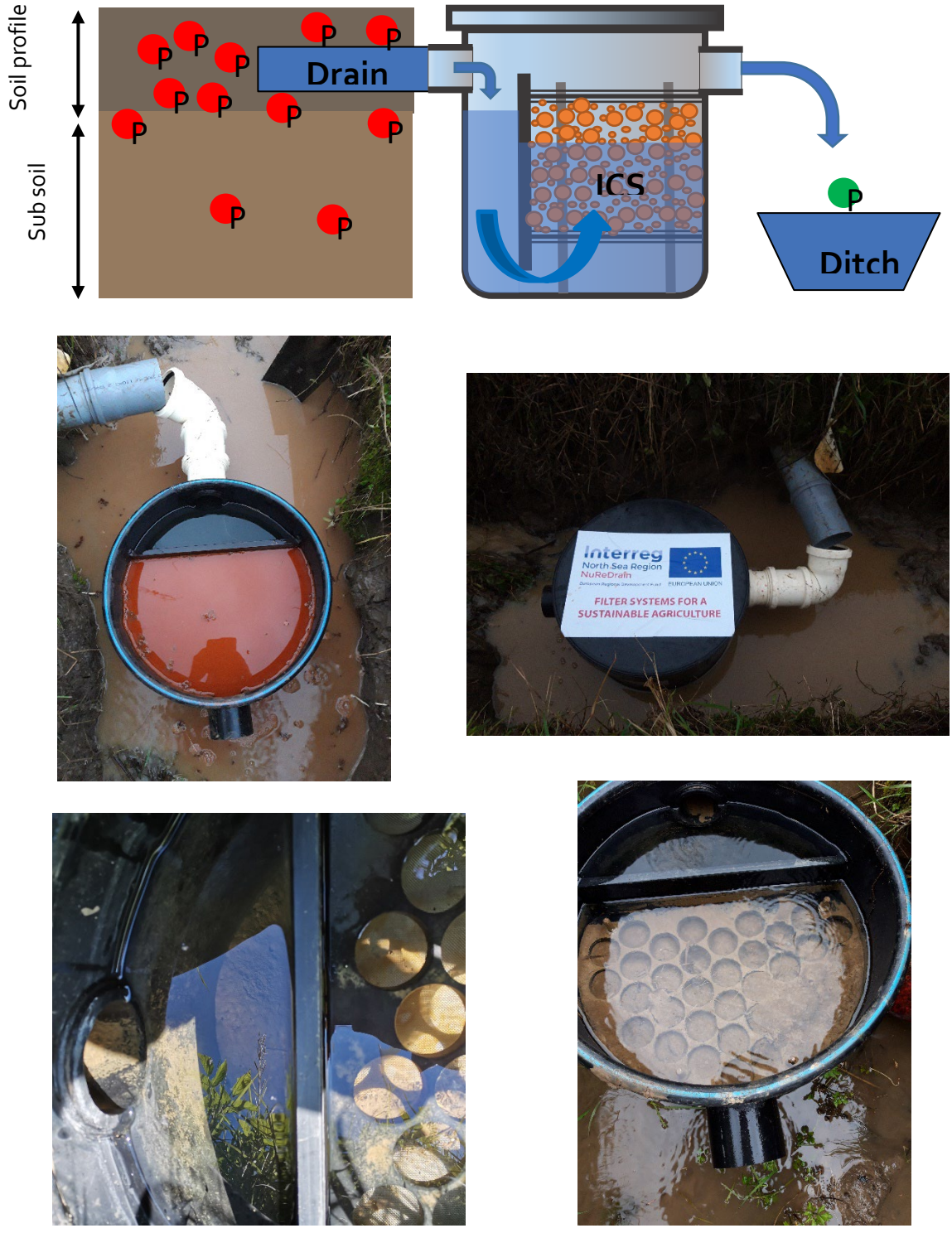

Figure 4 Prototype installed in the season of 2019-2020 and 2020-2021

Results (through the different seasons)

Season of 2017-2018

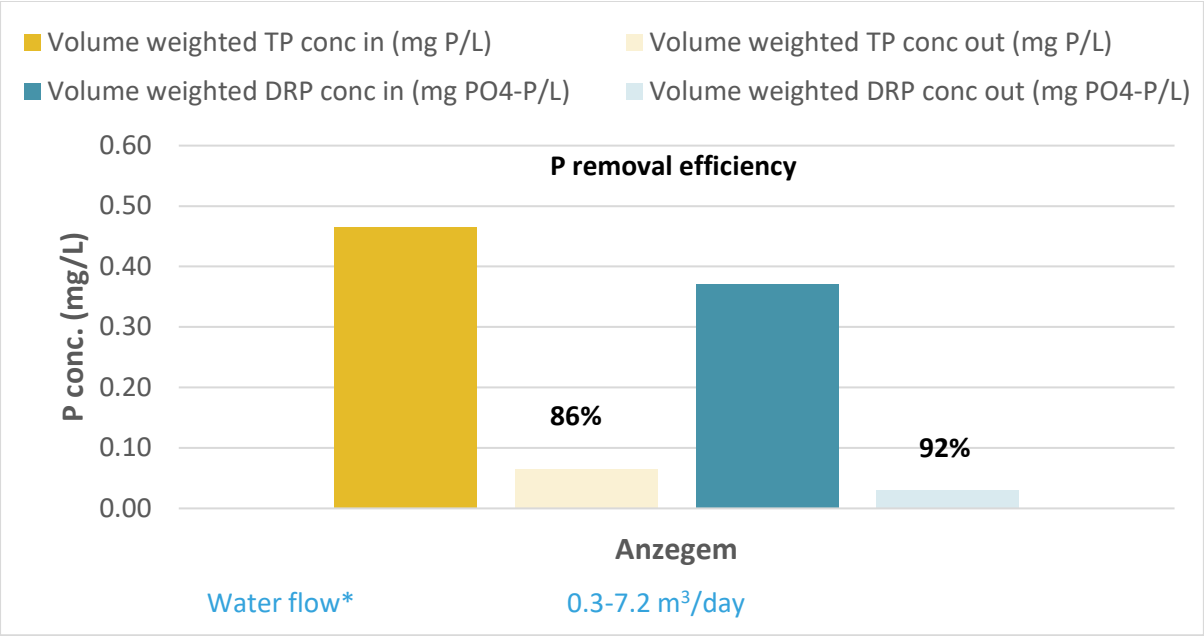

Figure 5 P removal efficiency of a custom-made filter ton during the season of 2017-2018.

*water flow was measured every week and this range represented the water flow on the measuring days.

At the site of Anzegem, 65% of total phosphorus (TP) and 60% of dissolved reactive phosphorus (DRP) was removed by the filter box during the period of 21/12/2017 - 16/4/2018 with an average water flow of 1.9 m^3/day. Clogging problems occured between 9/2/2018-6/3/2018 and frost problems during the period of 22/2/2018 - 28/2/2018.

Season of 2018-2019

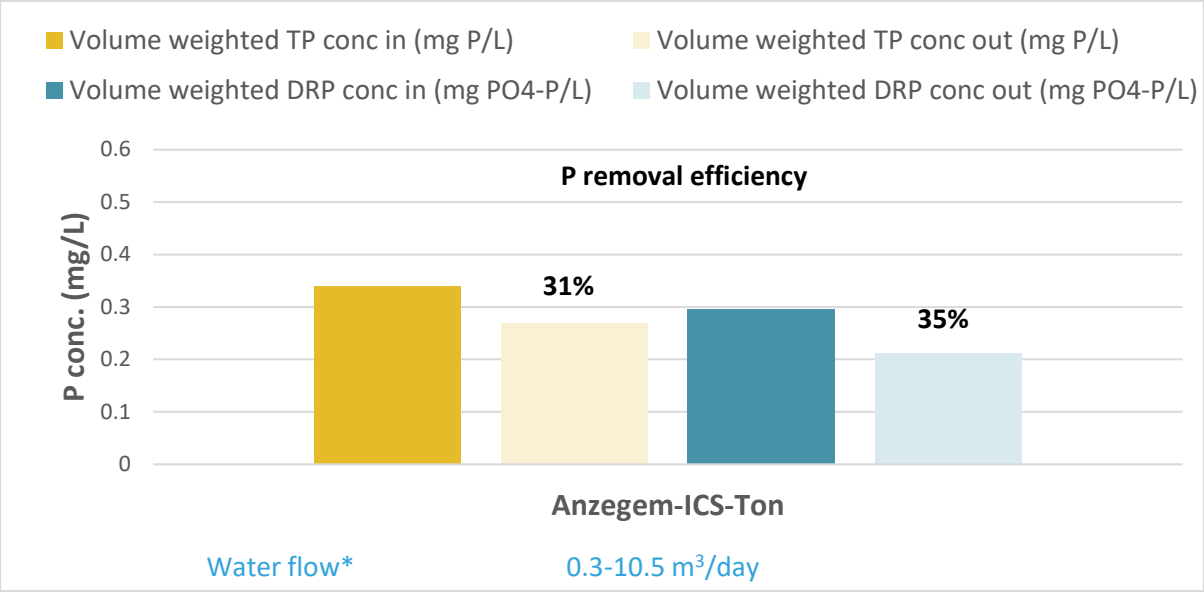

Figure 6 P removal efficiency of a custom-made filter ton during the season of 2018-2019.

*water flow was measured every week and this range represented the water flow on the measuring days.

At the site of Anzegem, 31% of TP and 35% of DRP was removed by the filter box during the period of 13/12/2018 - 18/4/2019 with an average water flow of 2.1 m^3/day. Overflow occurred on 7/2/2019.

Season of 2019-2020

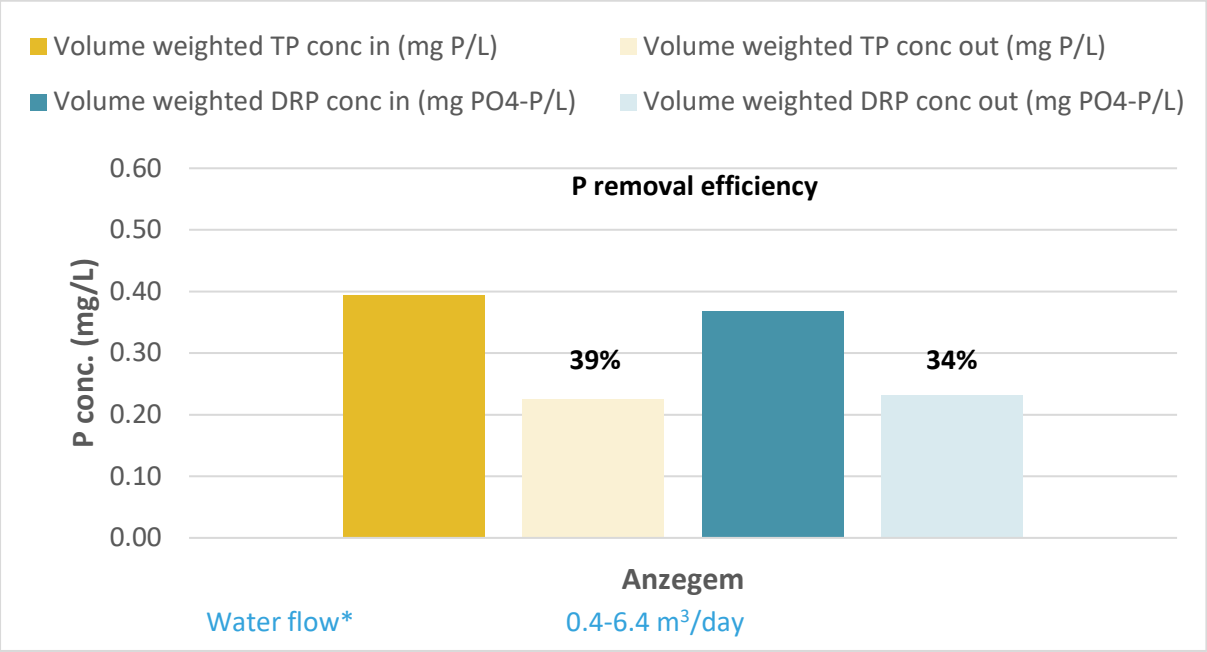

Figure 7 P removal efficiency of the prototype filter during the season of 2019-2020.

*water flow was measured every week and this range represented the water flow on the measuring days.

The same prototype filters were installed at three different sites. In Anzegem, 39% of TP and 34% of DRP was removed during the period of 23/12/2019 – 23/3/2020 with an average water flow of 2.3 m^3/day. Overflow occurred on 3/5/2020 but the water flow could not be measured.

Season of 2020-2021

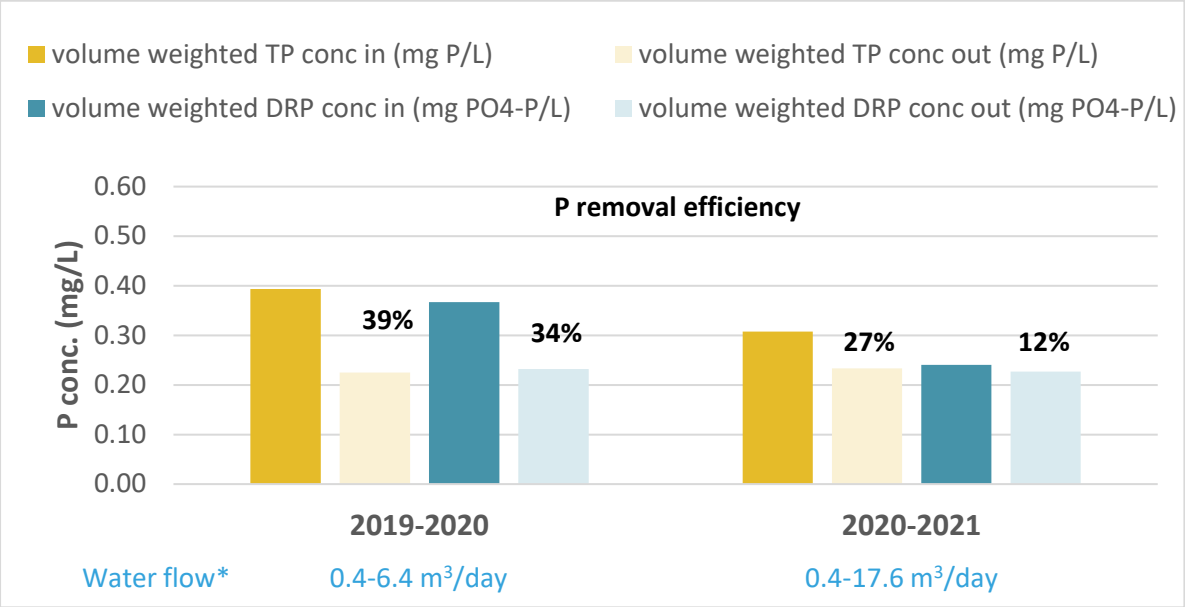

Figure 8 Long-term performance of the prototype filter in Anzegem over two drainage seasons

*water flow was measured every week and this range represented the water flow on the measuring days.

After two seasons, the P removal efficiency of the prototype filter decreased gradually: on average 39% and 27% of total P (TP) and 34% and 12% of dissolve reactive P (DRP) was removed in the first and second season, respectively (Figure 8). As seen in Figure 4, the filter box was clogged in the season of 2020-2021 and this could be one of the reason to explain the low P removal efficiency.

Conclusion

During the four seasons, different filter boxes filled with fresh ICS showed that the P removal efficiency varied from 39-86% of TP and 34-92% of DRP while the long-term performance of ICS reduced to 27% of TP and 12% DRP. The water flow of the drain could play an important role. Comparing between season 2017-2018 and 2018-2019: the first season had a lower water flow (max 7.2 m^3/day) and showed a much higher P removal efficiency even with the higher average P level. In general, the P removal efficiency in Anzegem was rather low compared to filters in Zedelgem due to the larger water flow (up to 18 m^3/day) which was beyond the designed processing capacity (6-8 m^3/day). Also it was noted that the sediments could be a problem at this site. Therefore, the filter will be cleaned and refilled with fresh ICS in the season of 2021-2022.