

Removal of nitrate from drainage water using woodchips

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Why ?

The nitrogen concentration in Dutch surface water is too high on many places. Leaching of nitrate from agricultural land is a major source of nitrogen in surface waters. With current fertilizer policy the water quality standards included in the Water Framework Directive cannot be met on short term. To meet these requirements, additional measures are therefore needed to reduce nitrate leaching from agricultural soils in the short term.



Chips from soft wood.

How ?

By denitrification nitrate can be converted into nitrogen: $\text{NO}_3^- \rightarrow \text{NO}_2^- \rightarrow \text{NO} \rightarrow \text{N}_2\text{O} \rightarrow \text{N}_2$ (Figure 1). On about 50% of Dutch farmland water is discharged to surface water via drainage pipes. By placing a filter with woodchips at the end of the drainage pipe the leached nitrate is converted to gaseous N_2 . Woodchips can be used as a source of organic matter.

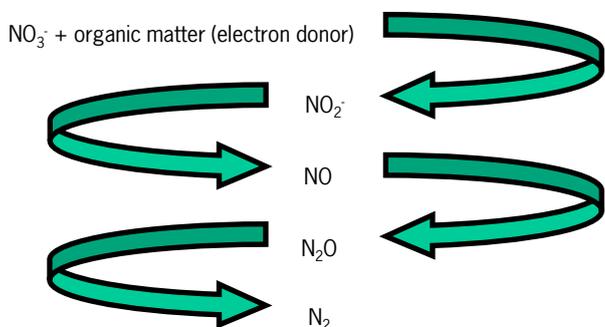


Figure 1: The denitrification process.

Does it work ?

Yes, 100% of the nitrate in the water could be removed in a column experiment (Table 1). The extent of nitrate removal depends on the type of woodchips and on the residence time of water in the filter.

Table 1: Percentage of nitrate removed in the column (the nitrate concentration at the beginning of the column was 100 mg L^{-1}).

Type of woodchip	Slow	Fast *
Hardwood	100	58
Softwood	95	21
Hardwood / sand mixture	100	38
Softwood / sand mixture	82	19

*Residence time in column 3.6 days (slow) and 1.7 days (fast)

Disadvantages and side-effects ?

A few days are needed to remove all nitrate from the water. For drainage flows expected in practice, the filter will therefore be too large for placing at the end of a drain pipe. Also, a risk of 'pollution swapping' exists: while nitrate is removed, losses may occur in the form of nitrous oxide (N_2O) and phosphate (Figure 2 and 3).

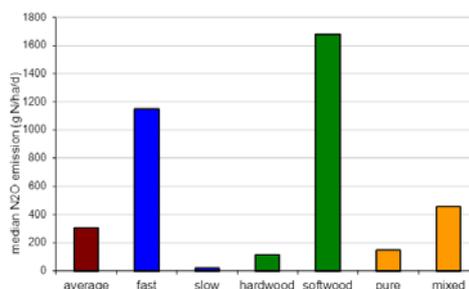


Figure 2: Influence of percolation speed, type of woodchip, and mixing with sand on emission of N_2O from woodchips

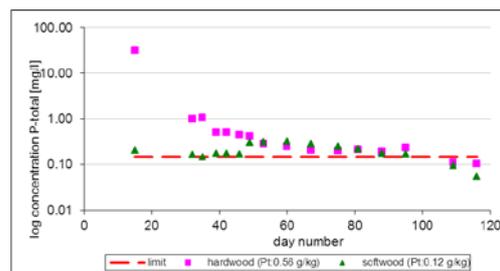


Figure 3: Phosphorus in leachate from hardwood and softwood chips. Especially in the beginning concentrations are high