SWS European Chapter Meeting
29th June – 3rd July 2008
Kuressaare, Saaremaa, Estonia

Expanded clay and lava rock as potential filter media for nutrient removal in vertical subsurface flow constructed wetlands

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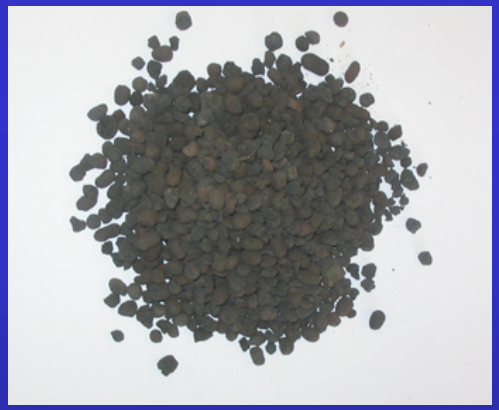
Introduction

Lightweight Expanded Clay Aggregates:

Literature → possible P-removal

Argex ??? ("Flemish" LECA)



Argex 0/4

- Aggregate size: 0 – 4 mm

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Introduction

Lava rock:

Commercial products: CW's treatment of wastewater, water from fish ponds, swimming ponds

- Two types: size: 2 – 12 mm and 8 – 16 mm

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Introduction

Optimizing nutrient removal with constructed wetlands

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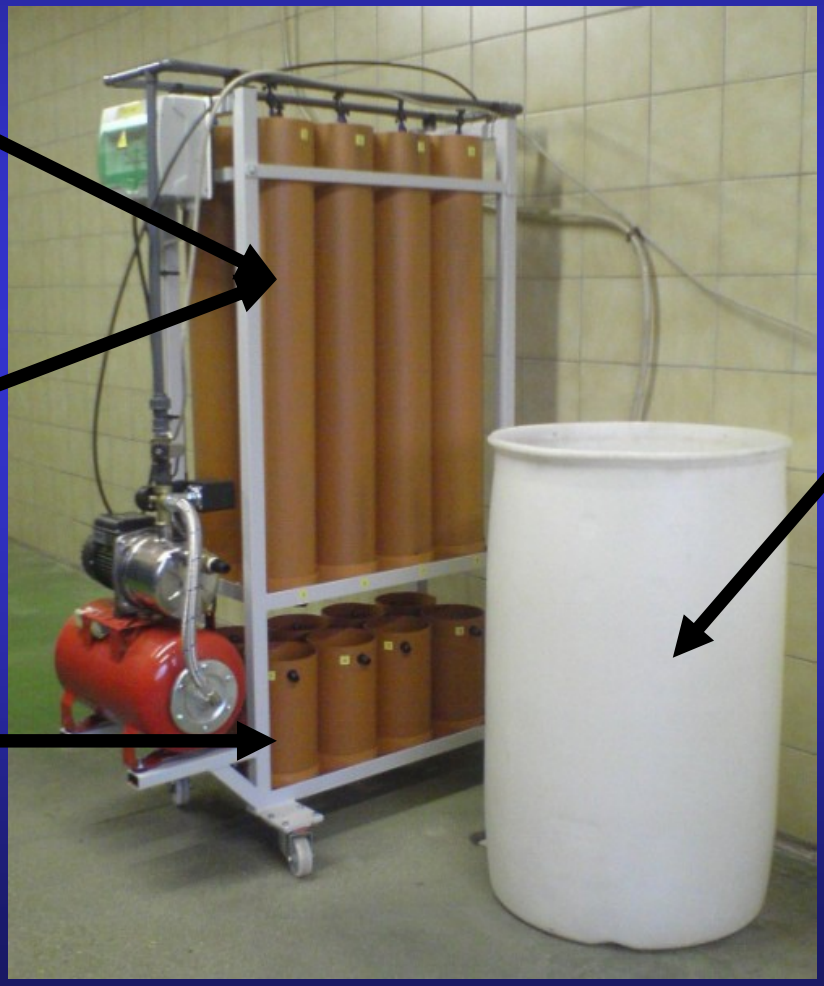
Methods and Materials

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)

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Methods and Materials

Adsorption tests

Determining maximum adsorption capacity

Method (described by Seo, 2005):

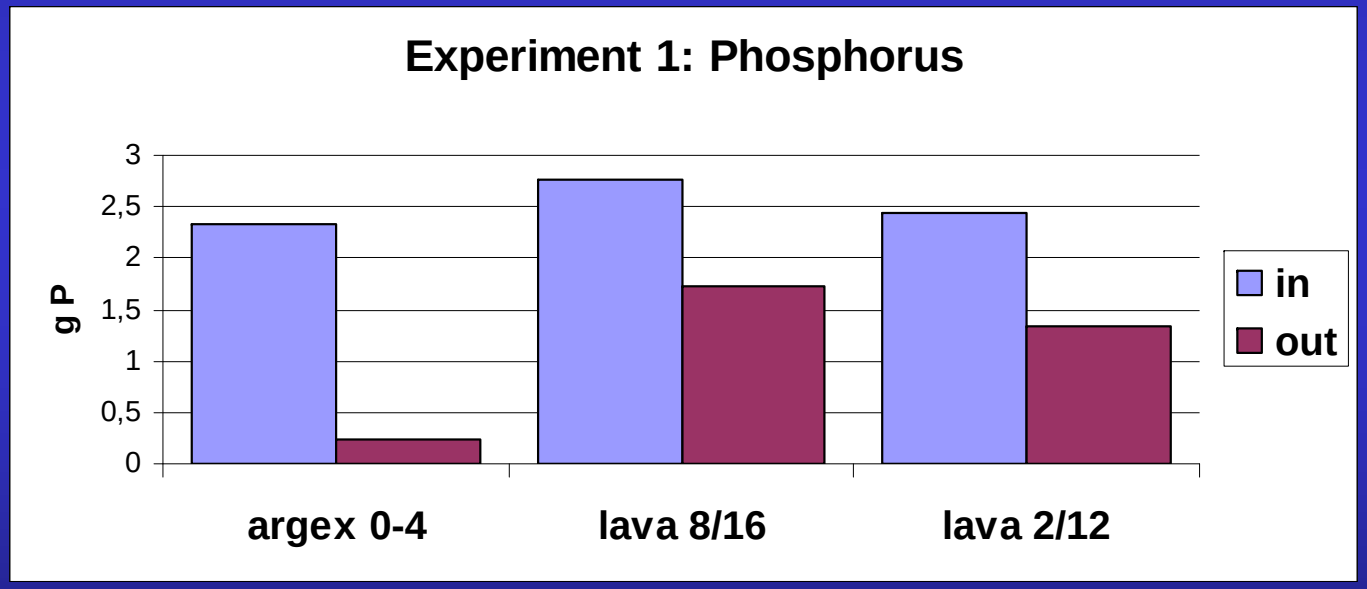
- 10 g of filter media
- Blanks + different P- or N-solutions (100ml)
- Continuously shaken for 24 h
- After settling, supernatant was filtered

Langmuir equation → apparent adsorption capacity

Phosphorus

Experiment 1: 15 mgP/l - 50 l/m².d

Results after 6 months:



Removal: 89.7% 37.7% 45.1%

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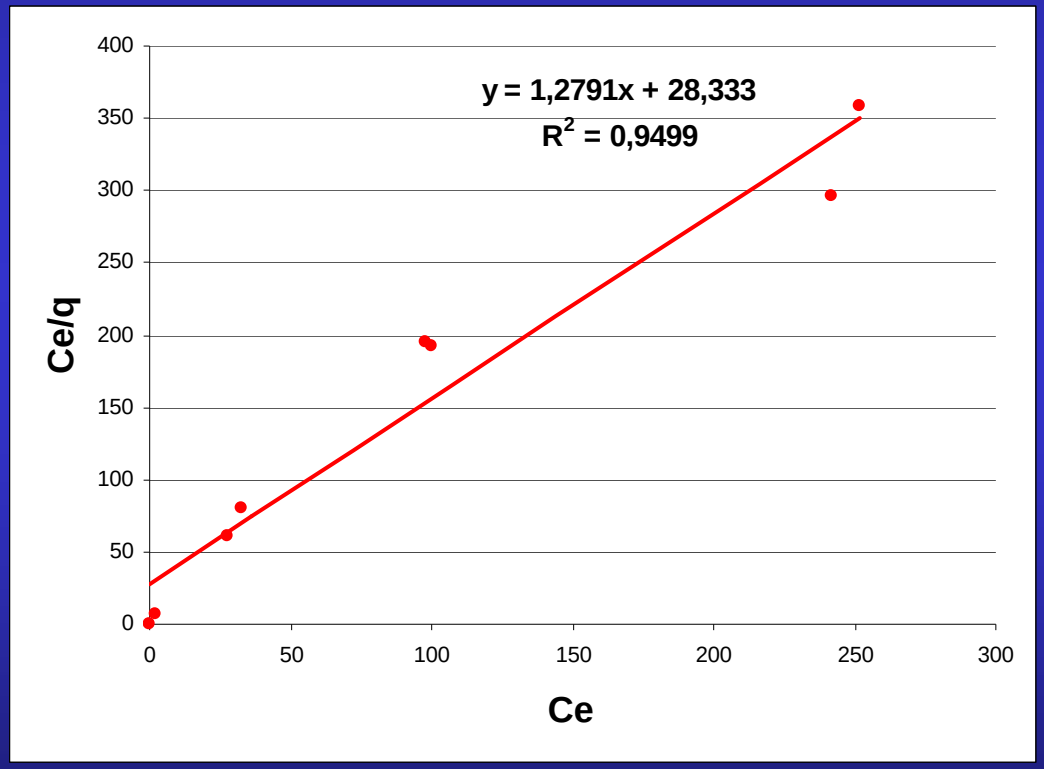
Phosphorus

Lineair **Langmuir** plot: **Argex 0-4**



Langmuir equation:

$C_e/q = C_e/b + 1/a.b$

$C_e/q = 1.2791.C_e + 28.333$

b = apparent maximum adsorption capacity

b = 0.78 mgP/g

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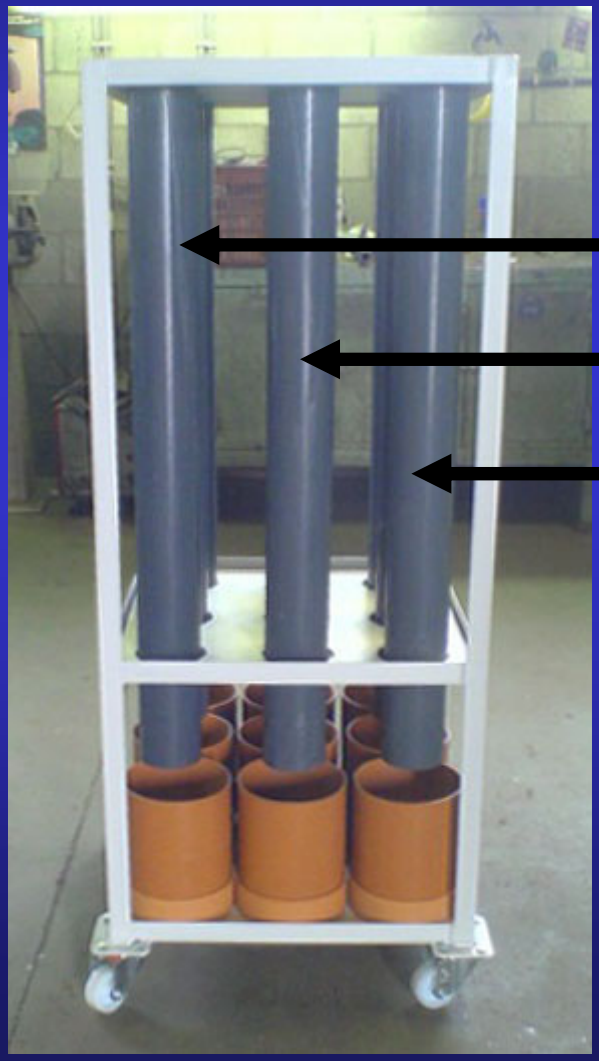
Phosphorus

Infiltration columns:

Height 80cm

Hydraulic loading
50 l / m².d

Sampling



Argex (LWA)

15 ppm P (KH_2PO_4)

75 ppm P (KH_2PO_4)

150 ppm P (KH_2PO_4)

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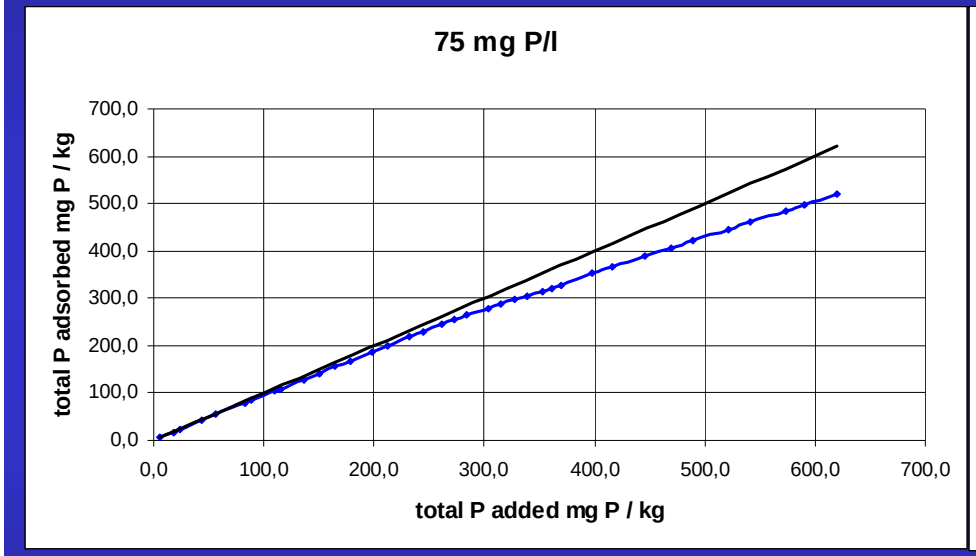
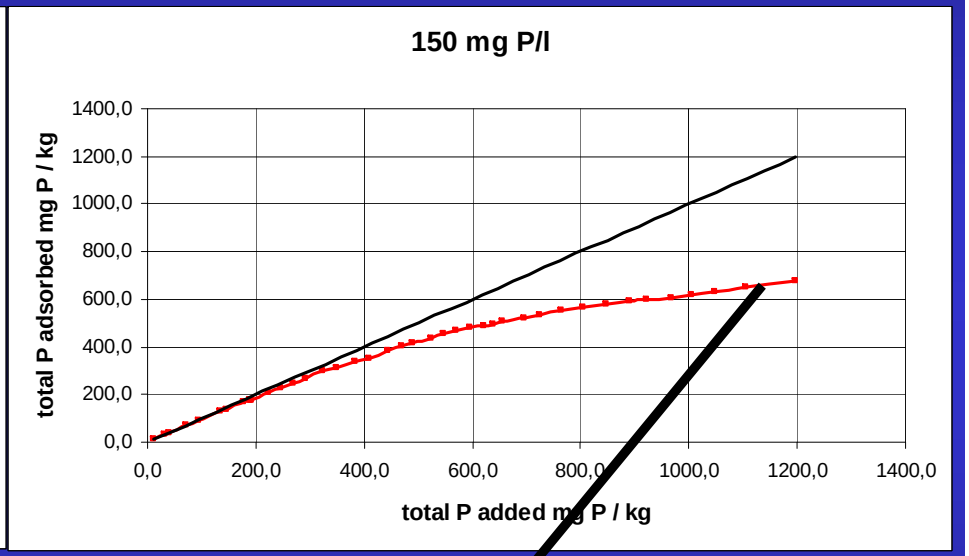
Phosphorus

Experiment 2: column study: maximum adsorption capacity Argex 0-4





maximum adsorption capacity = 0.67 mgP/g

Langmuir = 0.78 mgP/g

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Phosphorus

Z. Tong, et al. (1996)

	Total Metal mg/g	Ca mg/g	P-sorption mg P/g
Filtralite	589	310	2.21
LECA	226	85	0.565
Argex 0-4	**213**	**14**	**0.781**
Arkansas LW	140	12	0.037

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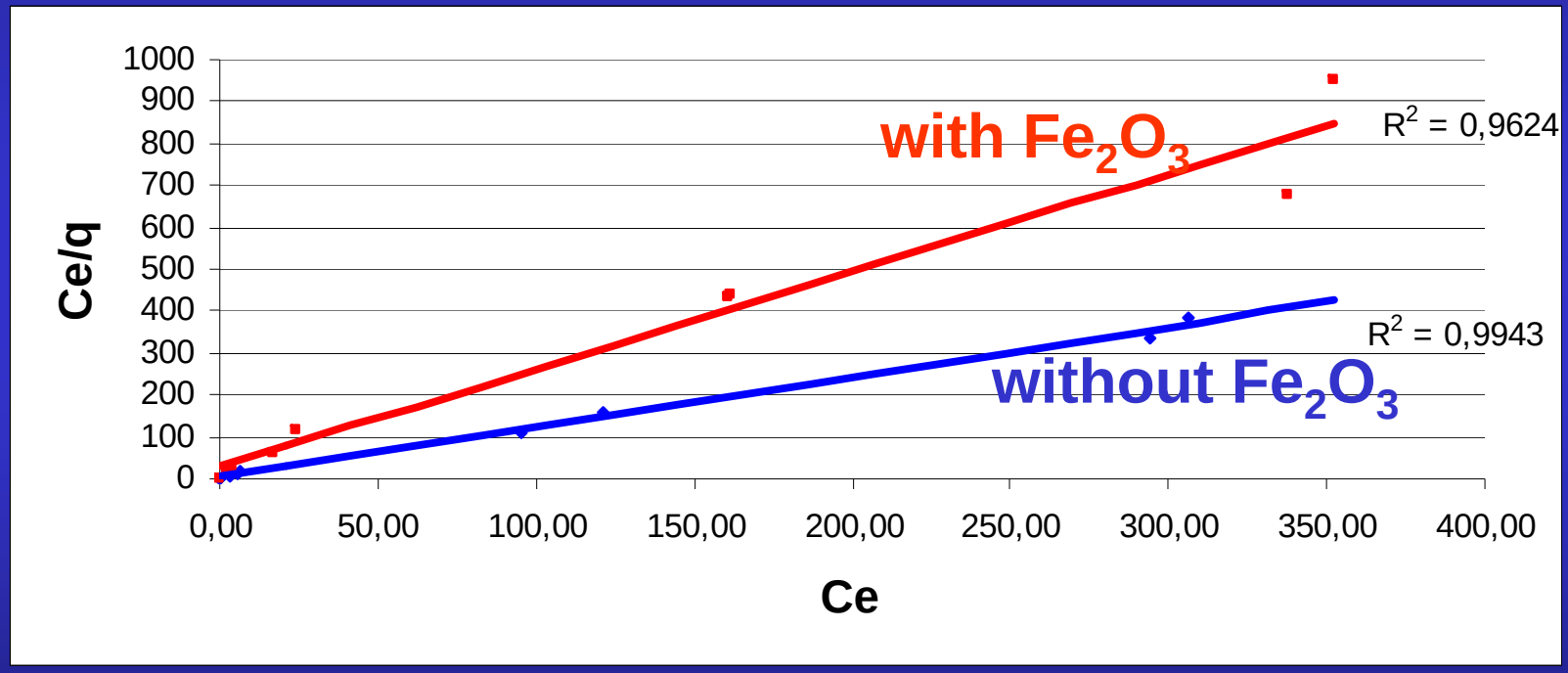
Phosphorus

Lineair Langmuir plot:

Argex with Fe_2O_3 and without Fe_2O_3



b = 0.84 mgP/g b = 0.43 mgP/g

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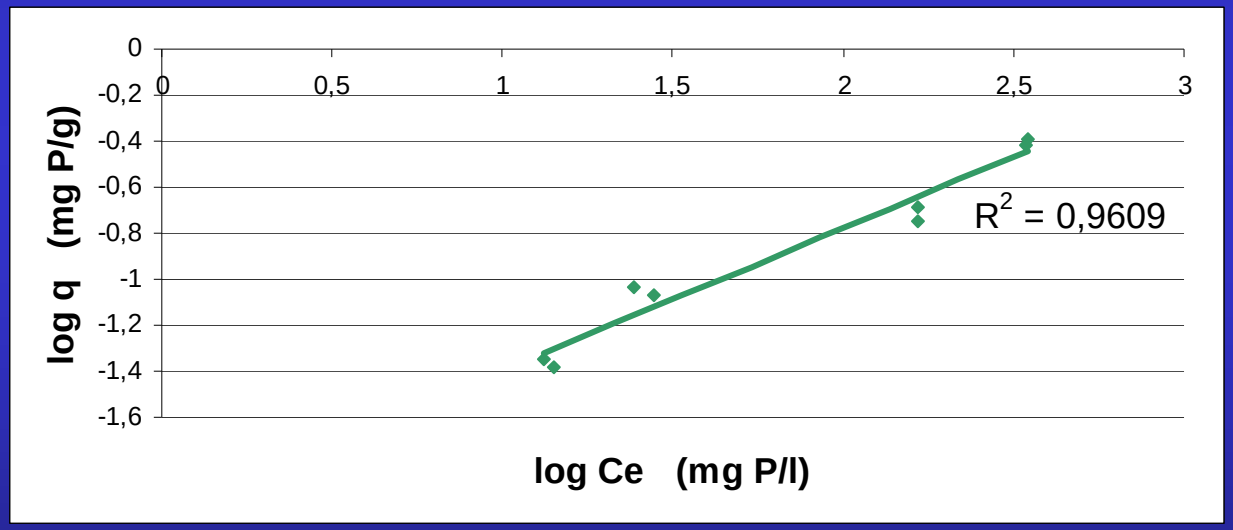
Phosphorus

Lineair **Freundlich** plot: **Lava 2/12**

$$\log q = \log k_f + \frac{1}{n} \log C_e$$



Adsorption tests → max. adsorption capacity = 0.4 mgP/g

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Phosphorus

Freundlich isotherm: $\log q = \log k_f + \frac{1}{n} \log C_e$

	k_f	n	R^2
Lava 2/12	0.008	1.62	0.96
Argex 0-4	0.22	4.81	0.91

Langmuir isotherm: $C_e/q = C_e/b + 1/a.b$

	b	R^2
Lava 2/12	0.410	0.72
Argex 0-4	0.782	0.95

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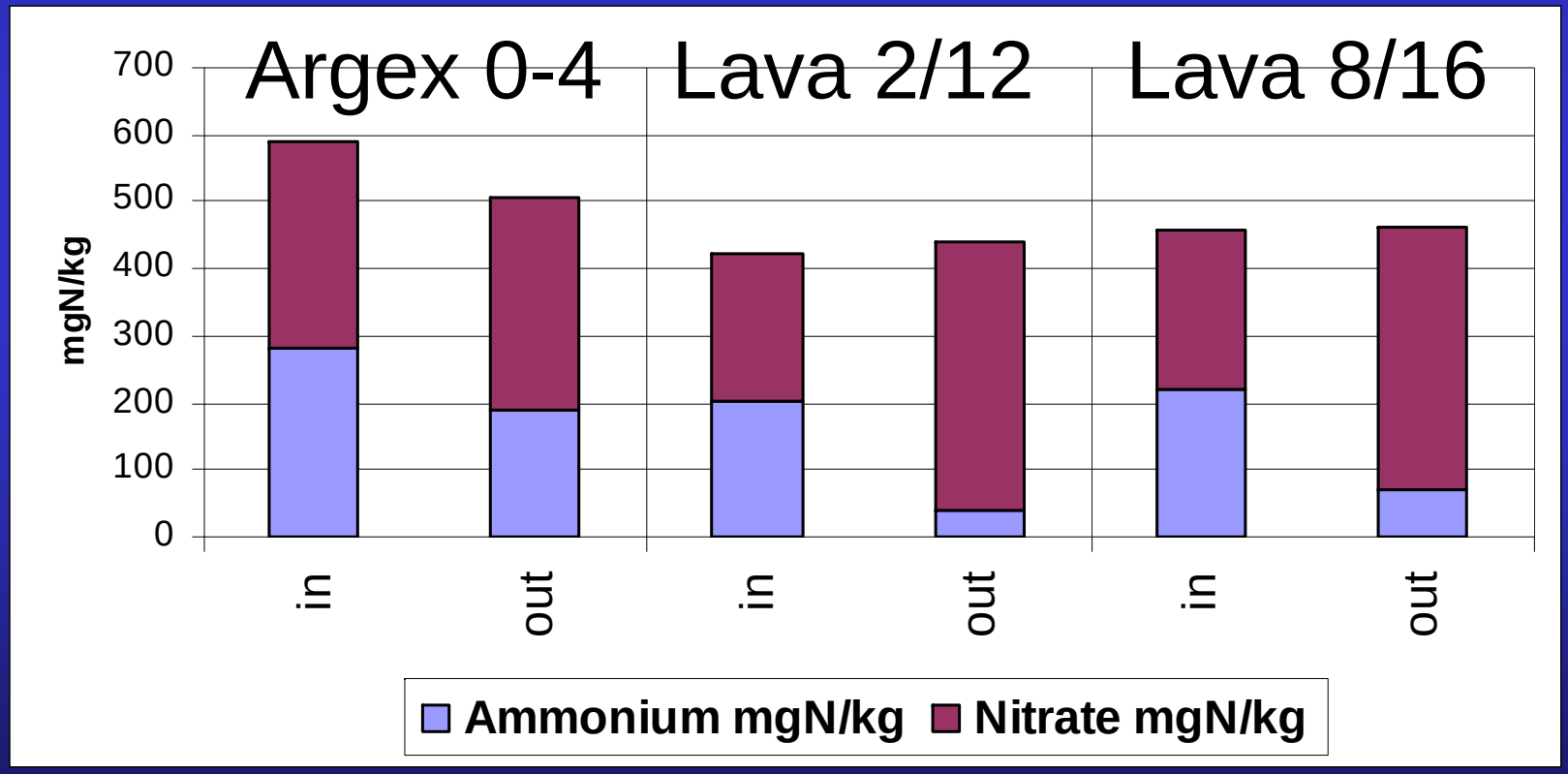
Nitrogen

Experiment 1: 45 mgN/l - 50 l/m².d

Results after 6 months:



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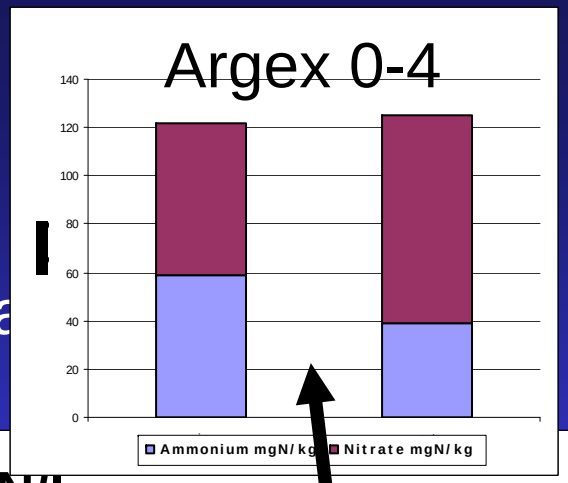
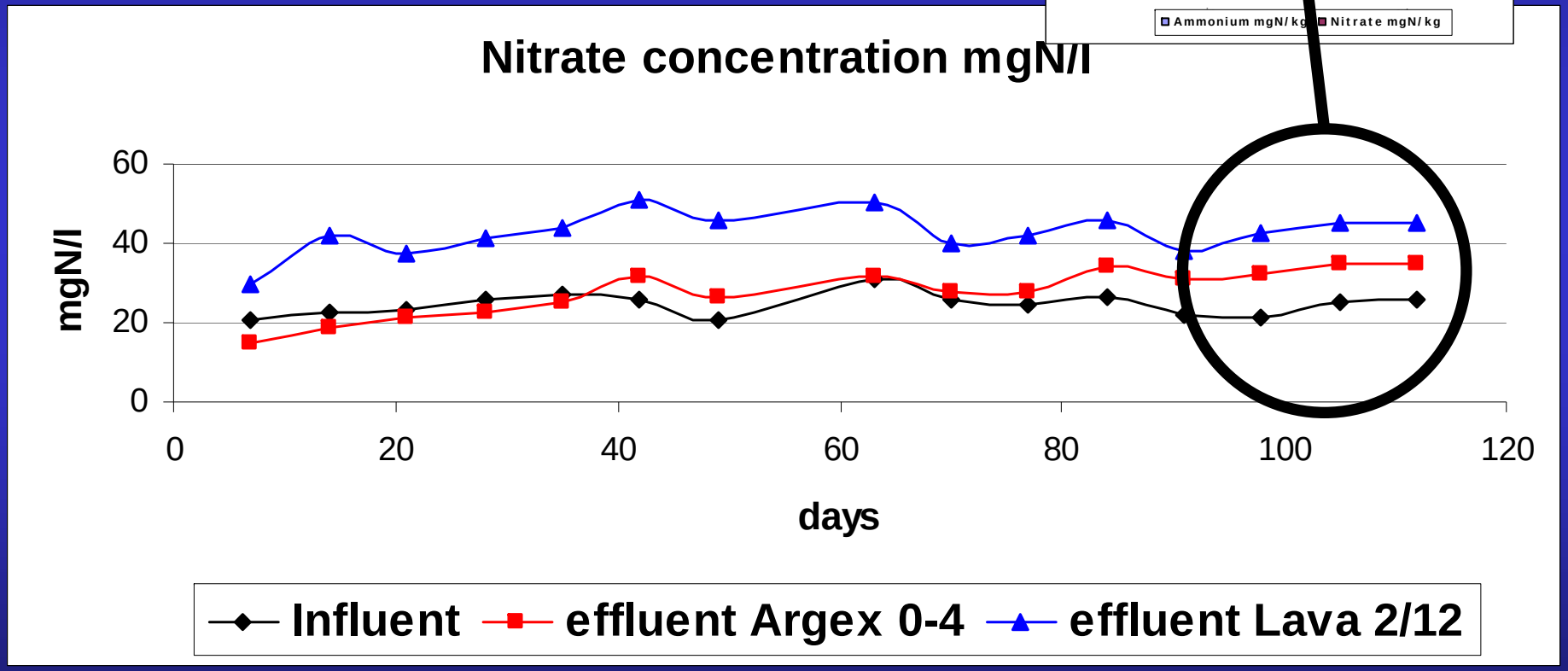
Nitrogen

Experiment 1 16 weeks from the sta





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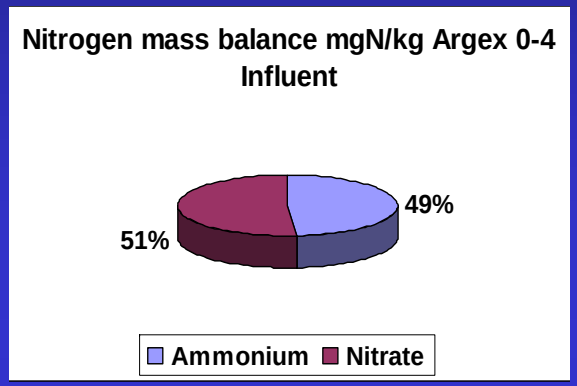
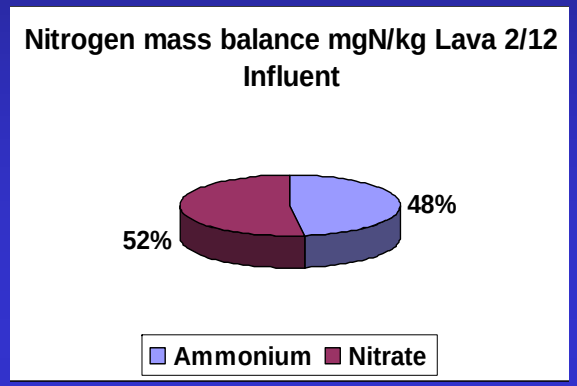
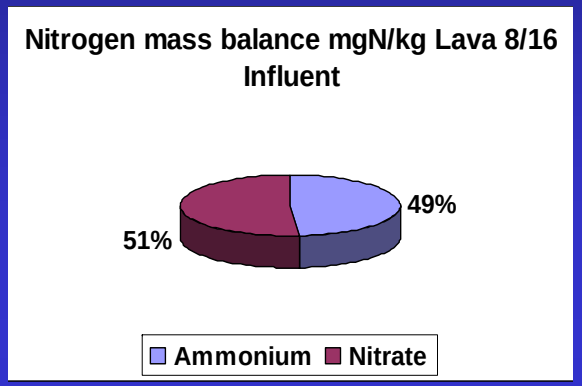
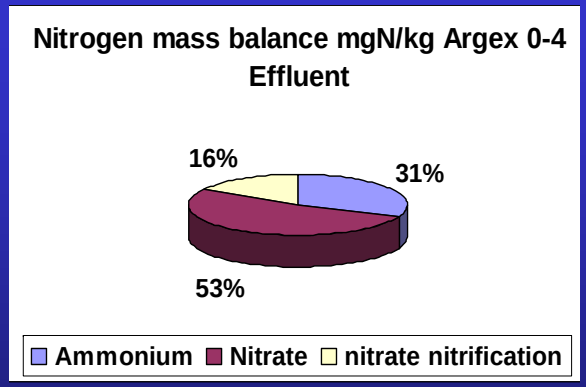
Nitrogen

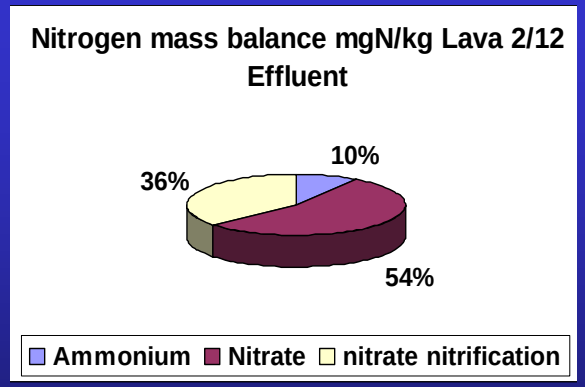
During nitrification:

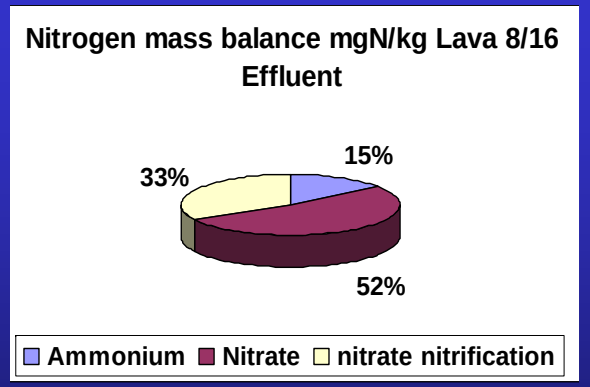












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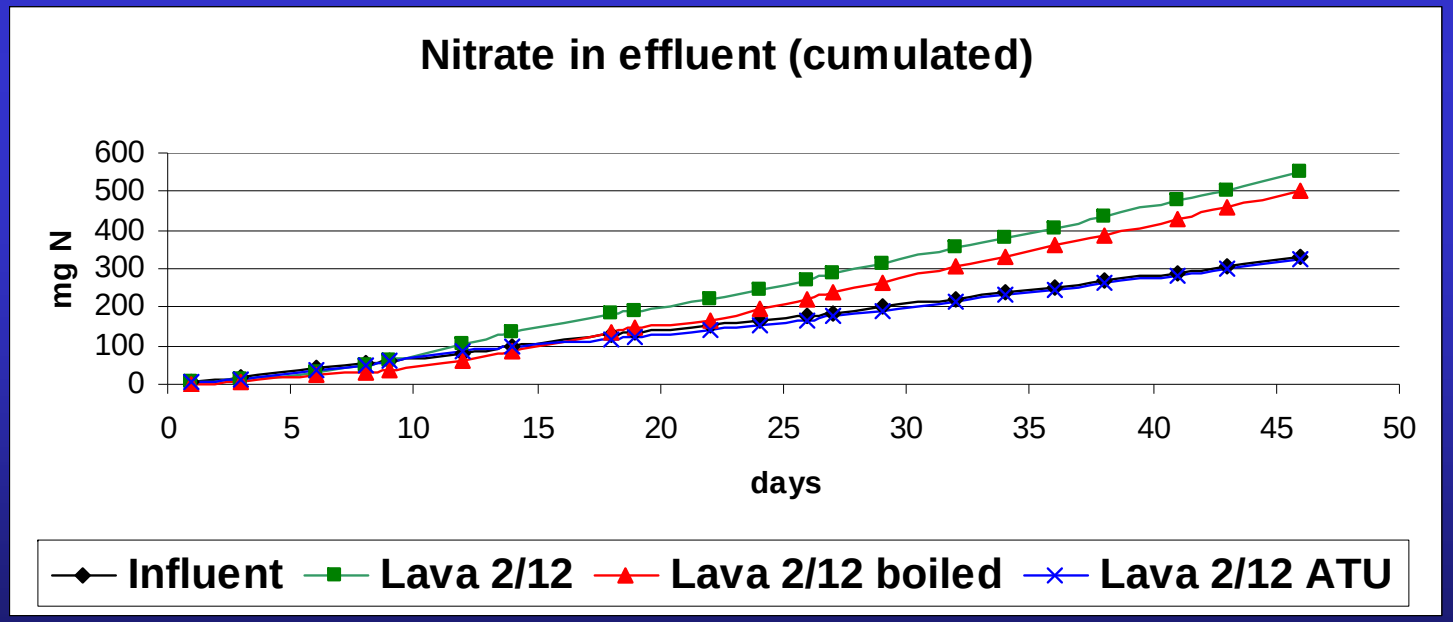
Nitrogen

Experiment :

Lava 2/12: + 45 ppm N (NH_4NO_3)

Lava 2/12 washed with boiling water: + 45 ppm N (NH_4NO_3)

Lava 2/12: + 45 ppm N (NH_4NO_3) + AllylThioUrea (nitrification inhibitor)



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Nitrogen

Experiment 3: Total Nitrogen removal

	% removal
Lava	4.6
Lava (boiled)	12.7
Lava + ATU	36.5

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Nitrogen

Adsorption tests

Argex 0-4: **Ammonium**: no adsorption

Lava 2/12: **Ammonium**: adsorption capacity 0.15 mgN/g

Argex 0-4: **Nitrate**: adsorption capacity 0.10 mgN/g

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Conclusions

- Argex → P-adsorption
  - In a constructed wetland?
  - Quality ?
- Lava rock: Nitrification in a multi-stage system

Thank you!!!

AKNOWLEDGMENTS

• Supported by the Flemish Ministry for Economy, Enterprise, Science, Innovation and Foreign Trade;
• Argex nv, Kruibeke, Belgium;
• Dockx en Co nv, Mechelen, Belgium
• KVLT, Geel, Belgium

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