

# Immobilizing soil phosphorus for nature development.

W.J. Chardon, J.E. Groenenberg and G.F. Koopmans

## Why ?

A high soil content of plant available P is an indication of a risk for P leaching to surface water. However, it is also a bad starting point for nature development on former agricultural soils. Grassland species richness tends to be highest when P-Olsen is (very) low (Fig. 1). Decreasing plant availability of P can thus both decrease P leaching risk and improve the chance for developing a species rich vegetation.

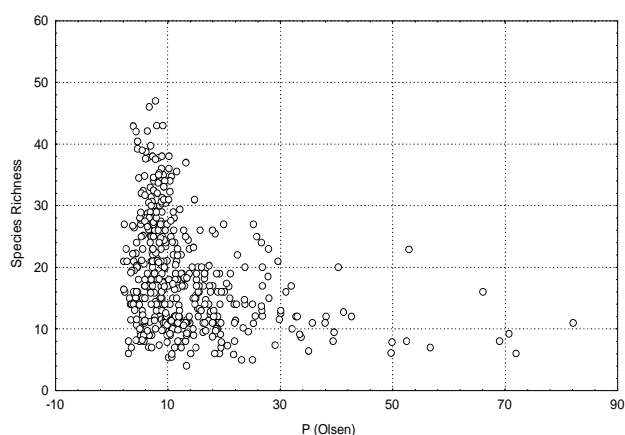


Fig. 1. Grassland species richness vs P-Olsen (Chambers et al. 1999)

## How ?

Iron and aluminium sludge (AL-WTR), side products of drinking water production, are able to bind a large amount of P as was shown in lab studies (Chardon et al., 2012). We mixed, in 2 doses, samples from 2 soils with Fe-sludge or Al-WTR. Table 1 gives initial P availability and classification of both soils. After incubation we followed during 90 days P-Olsen, P-water and P-CaCl<sub>2</sub>.

Table 1. Initial values of Pw and P-Olsen of soils used, and P-status classification as summarized in Tunney et al. (1997)

Soil	Pw mg P/kg	status	P-Olsen mg P/kg	status
A	13	medium	61	very high
B	22	high	107	very high

Chambers, B.J. et al., 1999. Report MAFF Project BD1429, ADAS UK, 71 pp.

Chardon, W.J. et al. 2012. J. Environ. Qual. 41:636-646.

Tunney, H. et al. 1997. CAB International, Wallingford UK., p. 177-203.

## Does it work ?

Yes, measured Pw and P-CaCl<sub>2</sub> decreased fast, and were >80% lower after 90 days incubation than initial values (see Fig. 2 for soil A as example). However, P-Olsen values decreased more gradually, up to 30% only.

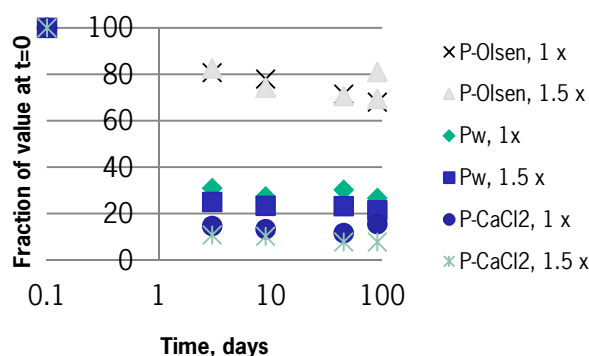


Figure 2. Decrease of P fractions, due to adding iron sludge, soil A

After immobilization with iron sludge and 90 days incubation, both soils can be classified as having P-status 'very low' based on Pw, but still as being 'very high' when based on P-Olsen (Table 2). Al-WTR caused a very fast and even larger decrease of Pw (data not shown).

Table 2. Decrease of Pw and P-Olsen after 90 days incubation with iron sludge, as % of initial values and classification of P-status.

Soil	dose	Pw	status *	P-Olsen	status
A	1 x	73 %	very low	32 %	very high
A	1.5 x	79 %	very low	31 %	very high
B	1 x	79 %	very low	50 %	very high
B	1.5 x	83 %	very low	52 %	very high

## Uncertainties ?

Using different soil test methods for judging effectiveness of P immobilization in former agricultural soils leads to contrasting results. Both Pw and P-CaCl<sub>2</sub> showed a fast and strong decrease, P-Olsen decreased much more slowly and a lesser extent, even after 90 days of incubation.

A possible explanation is that the high pH of 8.5, applied during the P-Olsen extraction, prevents desorbed P to reabsorb to the freshly added hydroxides from the iron sludge or Al-WTR. The Pw and P-CaCl<sub>2</sub> methods are done at soil pH, where reabsorption can occur.

At this moment field testing of iron sludge is done.