Interreg North Sea Region NuReDrain

European Regional Development Fund

EUROPEAN UNION

FILTER SYSTEMS FOR A SUSTAINABLE AGRICULTURE

FIELD CASE DESCRIPTION

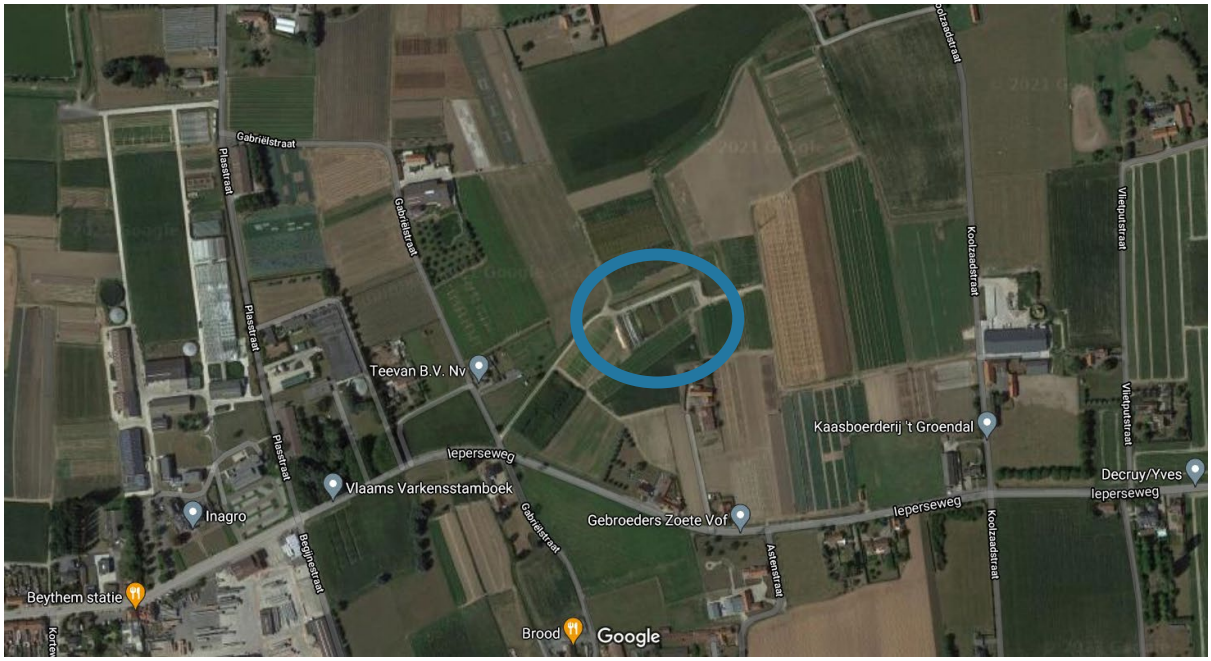
Nitrogen removal at the Godelieve fields of Inagro

inagro

ONDERZOEK & ADVIES IN LAND- & TUINBOUW

Location

Country: Belgium
City: Roeselare
Coordinates: 50,903891 – 3,132012



Location of the N removal plant (Iepeseweg wn, Roeselare)

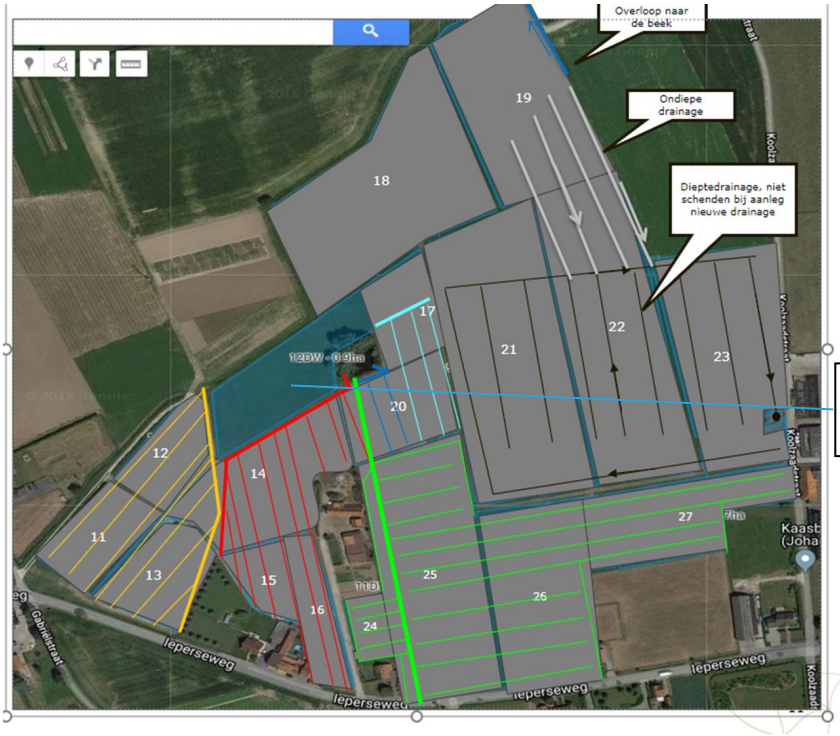
Problem description

Despite the fact that farmers adjust their fertilization strategy to the N-needs of the crops, the risk remains that the nitrate pressure in drainage water is too high. End of pipe techniques that remove nitrate from drainage water before it is discharged to the ditch may be part of the solution. Three different denitrification techniques have been tested on their capability for N removal from the drainage water from pilot plots at Inagro

1. constructed wetland
2. wood chips filter
3. moving bed bioreactor

Filter description

The fields near the Godelieve ditch were recently bought by Inagro. Research for arable farming and vegetable cultivation is done on these test fields. Because the plots had to be drained, this was an opportunity to make a practice-based comparison of the effects of various denitrification techniques.
Because the availability of sufficient water for irrigation is also an important concern, the location for the run-off collection was first determined. The drainage water from 7 ha is also collected in this open well. The overflow of water from the open well flows towards the constructed wetland. The MBBR is also fed with this water. Part of the plot (1.5 ha) could not be connected to the open well. This drainage water is collected in a separate basin from where it flows through the wood chip filter before entering the ditch.



Location of MBBR, constructed wetland and wood chips

Constructed wetland

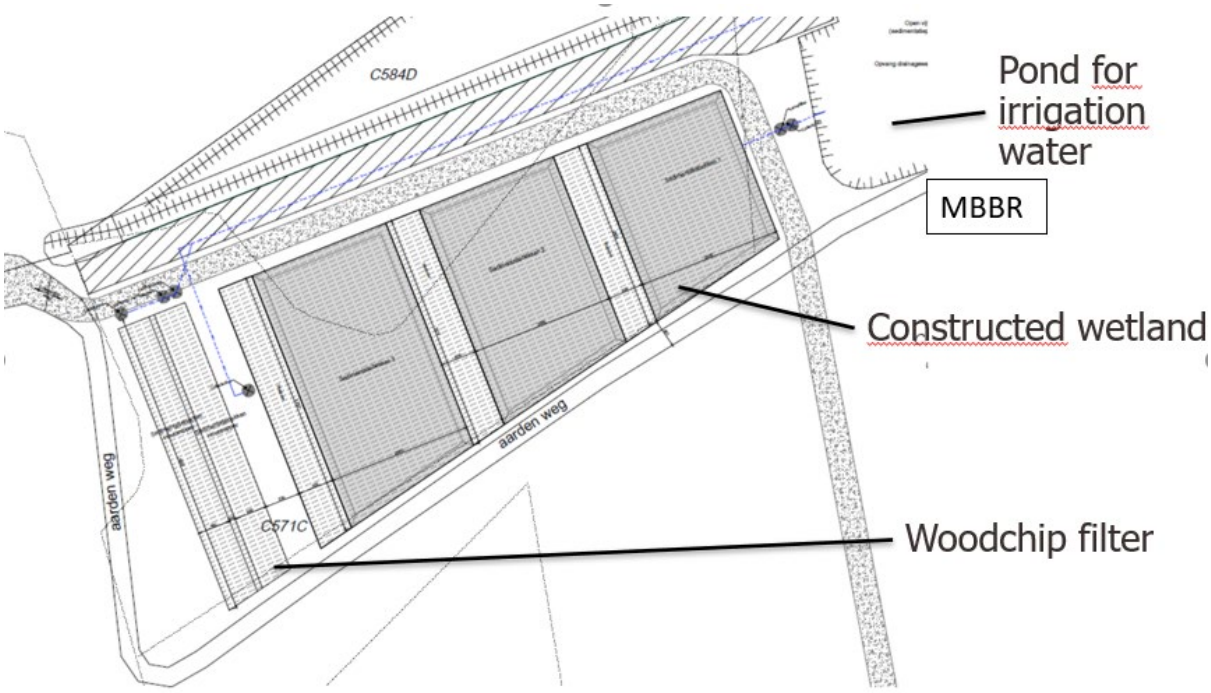
The total area of the constructed wetland is about 1500 m² (or 2% of the total drained area). The wetland itself is divided into three parts. The division was done by constructing two sandbanks (5 – 7 m width) through which the water must pass. Straw was mixed into these sandbanks. In this way, a carbon source is mixed in as carbon is necessary for the denitrification reaction. Reed was planted on top of the sandbanks. The maintained water column is about 70 cm high.
The overflow of the open well is connected to the constructed wetland. The water flows through the wetland. At the end of the wetland, drains have been installed for discharge into the canal.

Wood chips filter

Before the drainage water passes through the wood chips, it is buffered. Both the buffer section and the section filled with wood chips are 40 m long and 4.6 m wide. The maintained water column is about 80 cm. About 150 m³ of wood chips (without bark) were placed in the wood chips section. After passing through the wood chips, the treated drainage water is discharged via an overflow.

MBBR

The MBBR treats the water from the open well. The MBBR has a total volume of 10 m³, of which 8,5 to 9 m³ is filled with water. In the MBBR 3 m³ of carrier material was installed. Carbo ST is used as carbon source. The used dose of Carbo ST is 0,13 l/h. Every 2 hours the carriers are pumped around during 1 minute so that they don't start clogging.



Photo's filter

Constructed wetland

Wood chips filter

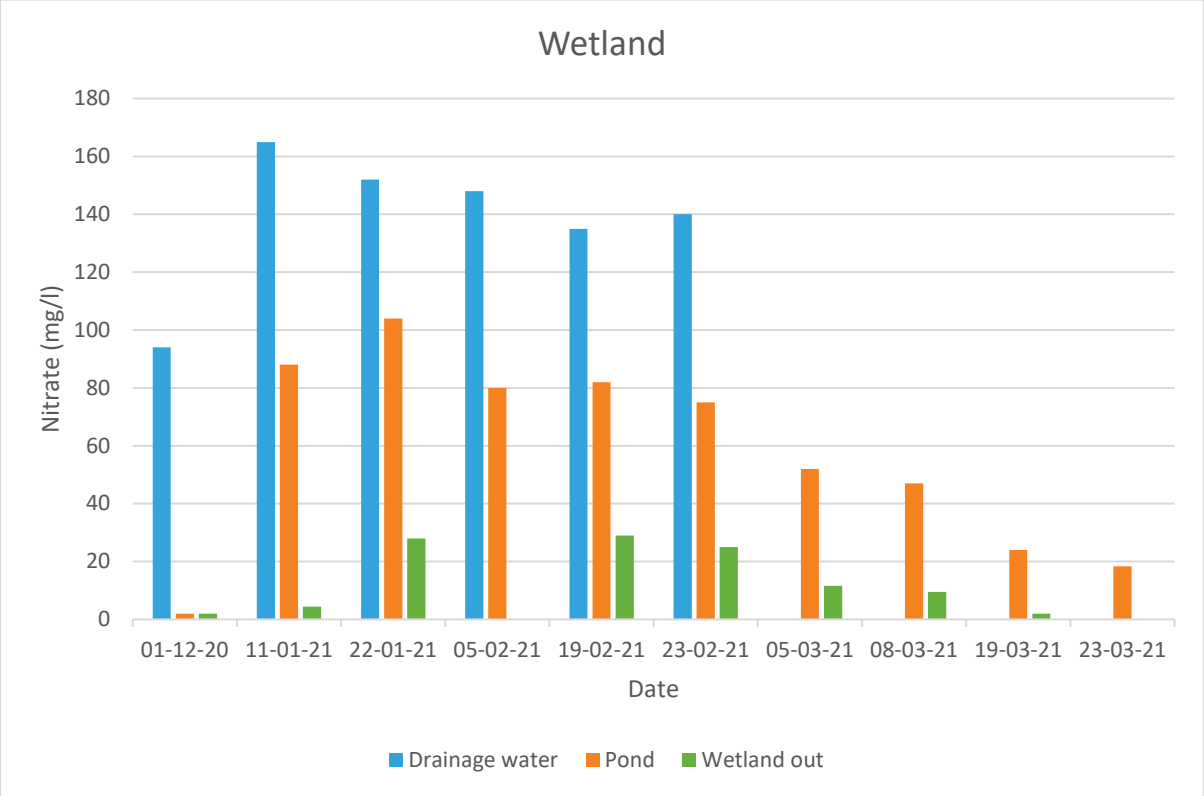
MBBR

Results (through the different seasons)

The drainage season of 2020-2021 was the first drainage season in which the various systems were operational. Due to the very dry summer in 2020 the drainage season only started in early December. Because at that time the open pond was still filled with run-off water, it was waiting until the beginning of January until the measured nitrate pressure in the open pond was high enough to evaluate the functioning of the different denitrification systems. Due to hydraulic problems, the wood chips filter could not be started up. Below are the results of using the constructed wetland and the MBBR to reduce the nitrate pressure from drainage water to surface water.

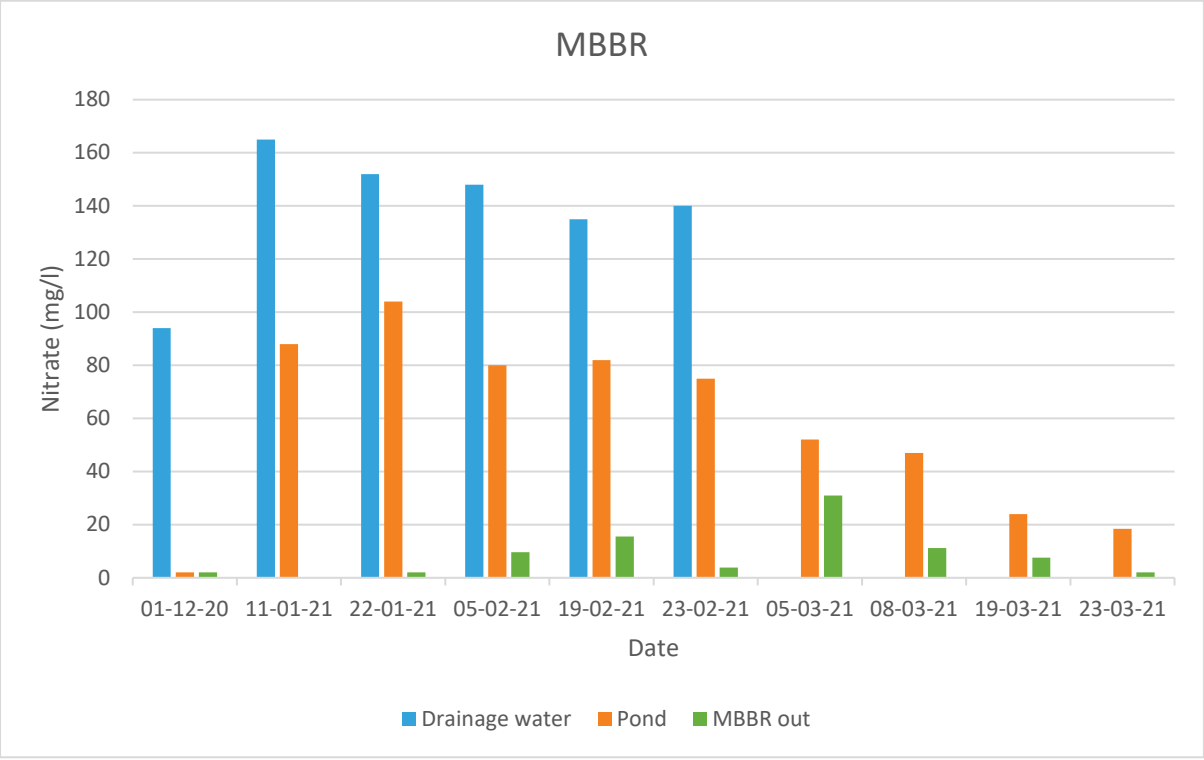
Constructed wetland

The drainage season started at the beginning of December. The measured starting concentration was 94 mg NO3/l. Because at that moment the pond contained mainly rainwater and run-off, the measured nitrate pressure in the pond was still very low. It was necessary to wait until January to measure sufficiently high nitrate concentrations in the pond to be able to evaluate the functioning of the constructed wetland. During the rest of the drainage season the nitrate pressure in the drainage water remained high (135 - 140 mg NO3/l) and the nitrate pressure in the open well also remained above 50 mg NO3/l for a long time. Beyond the constructed wetland, the measured nitrate concentration was always far below 50 mg NO3/l, even in the period of severe frost (8-18/02).



MBBR

The drainage season started at the beginning of December. The measured starting concentration was 94 mg NO3/l. Because at that moment the pond contained mainly rainwater and run-off, the measured nitrate pressure in the pond was still very low. The start of the running of the drains also meant the startup of the MBBR. It was necessary to wait until January to measure sufficiently high nitrate concentrations in the pond to be able to evaluate the functioning of the MBBR. During the rest of the drainage season the nitrate pressure in the drainage water remained high (135 - 140 mg NO3/l) and the nitrate pressure in the open well also remained above 50 mg NO3/l for a long time. Throughout the period, the measured nitrate concentration after MBBR treatment was well below the target value of 50 mg NO3/l. The MBBR processed 1.5 m³ of drainage water per hour in the period from 1 December to the 3th of March. Afterwards, the flow rate was increased to 2 m³/h on 3 March and 2.5 m³/h on 17 March . Due to a period of severe frost, the water was circulated internally through the MBBR from 8 to 18 February.



Financial aspect

With the current available information it is only possible to make a cost evaluation about the N-removal realized by the MBBR. The MBBR was operational between 11/01 and 23/03 and removed 127.9 kg NO3. The total cost for this removal is € 5.306 (capex 1.964 €/y and opex 3.102 €/y) or € 41,19/kg NO3 processed.

Conclusion

At present, there are only results available from one drainage season. The different systems (including the system with the wood chips filter) will be followed up in the coming winters. There is also the ambition - if funding is granted - to roll out these systems in a catchment area where there is both guidance for farmers in improving fertilization practices and (end-of-pipe) techniques to tackle nitrate pressure from drainage systems.