From removal to recovery: Recovery processes

RAVITA

19.3.2018 Laura Rossi

HSY

Basic task

We produce and organise water services,
waste management services and environmental regional information

Customers

Residents and business companies in the Helsinki Metropolitan Area

Member municipalities

Espoo
Helsinki
Kauniainen
Vantaa

HSY

Purely better, every day

RAITA

Viikinmäki WWTP, Helsinki

- Start-up in 1994
- The largest treatment plant in Nordic countries
- PE 1 100 000, influent 270 000 m³/d
- Is located mostly in underground rock caverns
- Biological treatment is combined with chemical treatment

t/a	IN	OUT	Red. %
Total phosphorus	650	21	97
Total nitrogen	5 000	409	92

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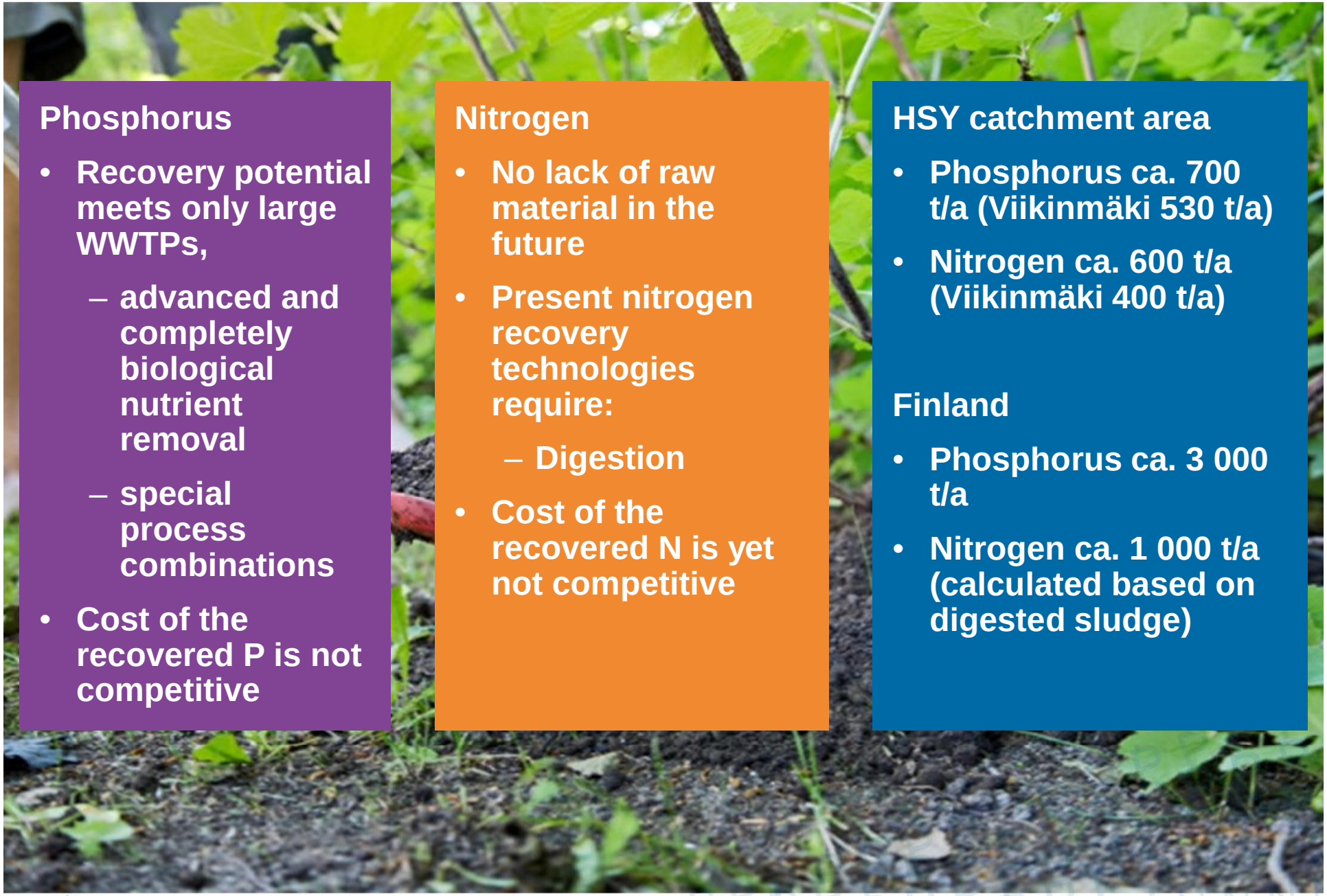
Viikinmäen jätevedenpuhdistamo



Phosphorus

- Recovery potential meets only large WWTPs,
  - advanced and completely biological nutrient removal
  - special process combinations
- Cost of the recovered P is not competitive

Nitrogen

- No lack of raw material in the future
- Present nitrogen recovery technologies require:
  - Digestion
- Cost of the recovered N is yet not competitive

HSY catchment area

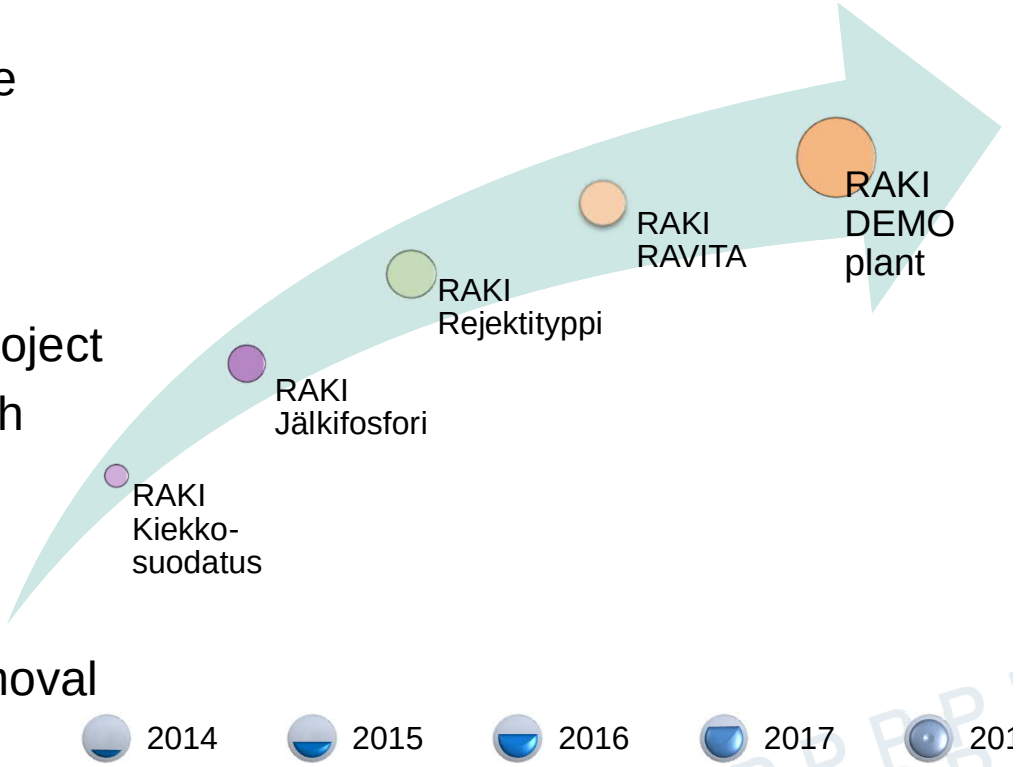
- Phosphorus ca. 700 t/a (Viikinmäki 530 t/a)
- Nitrogen ca. 600 t/a (Viikinmäki 400 t/a)

Finland

- Phosphorus ca. 3 000 t/a
- Nitrogen ca. 1 000 t/a (calculated based on digested sludge)

HSY RAKI Projects

- **RAKI Kiekkosuodatus *(disc filtration)* project**
  - 2014
  - Focus on extreme low main stream effluent phoshorus
    - Side product: chemical sludge
- **RAKI Jälkifosfori *(post-phoshorus)* project**
  - 2-11/2015
  - Spin off from RAKI disc filtration project
  - Focus on chemical sludge research
- **RAKI rejektityppi *(nitrogen of reject water)* project**
  - 2/2015 -2016
  - Focus on side stream nitrogen removal and recory
- **RAKI RAVITA**
  - 2016-2017
  - Focus on nutrient recovery by RAVITA process



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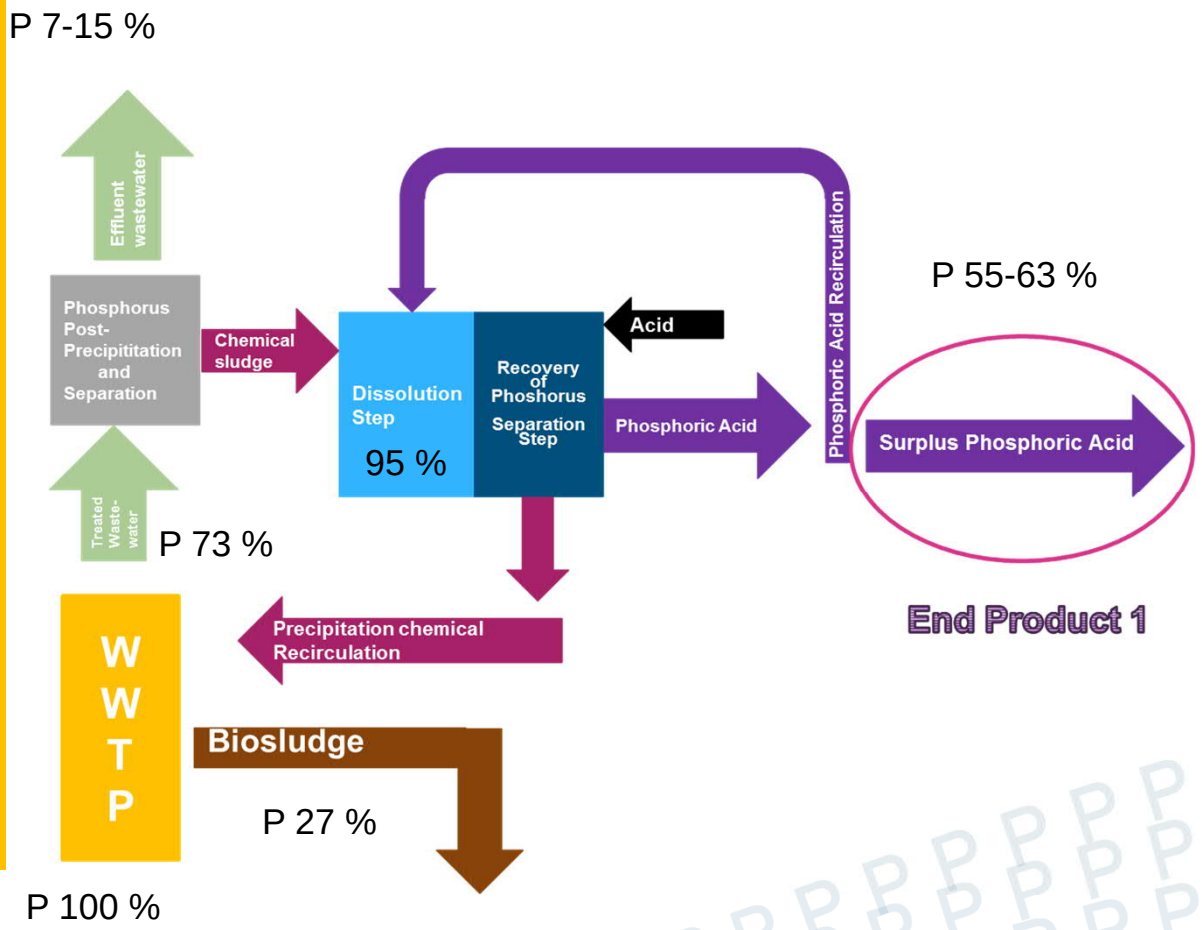
+ Recovery from <u>water phase</u>
+ Recovery as PHOSPHORIC ACID
+ Size neutral
+ Nutrient harvesting
+ Inner circulations
+ Combination with N recovery
+ Low heavy metal& micropollutant conc.

–Tertiary process phase

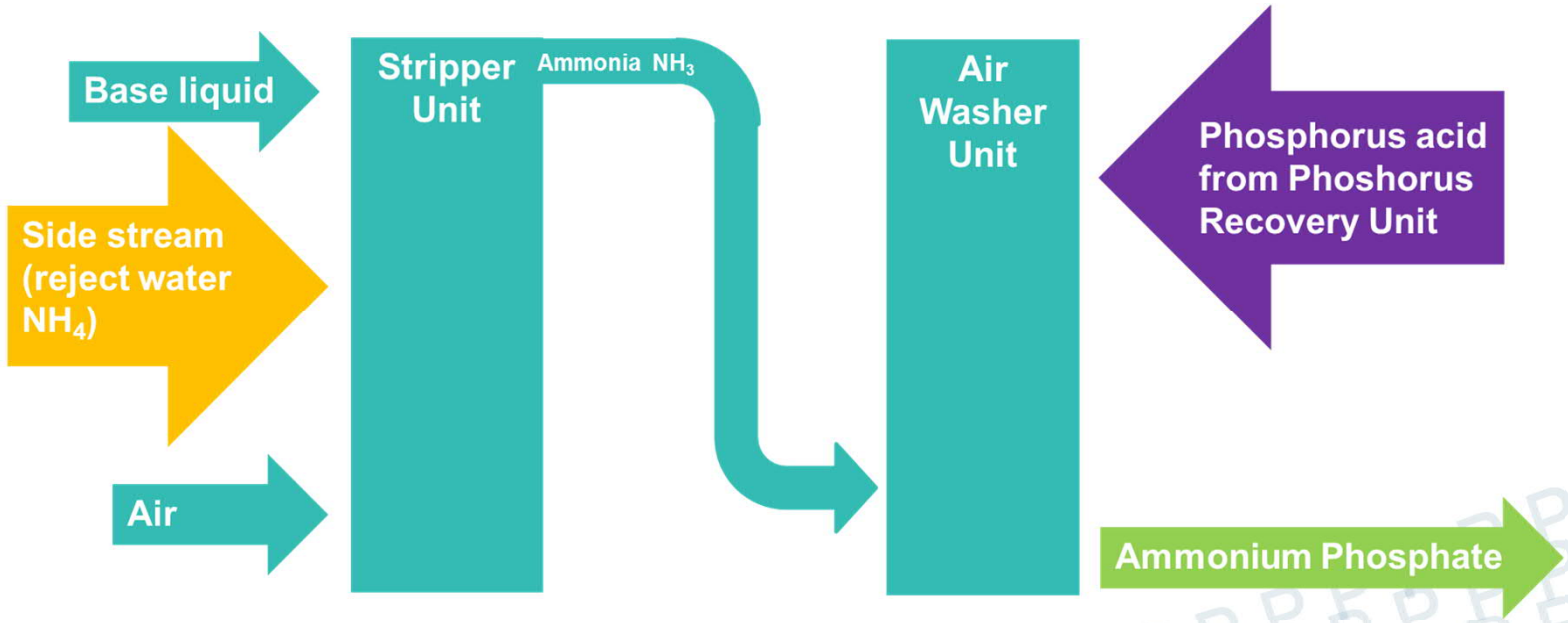
–New innovation requires still piloting and testing

- (TRL 5)



RAVITA Phosphorus Recovery Ideology

- Reject waters are high in N
  - 20 % of treatment plant's N load
- Phosphoric acid is used in the washer unit
- Product AMMONIUM PHOSPHATE



HSY RAVITA combination with nitrogen recovery

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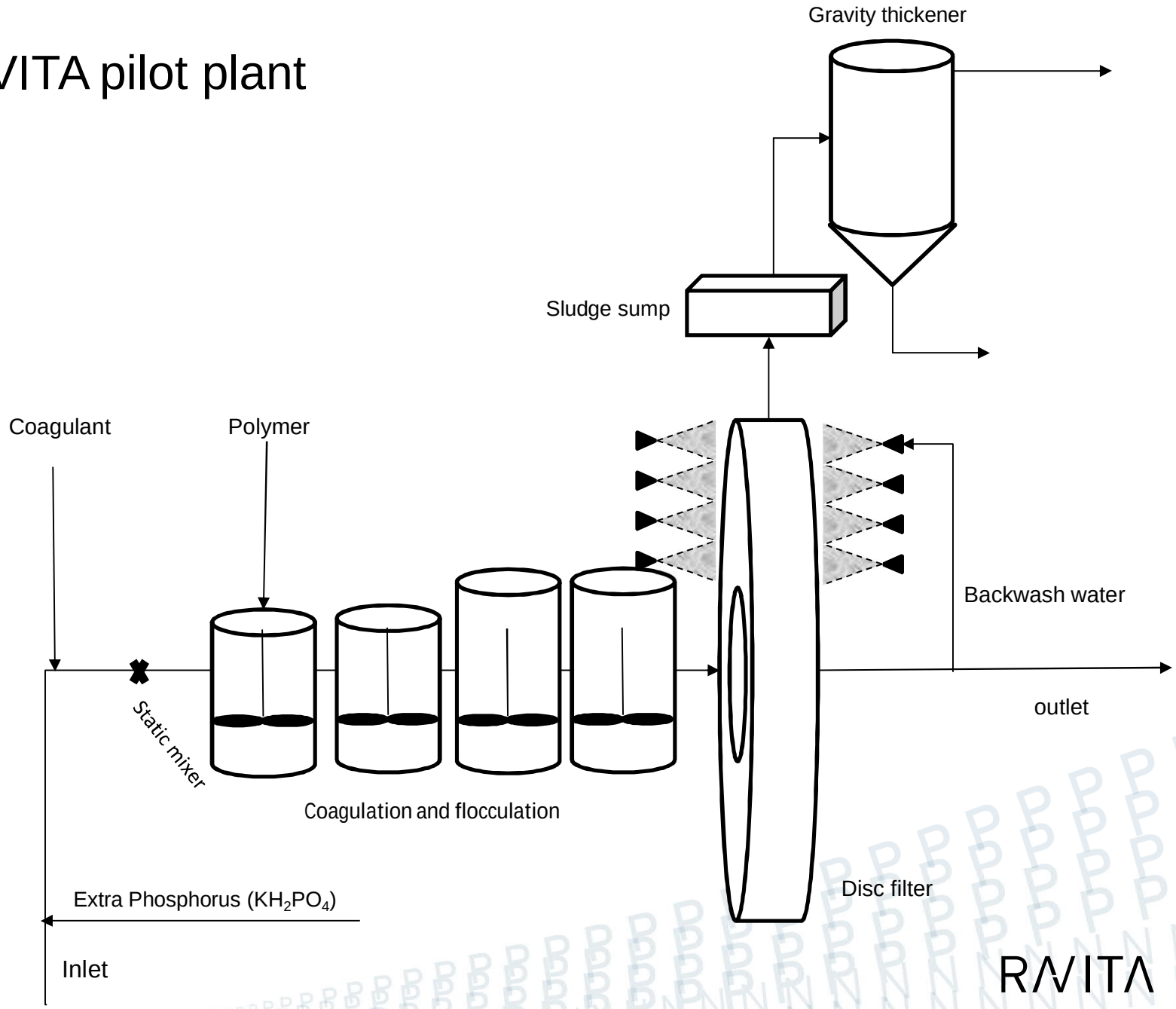
RAVITA pilot plant



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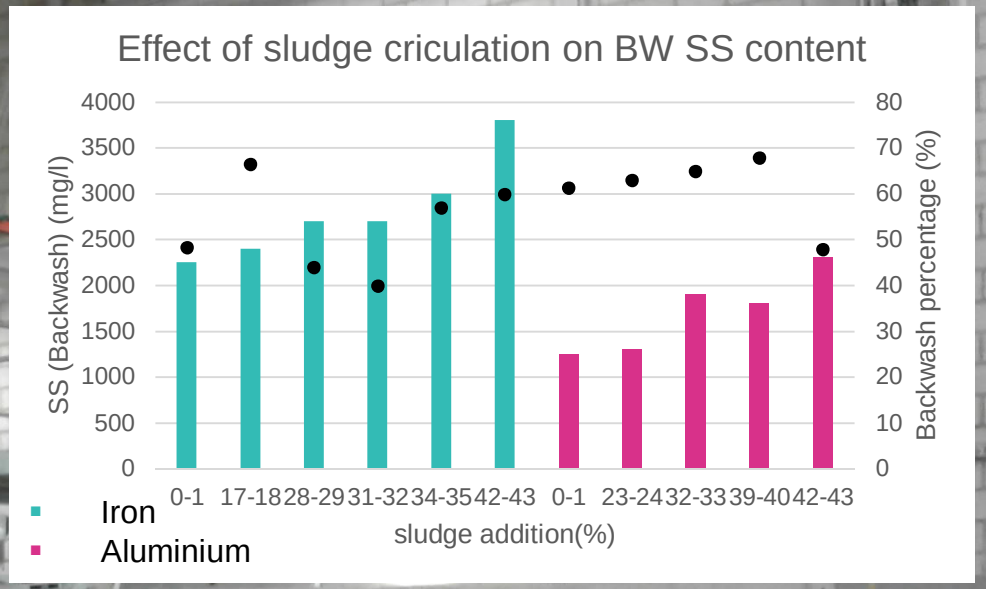
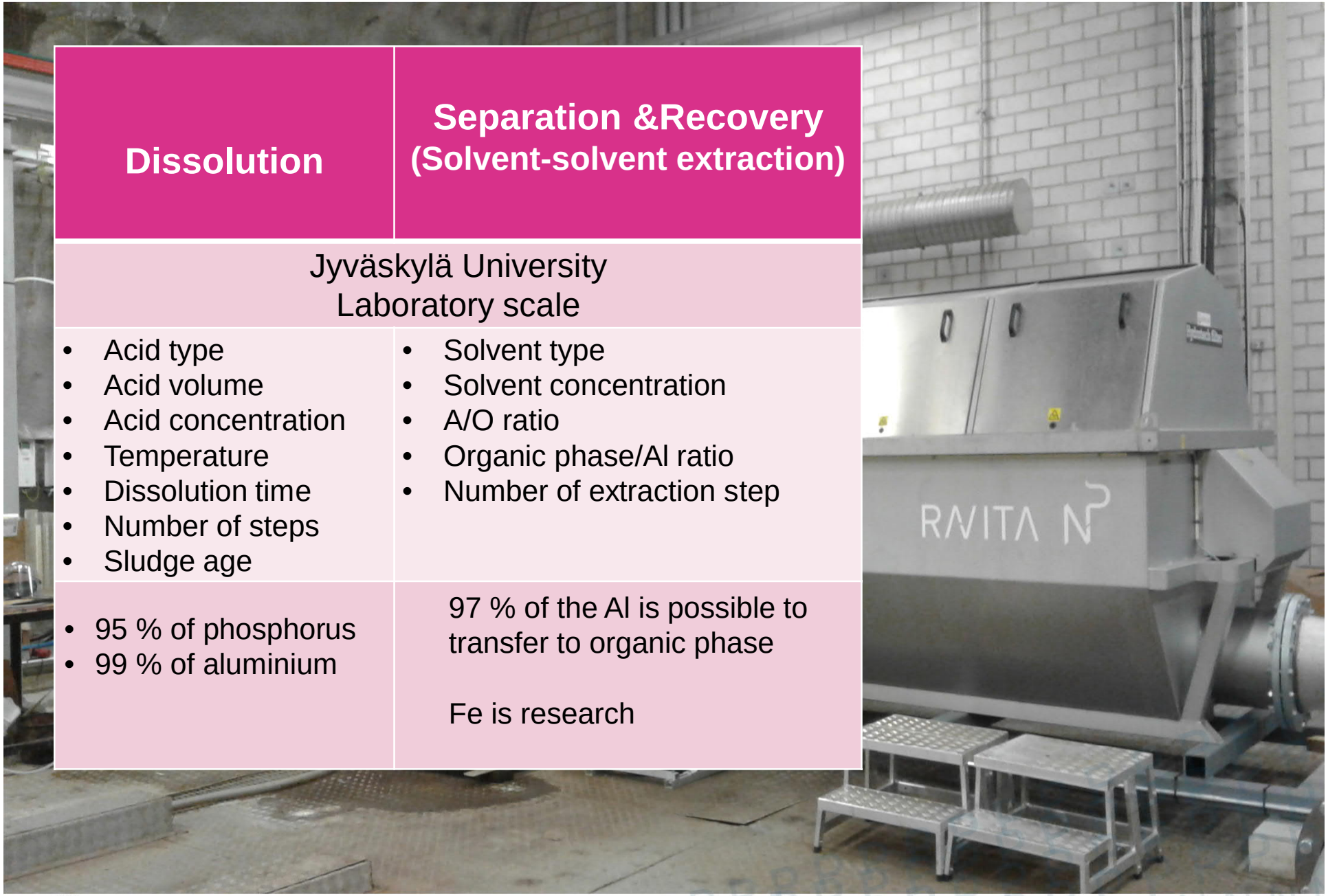
Post-precipitation Separation Drying

Viikinmäki WWTP
1000 PE pilot plant

- Chemical concentrations
- Retention time
- Sludge circulation
- Mixing intensity

- > 80 % of P removed
- Floc formation is critical
- 85 g P/kg SS
- Drying is challenging

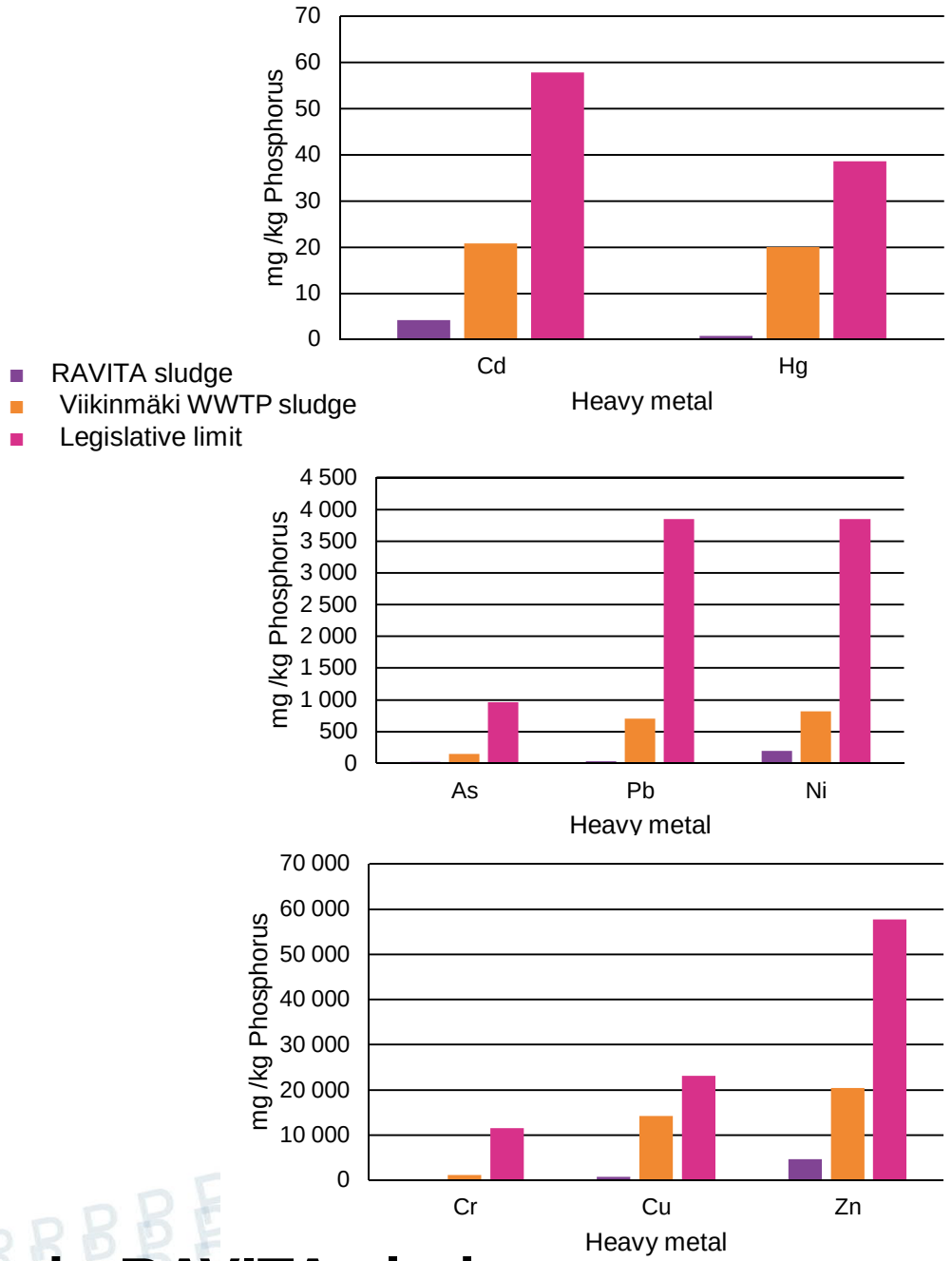




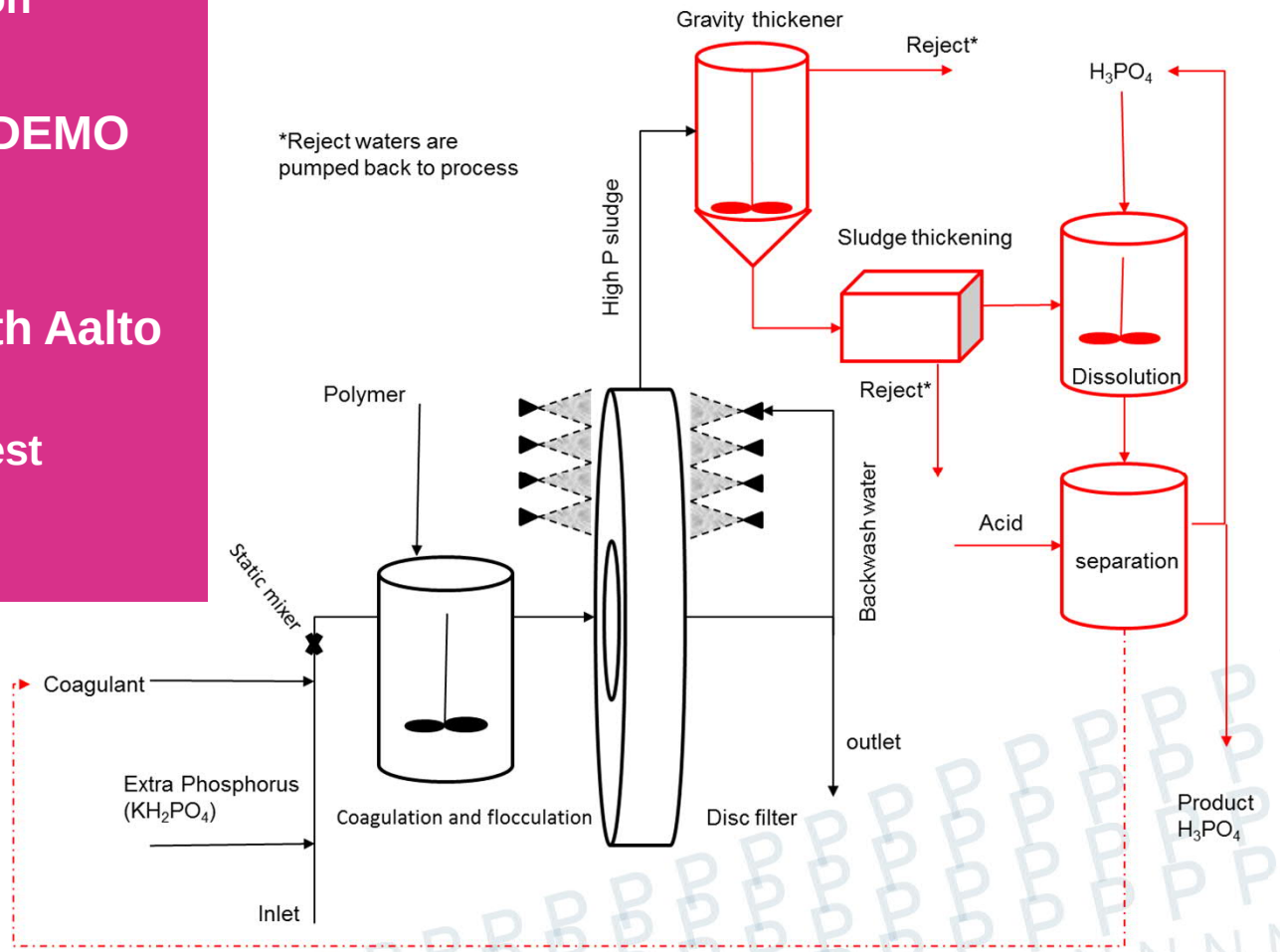
Dissolution	Separation &Recovery (Solvent-solvent extraction)
Jyväskylä University Laboratory scale	
• Acid type • Acid volume • Acid concentration • Temperature • Dissolution time • Number of steps • Sludge age	• Solvent type • Solvent concentration • A/O ratio • Organic phase/Al ratio • Number of extraction step
• 95 % of phosphorus • 99 % of aluminium	97 % of the Al is possible to transfer to organic phase Fe is research

Hazardous substances in RAVITA sludge

- Heavy metals and organic micropollutants compounds (Pharmaceuticals, PFC etc…)) were analysed
- Heavy metal conc. low
- Only BDE and Alkylphenols were detected
  - Concentrations are low
- More research is needed to ensure low concentrations



- **Building of DEMO plant**
  - **Sludge drying**
  - **Dissolution**
  - **separation**
- **Optimization of DEMO plant**
- **Co-operation with Aalto University**
  - **NP Harvest**



Research status

HSY

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GOVERNMENT KEY PROJECT

THANK YOU!

Questions?

Helsingin seudun ympäristöpalvelut –kuntayhtymä
Samkommunen Helsingforsregionens miljötjänster
Helsinki Region Environmental Services Authority