



IWA WETLAND 2008
11th International Conference on Wetland
Systems for Water Pollution Control,
Indore - India



**Coco products and peat as potential
filter media for nutrient removal in
vertical subsurface flow constructed
wetlands**

Rob Van Deun, Mia Van Dyck
Katholieke Hogeschool Kempen, Geel, Belgium

Introduction

Optimizing nutrient removal with constructed wetlands



Introduction

Coco products:

- **Coco chips:** fibrous material (5 – 11mm)
- **Coco peat non-buffered** (< 3mm)
- **Coco peat buffered**



Introduction

Peat:

- Mixture 50% Baltic peat – 50% Irish peat
- Untreated mixture
- Mixture treated with lime



1. peat 2. limed peat 3. coco peat 4. coco peat buffered

	1	2	3	4	
pH H ₂ O	4.29	5.16	6.12	5.58	
nitrate	0.00	0.00	0.00	46.33	mg/l substrate
ammonium	6.54	9.88	1.32	1.83	mg/l substrate
phosphorous	8.75	8.70	23.55	5.90	mg/l substrate
potassium	7.50	7.50	717.50	152.50	mg/l substrate
calcium	170.0	790.00	187.50	642.50	mg/l substrate
magnesium	90.00	172.50	115.00	50.00	mg/l substrate
sodium	22.50	25.00	207.50	32.50	mg/l substrate
chlorides	27.60	38.50	628.00	53.80	mg/l substrate
iron	0.45	1.20	0.15	0.20	mg/l substrate

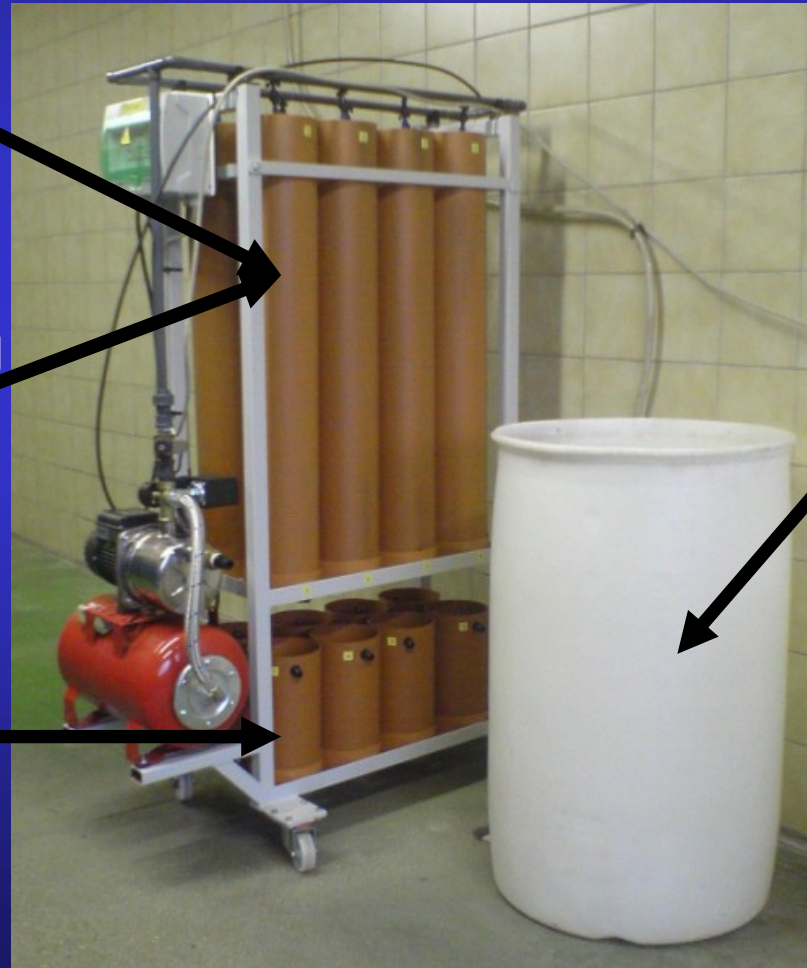
Methods and Materials

Column studies: Infiltration columns

Height 80cm

Hydraulic loading
50 l / m².d

Sampling



45 ppm N
(NH_4NO_3)
+
15 ppm P
(KH_2PO_4)

Phosphorus

	n	MV	STDEV
influent	28	14.3	1.83
coco chips	28	12.6	1.97
coco peat	28	12.5	3.31
coco peat buffered	28	12.3	2.54
peat	28	13.0	2.62
limed peat	28	11.9	2.35

mg P / l

Phosphorus

ANOVA

No significant difference between media

$\alpha = 0.05$

P-value= 0.652

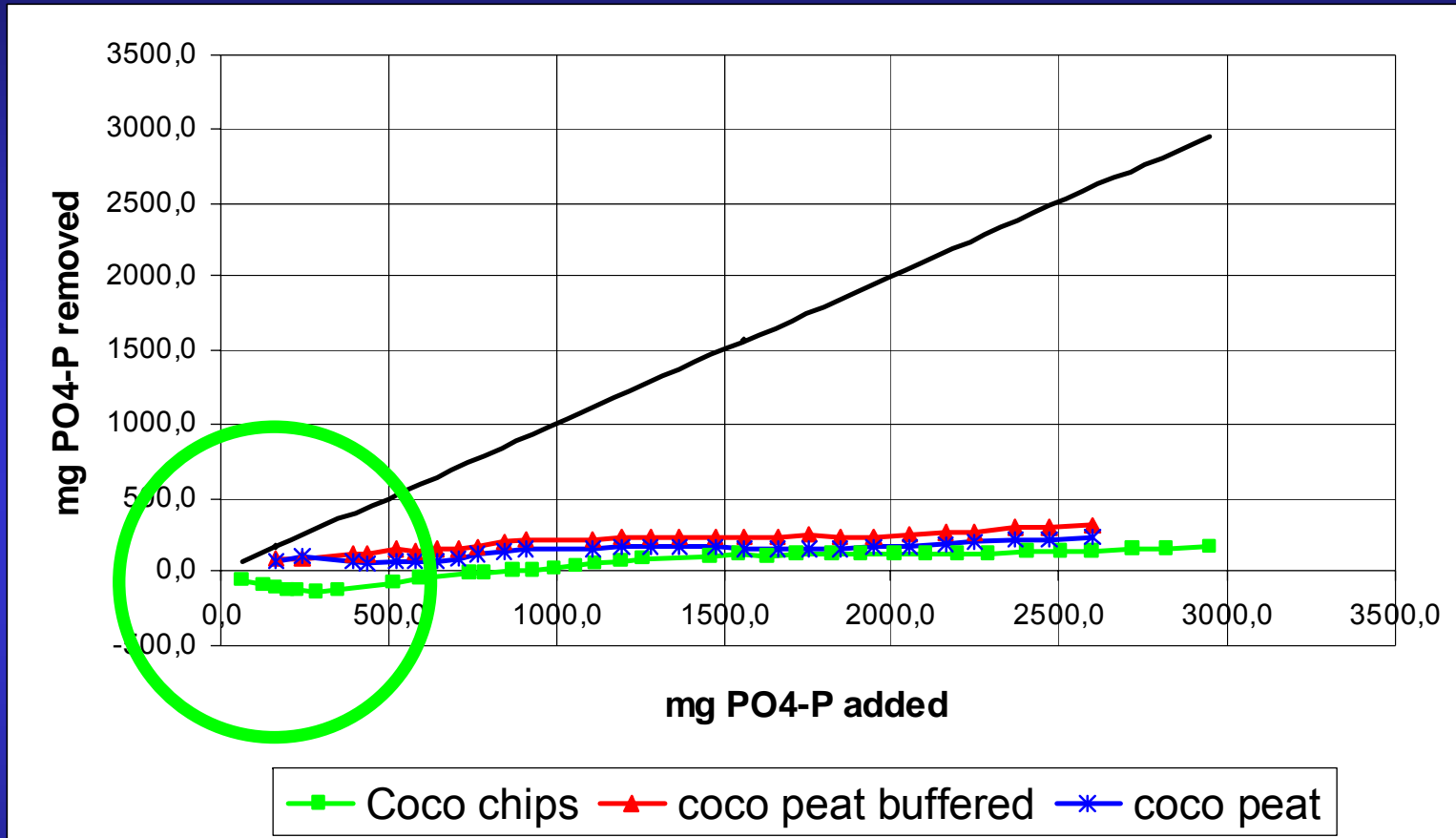
Phosphorus

Experiment : 15 mgP/l - 50 l/m².d

Results after 6 months:

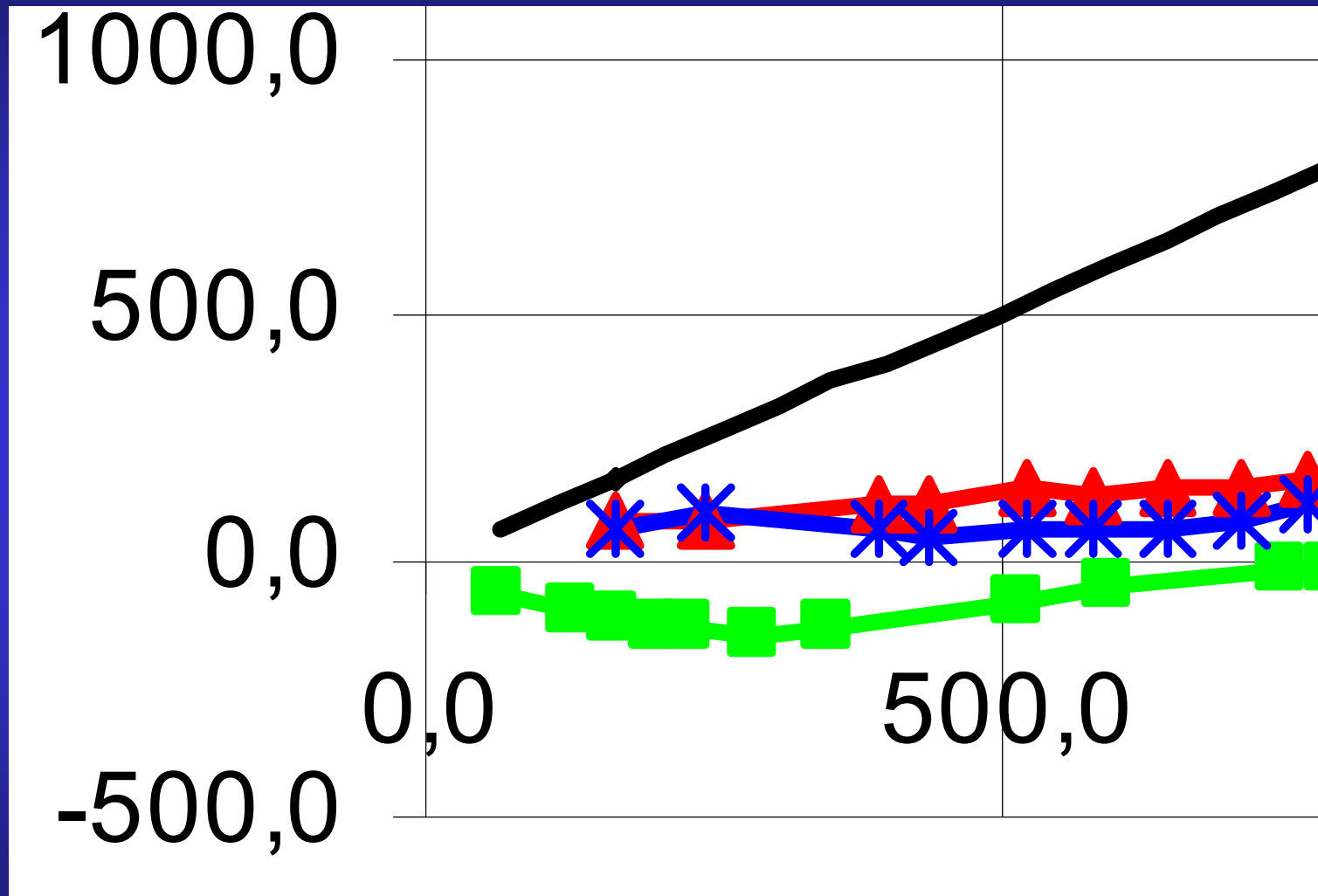
Coco chips	5.6 %
Coco peat buffered	12.0 %
Coco peat	8.8 %
Limed peat	15.7 %
Peat	8.6 %

Phosphorus

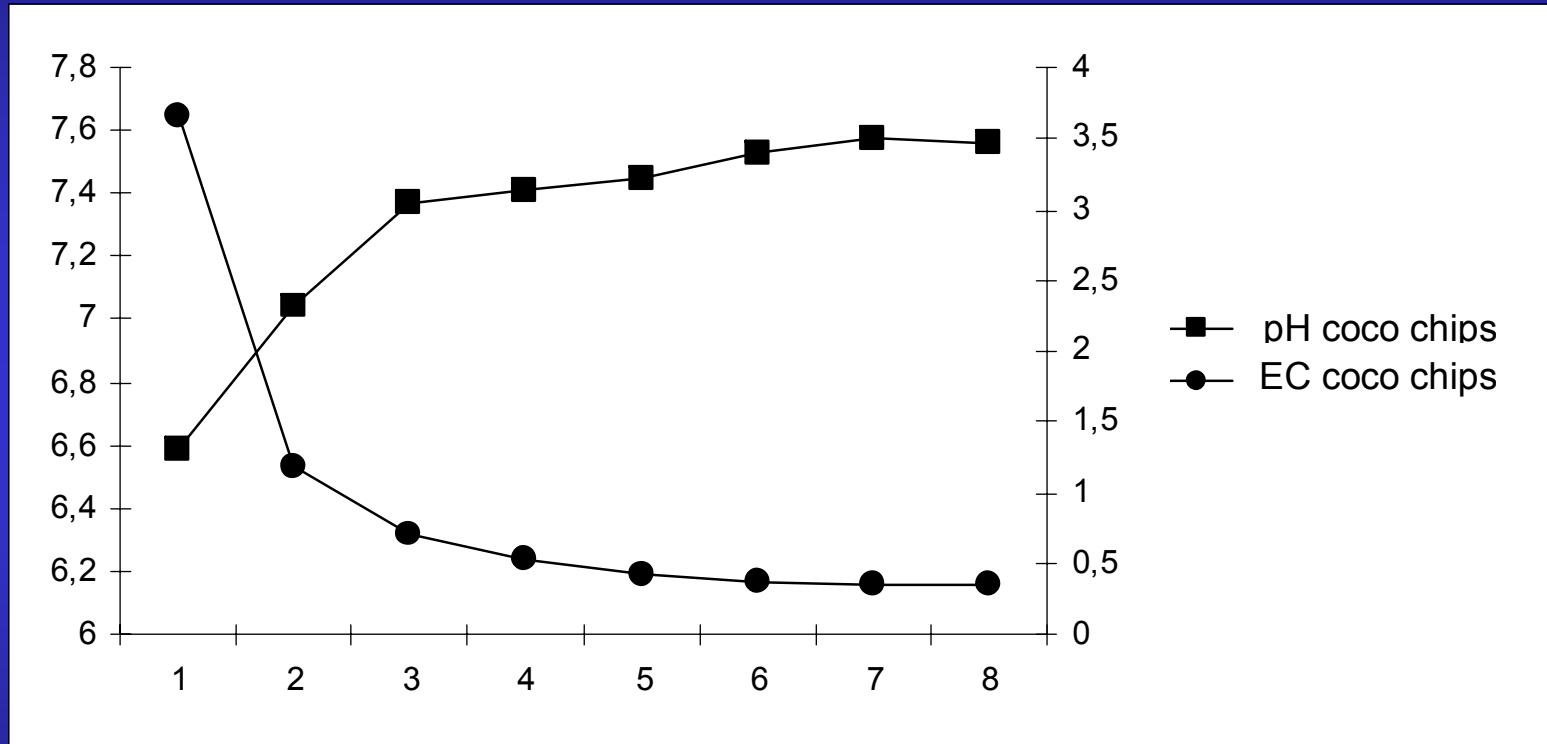


Cumulated mass balance: mg P removed - mg P added (per column)

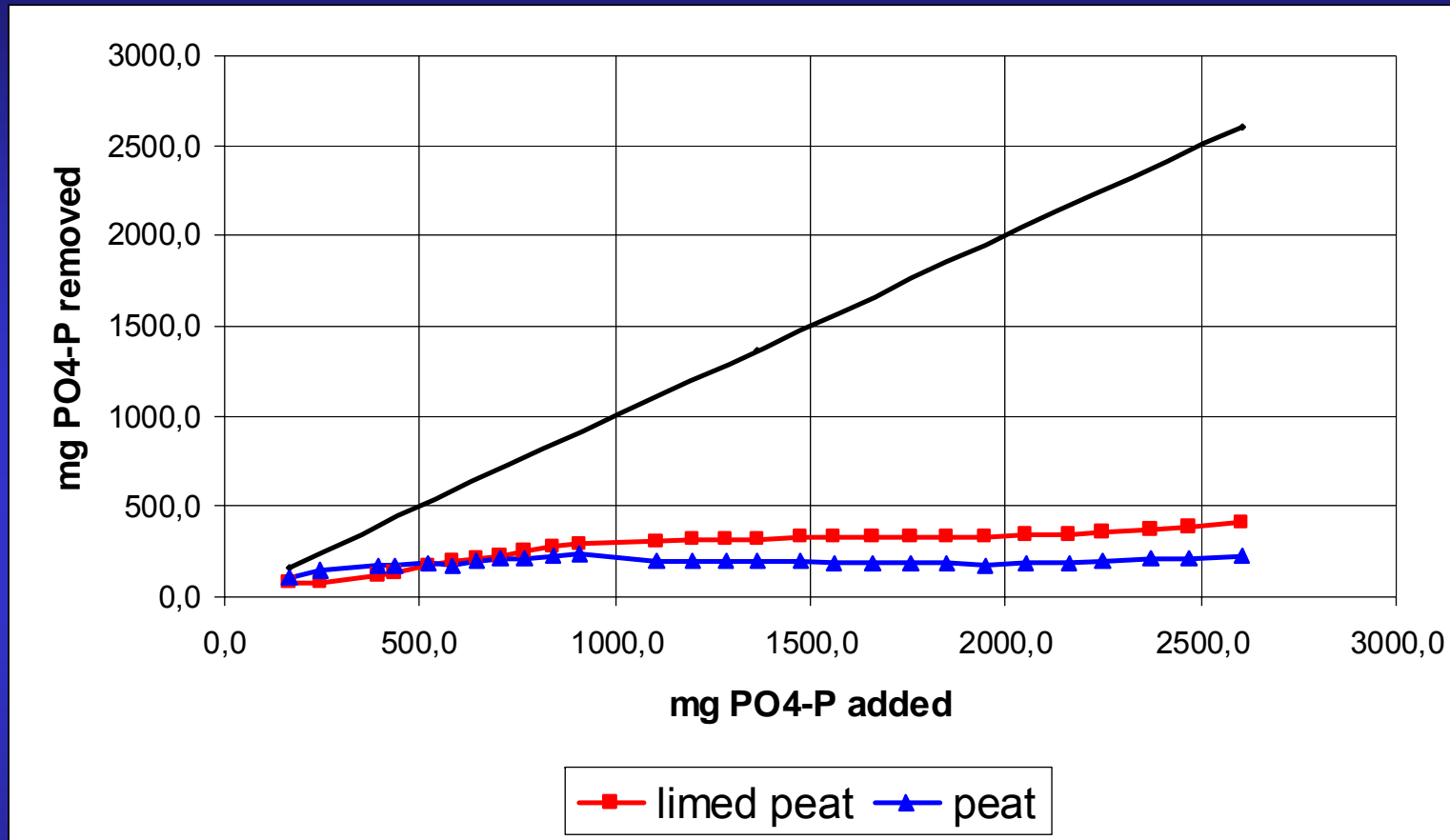
Phosphorus



Phosphorus

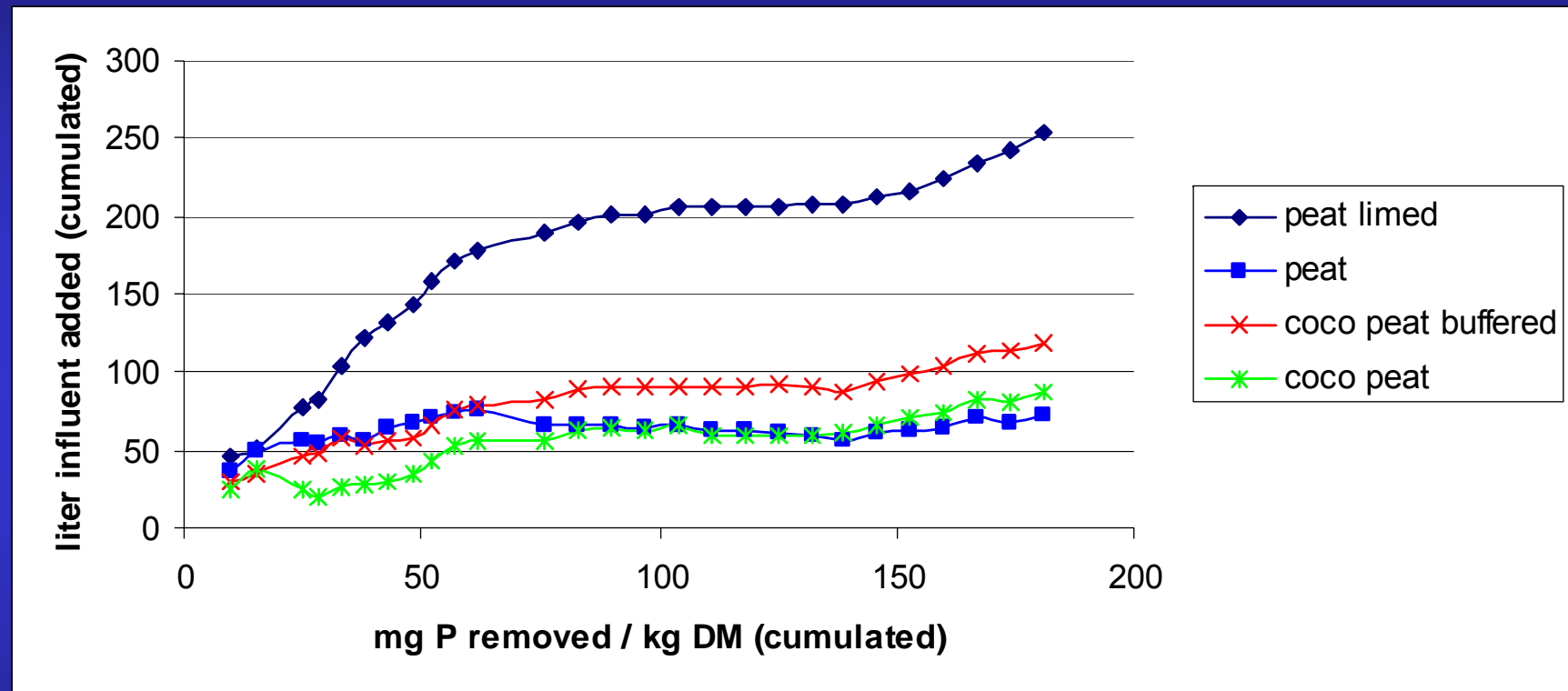


Phosphorus



Cumulated mass balance: mg P removed - mg P added (per column)

Phosphorus



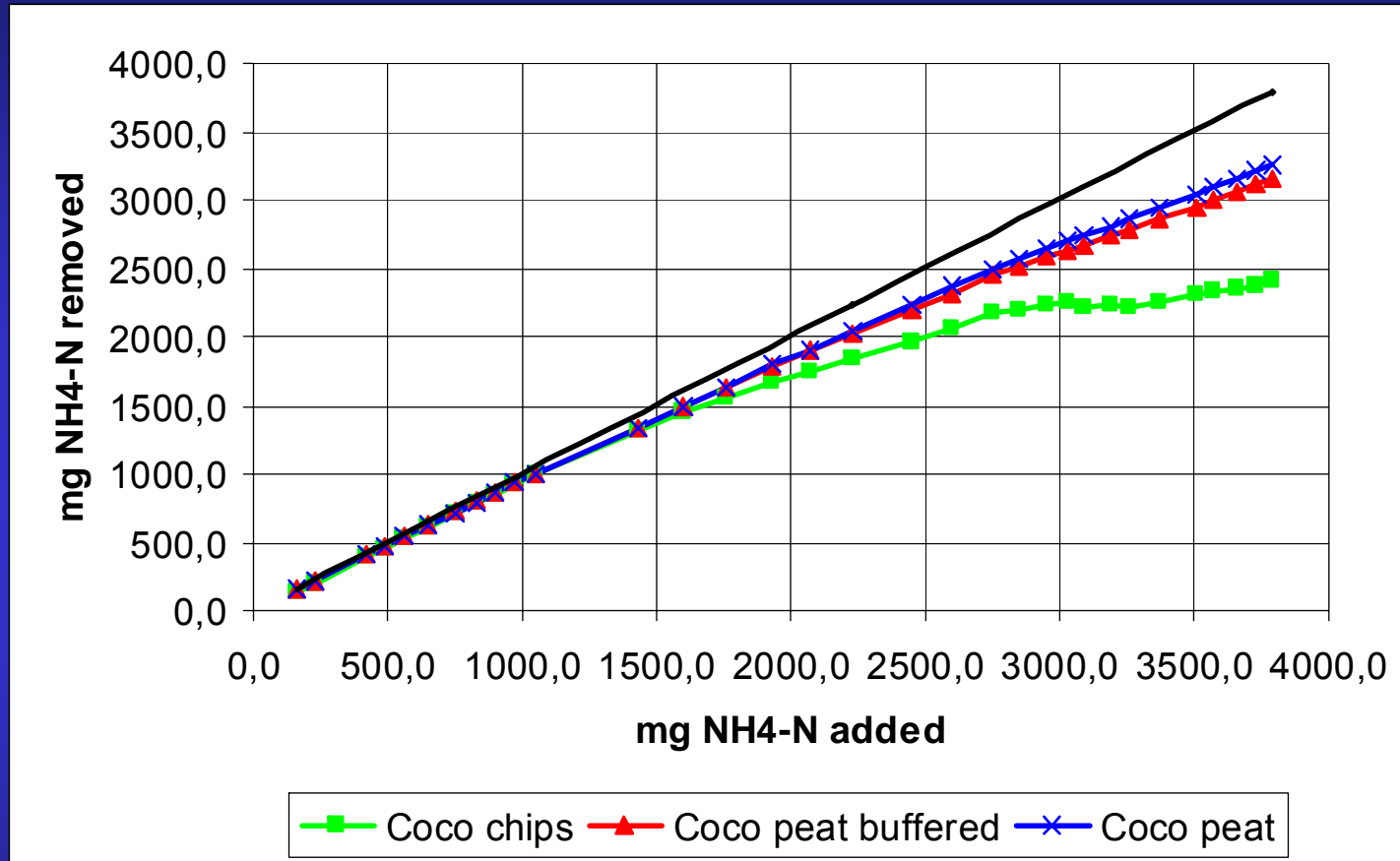
Nitrogen

Experiment 1: 45 mgN/l - 50 l/m².d

Results after 6 months:

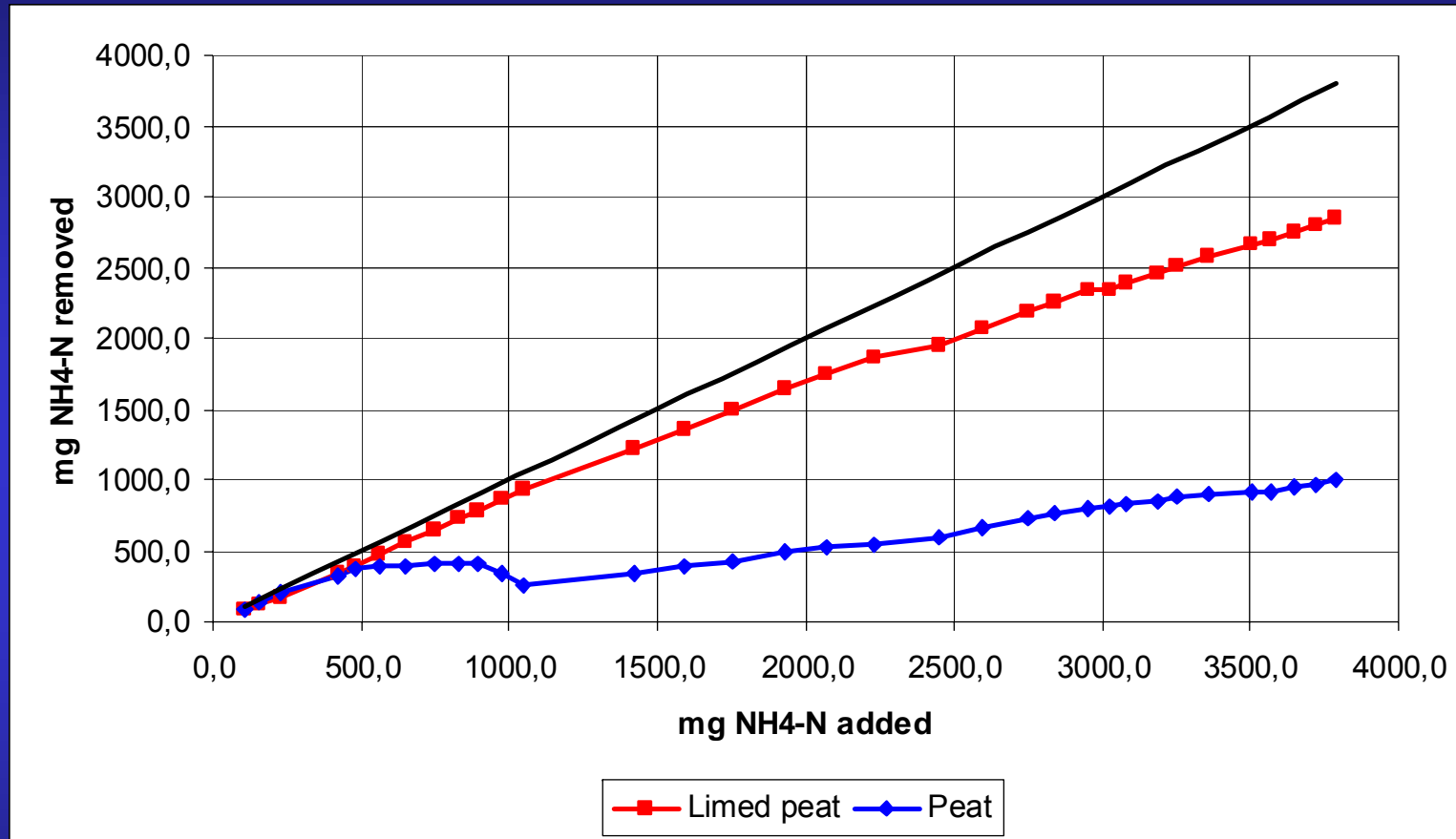
	Total N	NH ₄ ⁺ -N
Coco chips	6.5 %	63.5 %
Coco peat buffered	10.2 %	83.4 %
Coco peat	23.9 %	86 %
Limed peat	0 %	75.1 %
Peat	0 %	26.4 %

Nitrogen



Cumulated mass balance: $\text{mg NH}_4^+\text{-N}$ removed - $\text{mg NH}_4^+\text{-N}$ added (per column)

Nitrogen



Cumulated mass balance: $\text{mg NH}_4^+\text{-N removed} - \text{mg NH}_4^+\text{-N added}$ (per column)

Nitrogen

ANOVA ($\text{NH}_4^+\text{-N}$)

Significant difference between media

$$\alpha = 0.05$$

All media tested: P-value = 6.1687 E-20

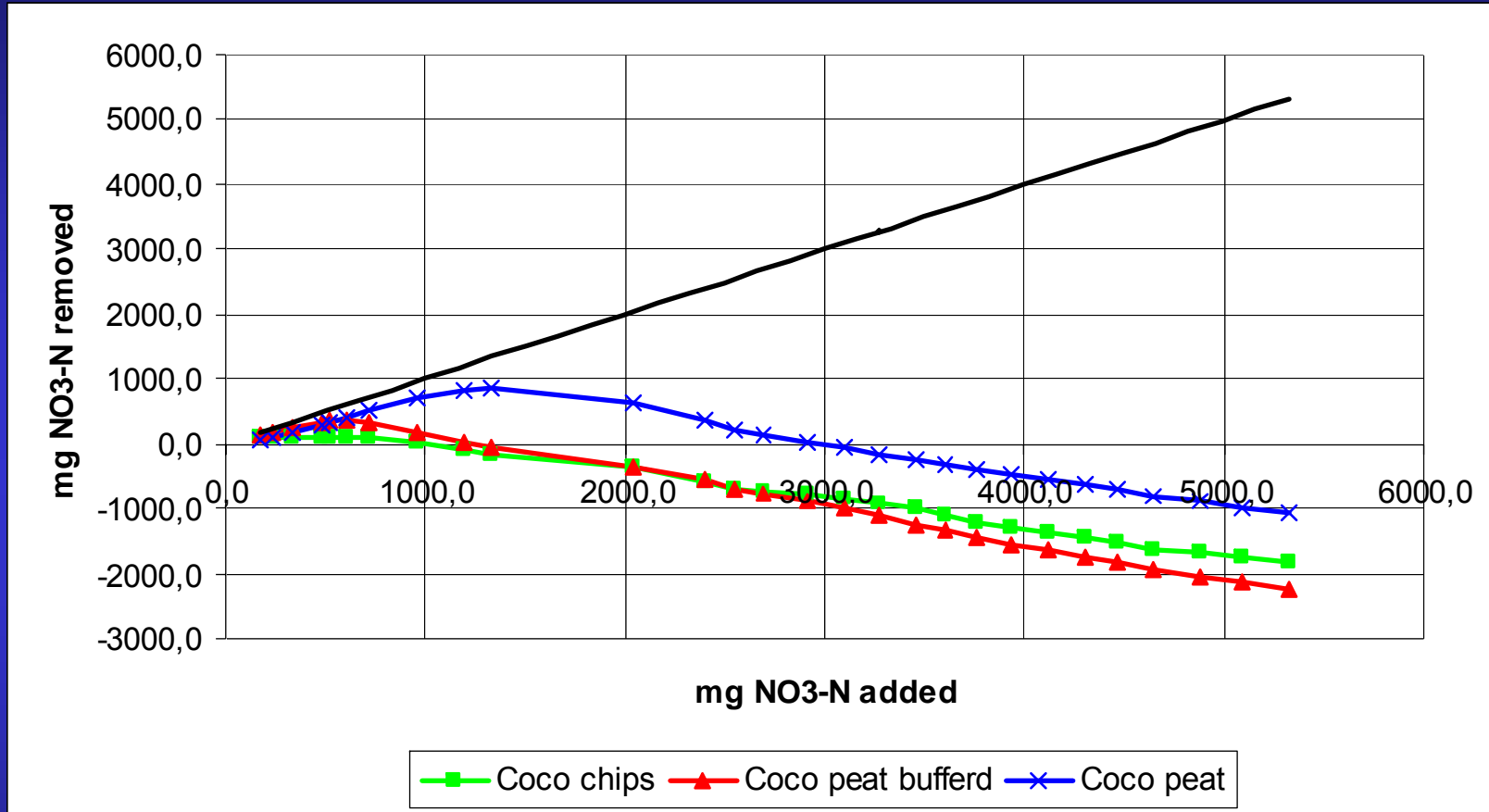
Peat products: P-value = 5.6645 E-08

Coco products: P-value = 7.6553 E-07

No significant difference between buffered and
non-buffered coco peat

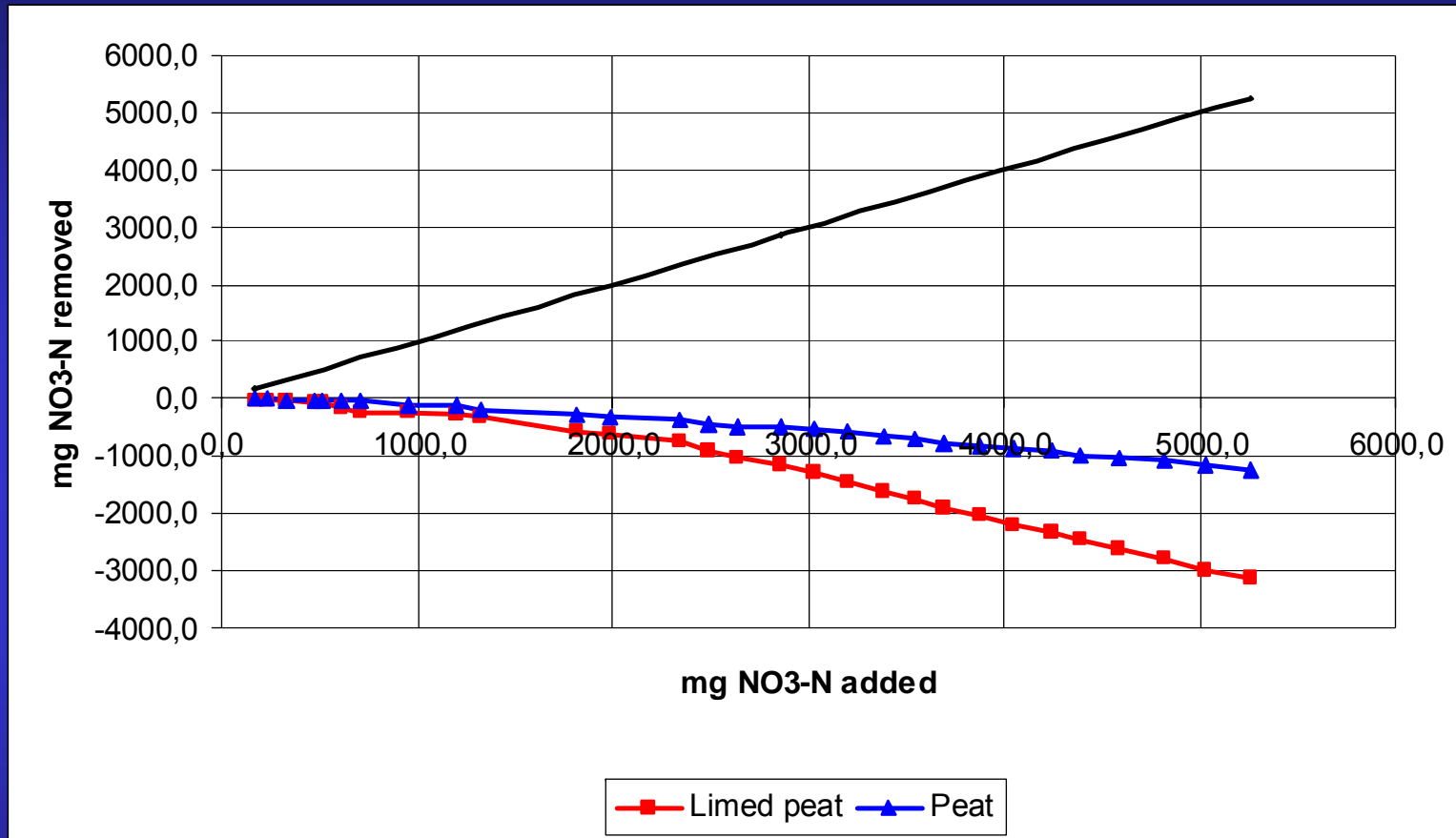
$$\text{P-value} = 0.3433$$

Nitrogen



Cumulated mass balance: mg NO₃-N removed - mg NO₃-N added (per column)

Nitrogen



Cumulated mass balance: mg NO₃-N removed - mg NO₃-N added (per column)

Nitrogen

ANOVA (NO_3^- -N)

Significant difference between media

$$\alpha = 0.05$$

All media tested: P-value = 0.0105

Peat products: P-value = 0.0005

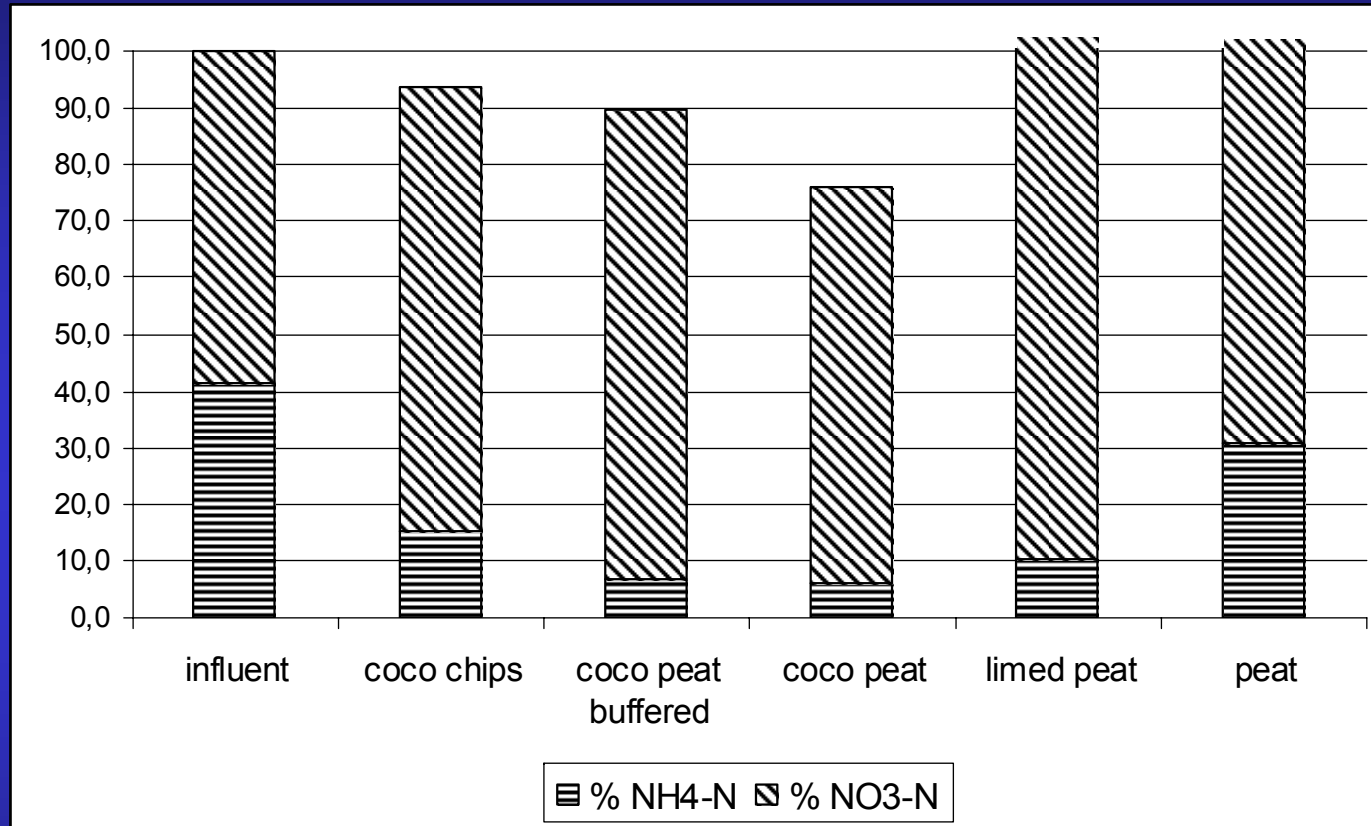
No significant difference between

Coco products: P-value = 0.2929

Buffered and non-buffered coco peat

P-value = 0.1764

Nitrogen



Ratio between $\text{NH}_4^+\text{-N}$ and $\text{NO}_3^-\text{-N}$ in %

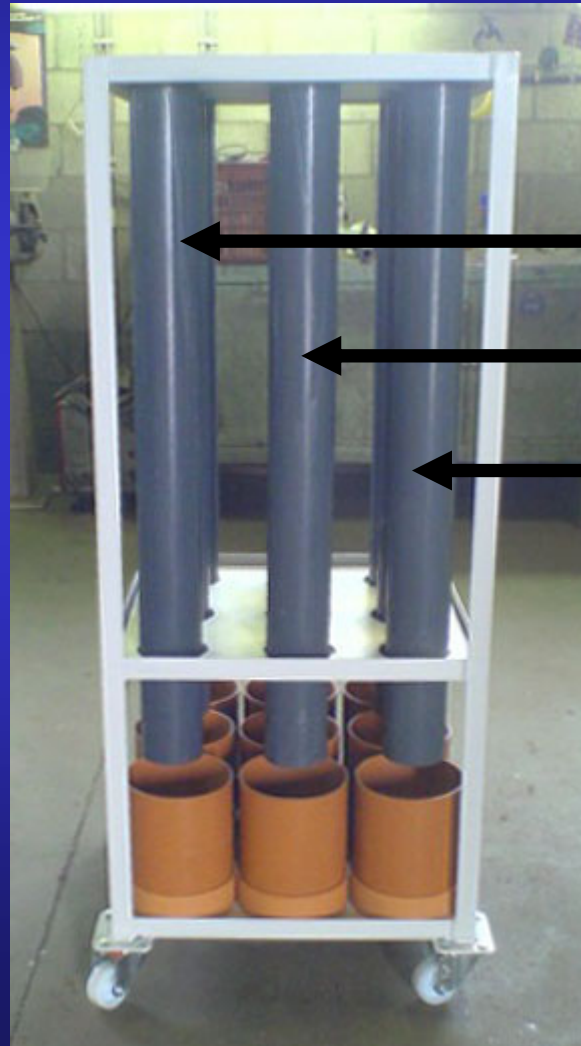
Nitrogen

Infiltration columns:

Height 80cm

Hydraulic loading
50 l / m².d

Sampling



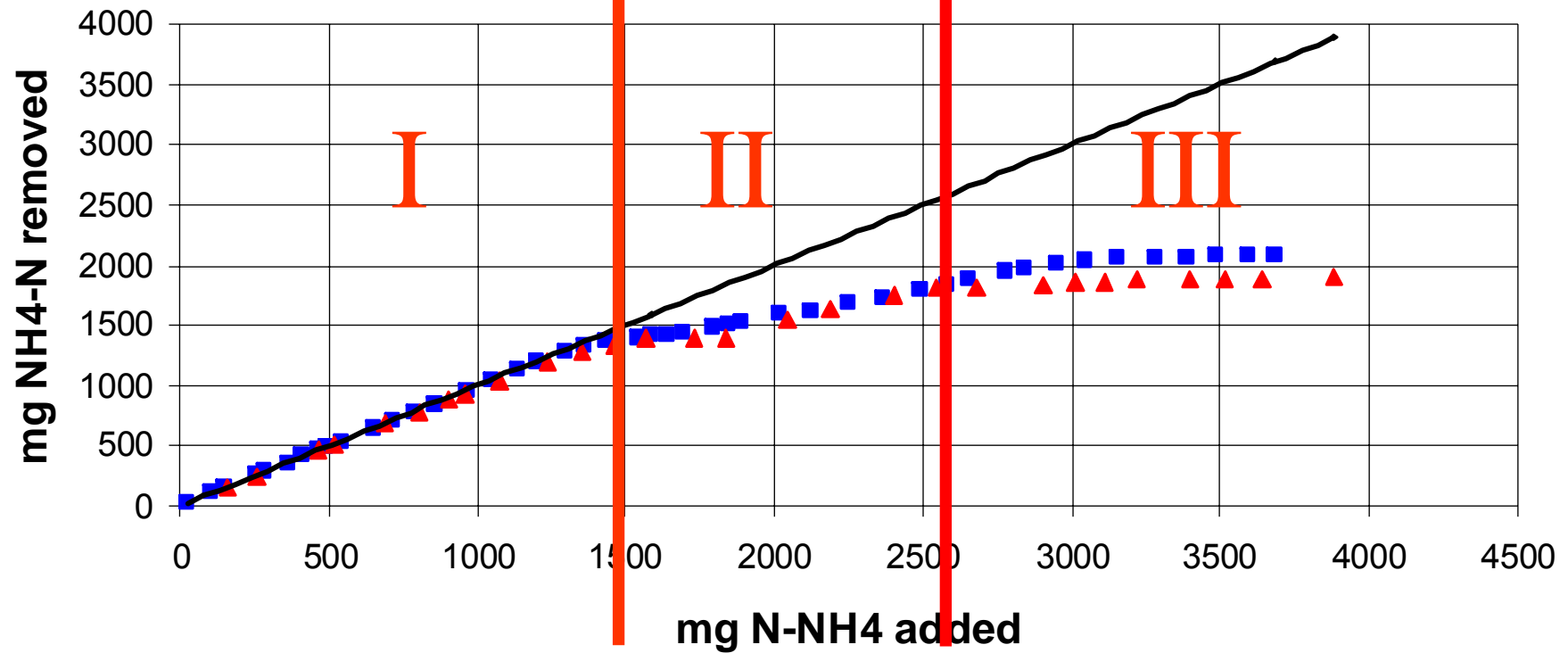
Coco peat

45 ppm N (NH_4NO_3)

225 ppm N (NH_4NO_3)

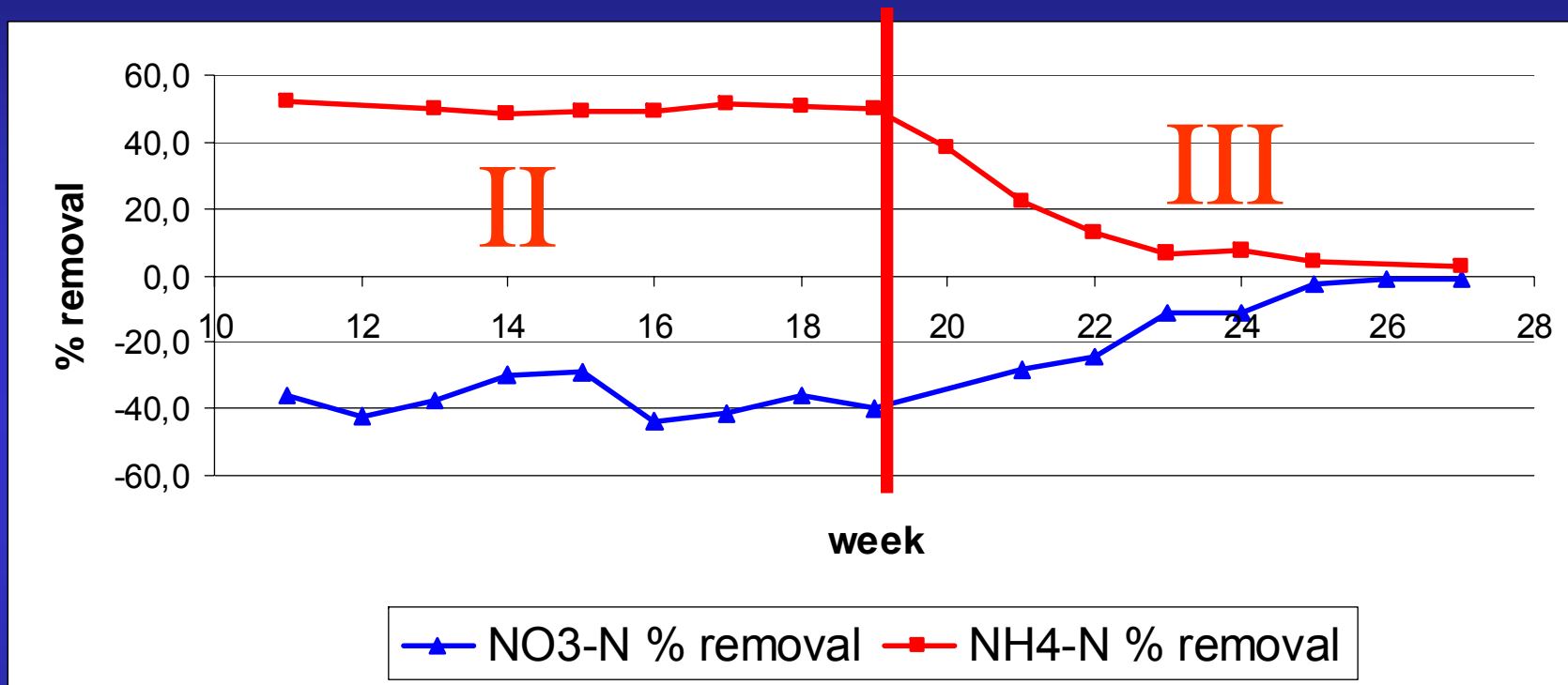
450 ppm N (NH_4NO_3)

Nitrogen

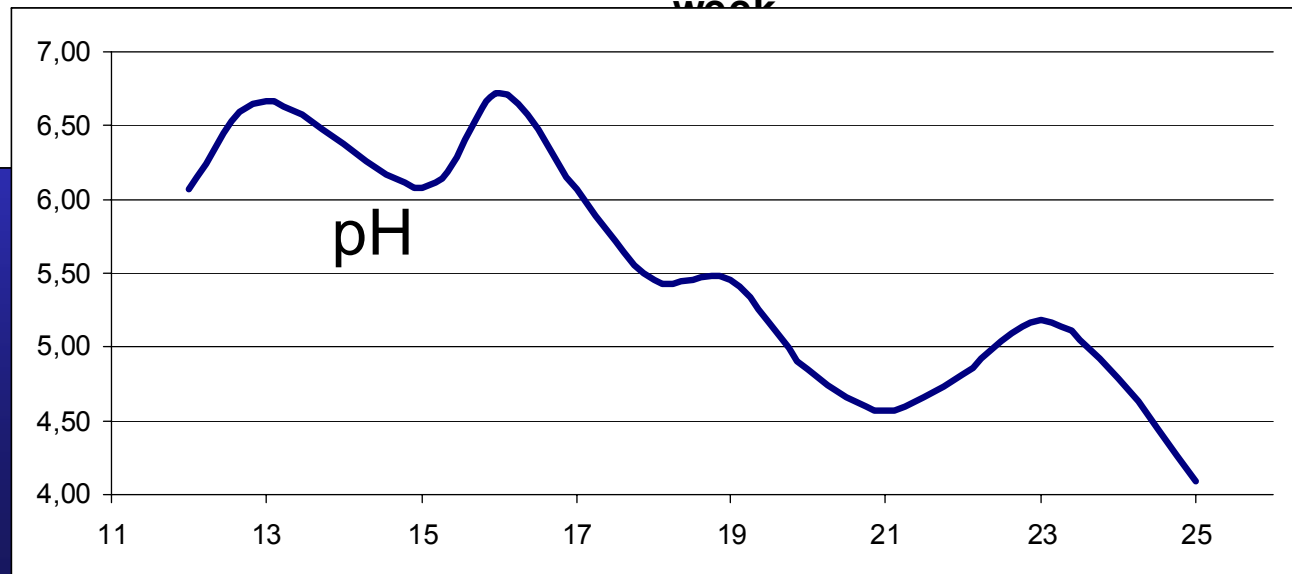
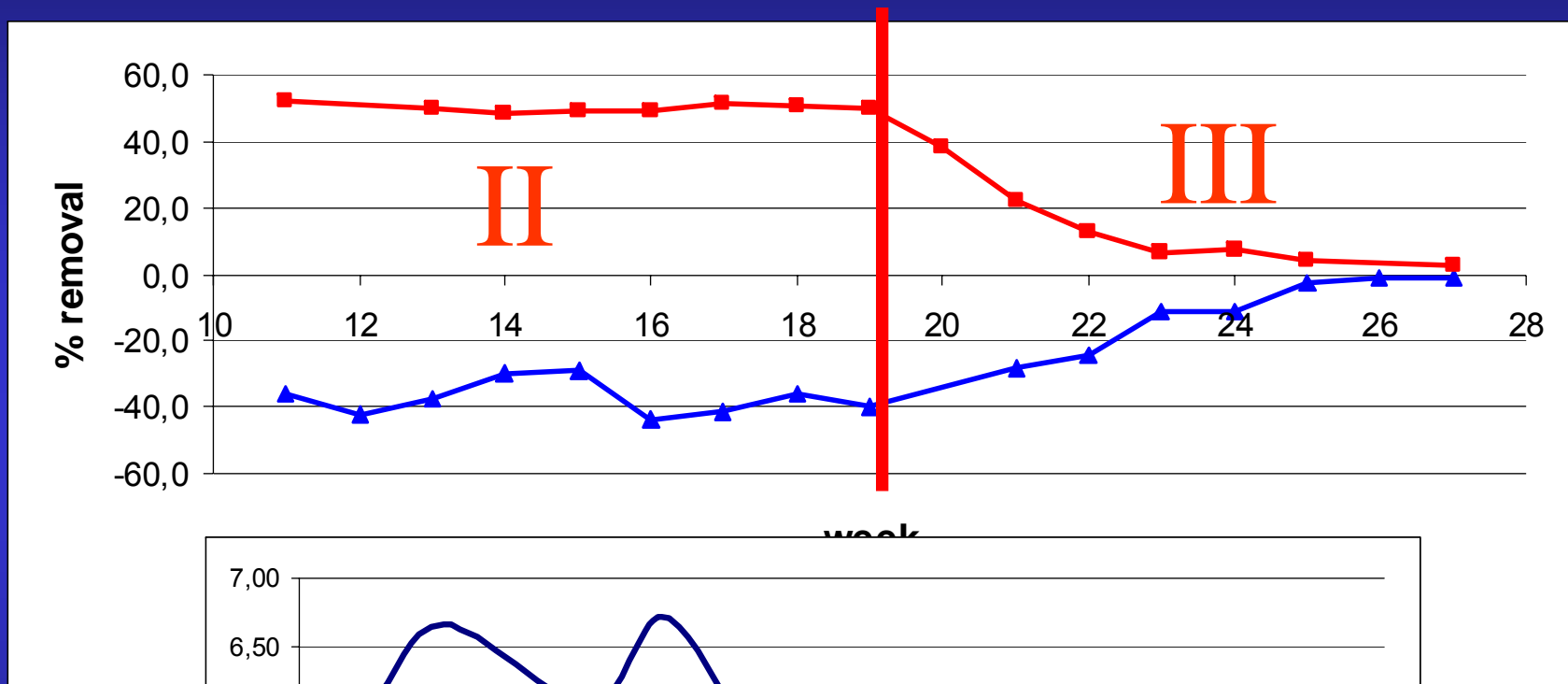


■ Influent TN 225 ▲ Influent TN 450

Nitrogen



Nitrogen



Conclusions

- Phosphorus removal : limited
- Total Nitrogen : limited
- Adsorption $\text{NH}_4^+\text{-N}$
- Nitrification evident in all filter media

Thank you!!!

AKNOWLEDGMENTS

- Supported by the Flemish Ministry for Economy, Enterprise, Science, Innovation and Foreign Trade;
- Peltracom nv, Gent, Belgium;
- Coconsulting, Belgium
- KVLТ, Geel, Belgium