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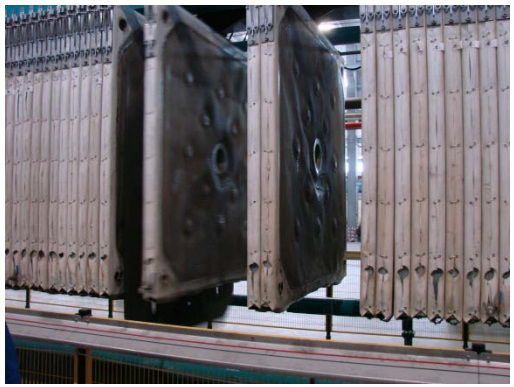
VAMORAS – Reuse of filter cakes as raw materials?

Dr. ir. Liesbeth Horckmans



From AMORAS…

Port of Antwerp

- Annual dredged sediments 500,000 tonnes DM
- Traditional solutions (lagooning fields, underwater cells) exhausted
- Need for sustainable solution

AMORAS

Antwerp Mechanical Dewatering **Recycling** and **Applications** of Sediment

- Construction 2008-2011, operational since October 2011
- 450,000 to 800,000 tonnes DM/year filter cakes
- Capacity of on-site storage facility 30 years – what after?
- Reuse of filter cakes considered from the start of the project

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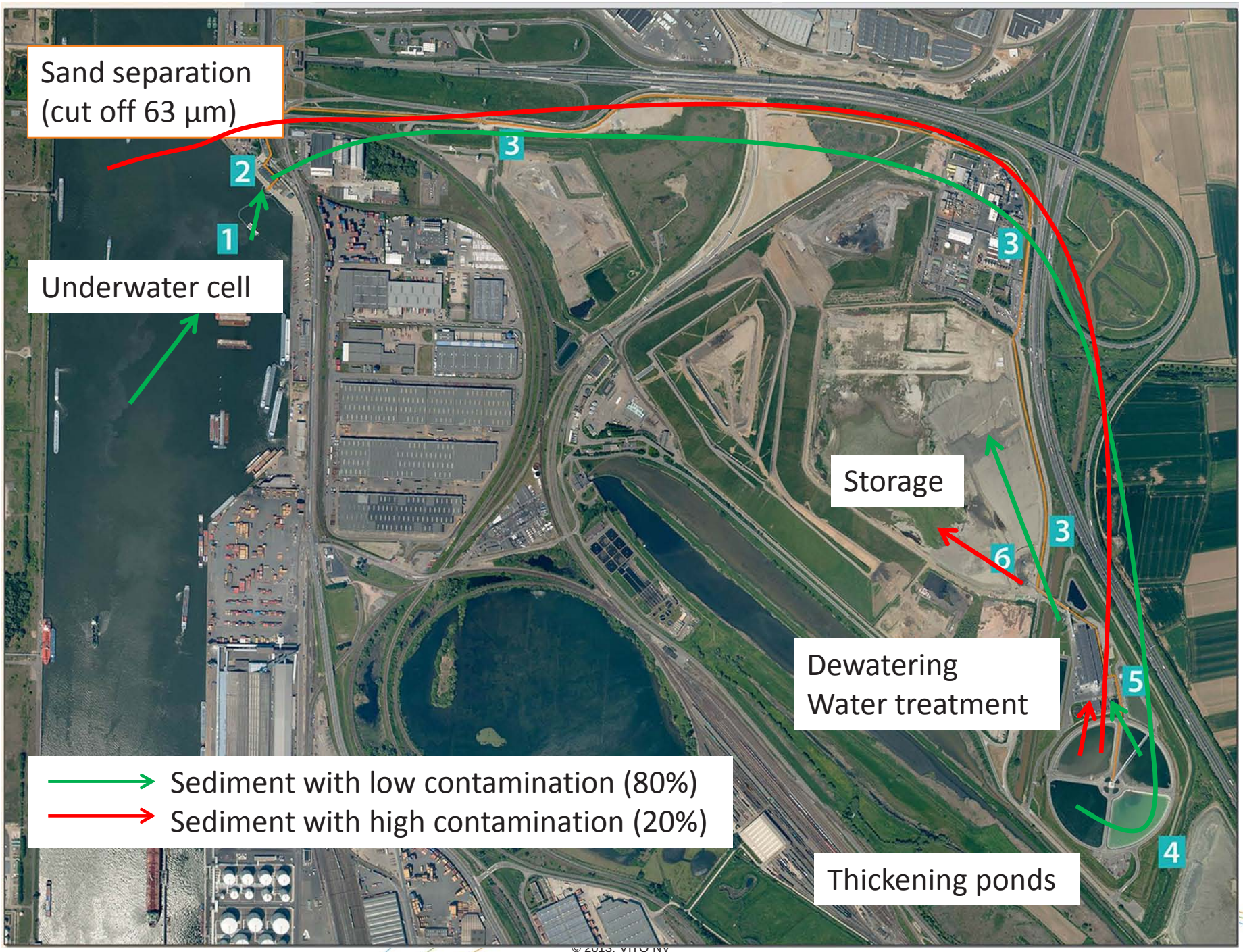
Sand separation
(cut off 63 µm)
2
3
1
3
Underwater cell
Storage
3
6
Dewatering
Water treatment
5
4
Thickening ponds
Sediment with low contamination (80%)
Sediment with high contamination (20%)

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… to VAMOS RA

Circa 500 kton DM filter cakes per year
Continuous, homogenous, fine-grained material of good environmental quality

Valorisation of filter cakes as raw materials?

- Clay replacement in ceramics
  - expanded clay aggregates
  - bricks
- Filler in concrete
- Infrastructure works (dykes, roads, …)

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VAMOS RA

2011-2013

argex

Wienerberger

departement Mobiliteit en Openbare Werken

Vlaamse overheid

Characterization & optimization of filter cakes

Financing

mip Supporting the green economy

IWT

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Port of Antwerp

dr

wtcb.be Onderzoekt • Ontwikkelt • Informeert

OCW

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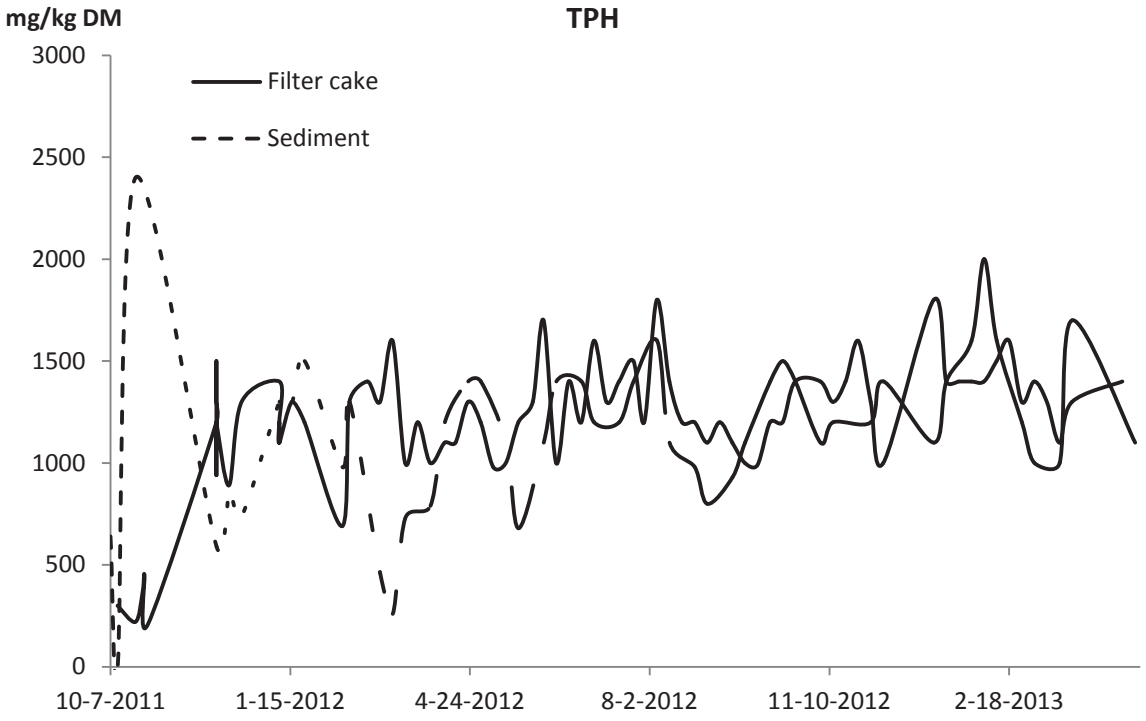
Characterization

Metals (mg/kg DM)	
Arsenic (As)	50 ± 9
Cadmium (Cd)	6 ± 1
Chromium (Cr)	140 ± 14
Copper (Cu)	82 ± 14
Mercury (Hg)	1.1 ± 0.2
Lead (Pb)	160 ± 67
Nickel (Ni)	38 ± 4
Zinc (Zn)	650 ± 137



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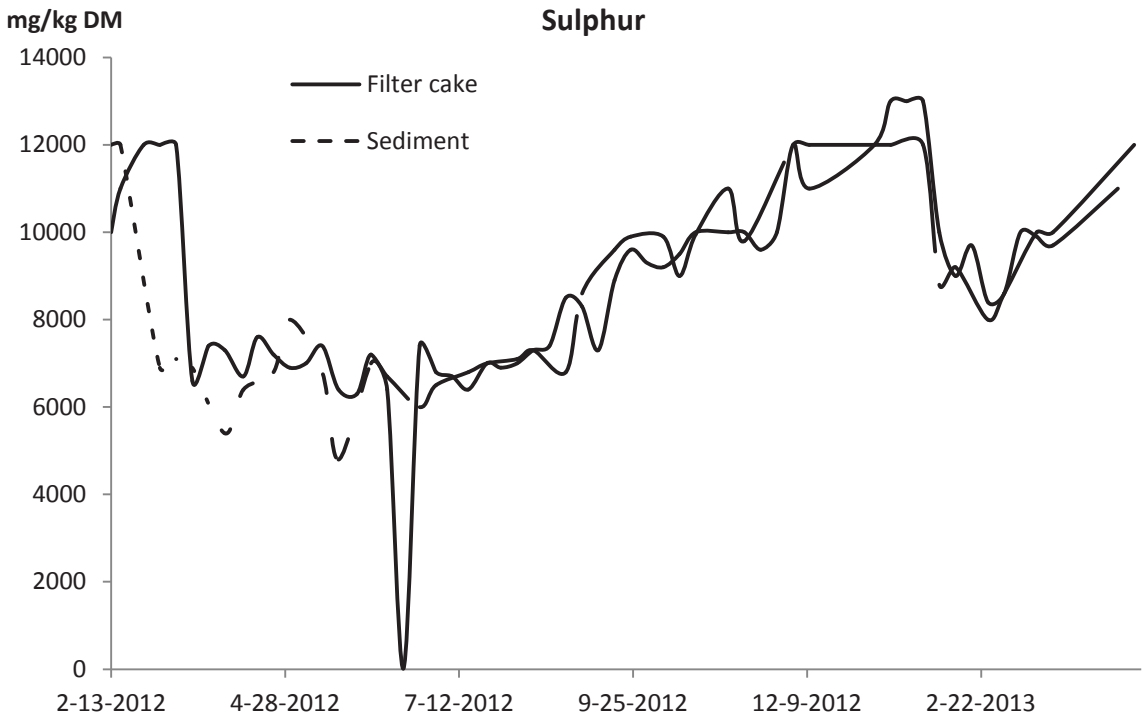
Characterization



- Linked to natural sulphides in sediment
- Seasonal trend
- Potential issue for sulphur emissions/sulphate leaching

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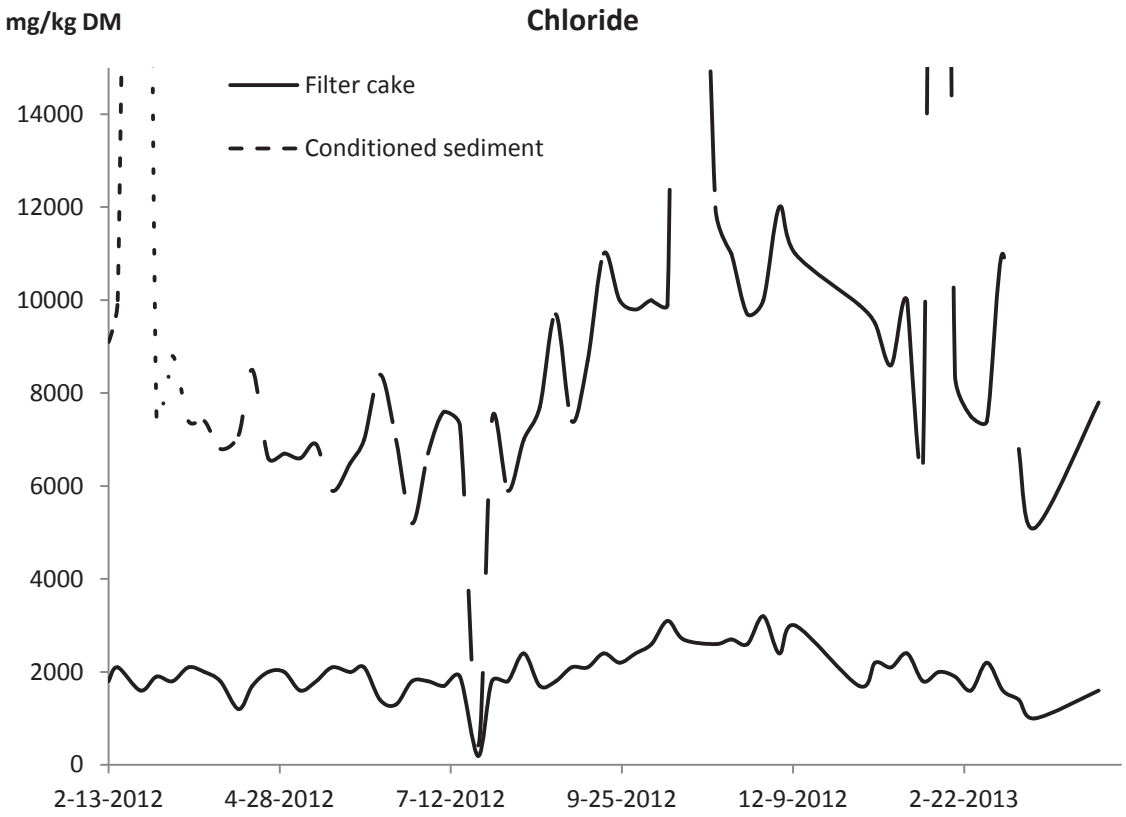
Characterization



- Linked to brackish water
- Seasonal trend (limited impact on filter cakes)
- Potential issue for chloride emissions/chloride leaching

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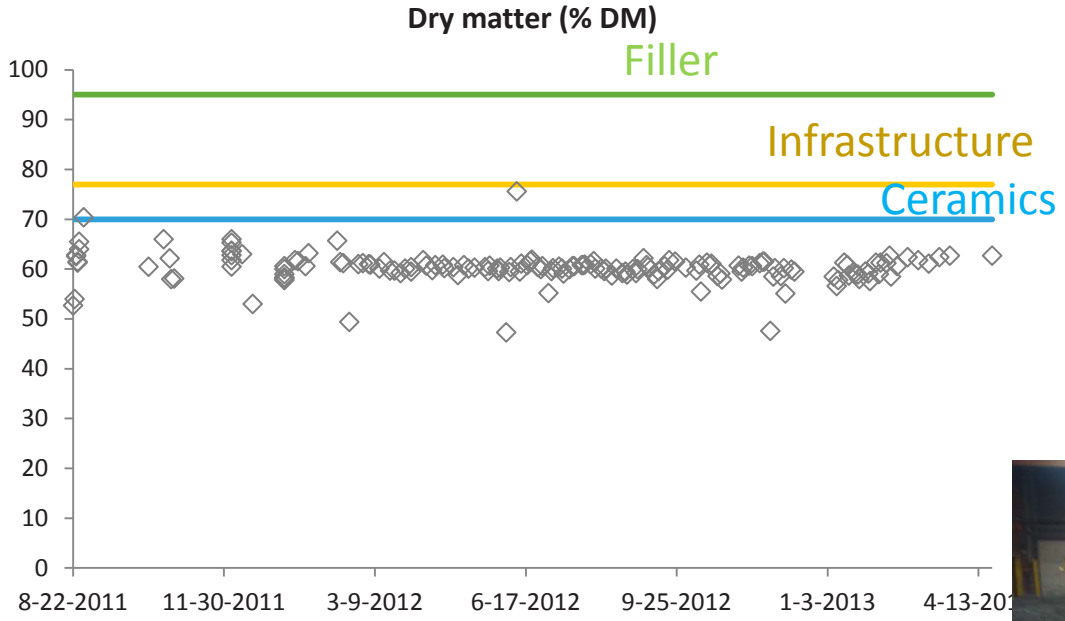
Optimization – Drying



Natural drying?

- Slow
- Heterogeneous
- Labour intensive
- Large covered surface needed

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Optimization – Drying

Thermal drying (filler)

- Drum dryer (500-600°C)
- Calibration/milling !
- Price estimate (high): ~50 EUR/ton filler

Direct mixing of lime/cement (infrastructure)?

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Optimization – As leaching

- As leaching (standard filter cakes) > Flemish threshold for reuse
- As from natural origin (sulphides, glauconite): 50 ± 9 mg/kg DM
- Test to determine influence on As leaching of
  - Composition of filter cakes
    - Type of coagulant (lime, lime + $FeCl_3$, PE)
    - Addition of Fe-rich sludge to immobilise As
  - Temperature (40°C, 600°C, 1000°C)

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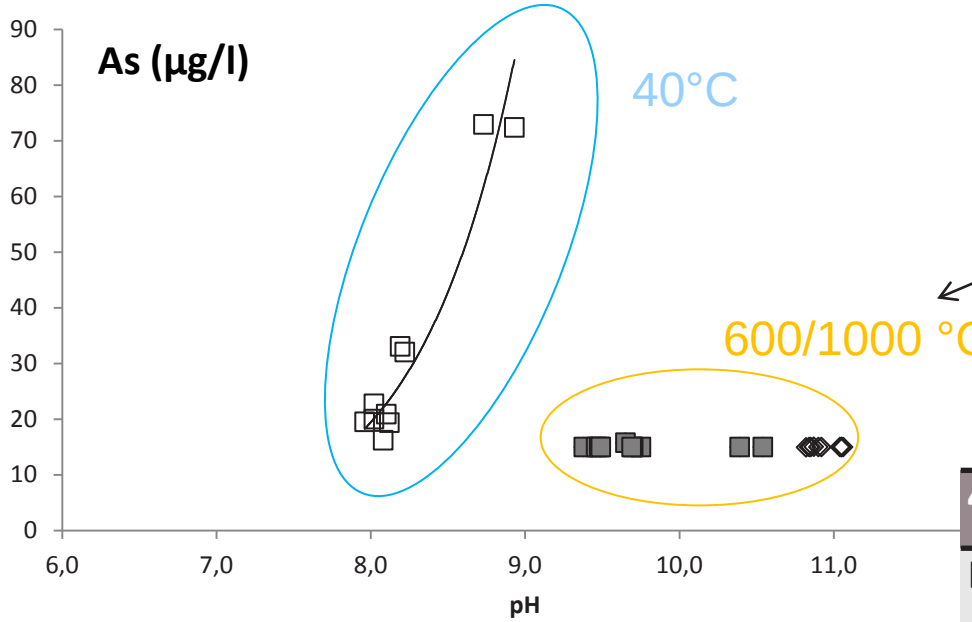
Optimization – As leaching



One step leaching, 24h, L/S 10

40°C	pH	As (µg/l)
Lime (2.5 m%)	8,8	73
Lime (2.5 m%) + $FeCl_3$ (0.45 m%)	8,1	22
→ PE	8,0	20
Fe-rich sludge 1m%	8,2	33
→ Fe-rich sludge 5m%	8,1	18

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Industrial applications

- Laboratory scale experiments
- Industrial production trials
- Pilot scale applications

- Testing of technical and environmental quality

- Market study to evaluate potential

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Industrial applications – main results

- **Ceramics** (expanded clay aggregates, bricks)
  - 5- 10% clay replacement feasible
  - Filter cakes can be used without preparation
  - Further optimization experiments ongoing
  - Economic feasibility depends on additional costs

- **Filler**
  - Drying/milling very important!
  - Increased w/c due to high water demand
  - Further optimization of recipe ongoing
  - High preparation costs: aim for high value filler!

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Main results industrial applications

- **Infrastructure**
  - Drying necessary – best method to be determined
  - Technically feasible as supporting layer
  - Additional strength obtained by mixing with lime/cement
  - Optimization needed for environmental quality

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Conclusions

- AMORAS process results in **continuous stream of homogeneous, fine-grained material of good environmental quality**
  - Optimization needed for leaching of As, chloride, sulphate

- Intermediary results for applications:
  - Expanded clay aggregates: **5-10% clay replacement feasible**, no pre-treatment needed, economically feasible
  - Bricks: **5-10% clay replacement feasible**, no pre-treatment needed, additional maintenance and production costs
  - Filler: high pre-treatment costs (drying, milling), additional research **aimed at high value filler**
  - Infrastructure: mixing with lime/cement needed for additional strength, drying necessary, further investigations into **optimal mixing method**

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Thank you for your attention!

Questions?

More information:

www.amoras.be

www.mipvlaanderen.be/nl/webpage/99/vamoras.aspx

www.portofantwerp.com

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