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# Potential for increasing phosphorus recovery from sewage sludge by Bio-Acidification

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# Due to different P removal technologies, chemistry of P in sludge is complex

Wastewater

**P**

**E**nhanced **Biological P R**emoval (EBPR)
Accumulation of P in specific micro-organisms **(PAO)**

**OR/AND**

**Chemical** P removal
Precipitation by Fe, Al or Ca salts

Cleanwater
P

**P**

**Sewage sludge (various BioP, FeP, AlP, CaP)**

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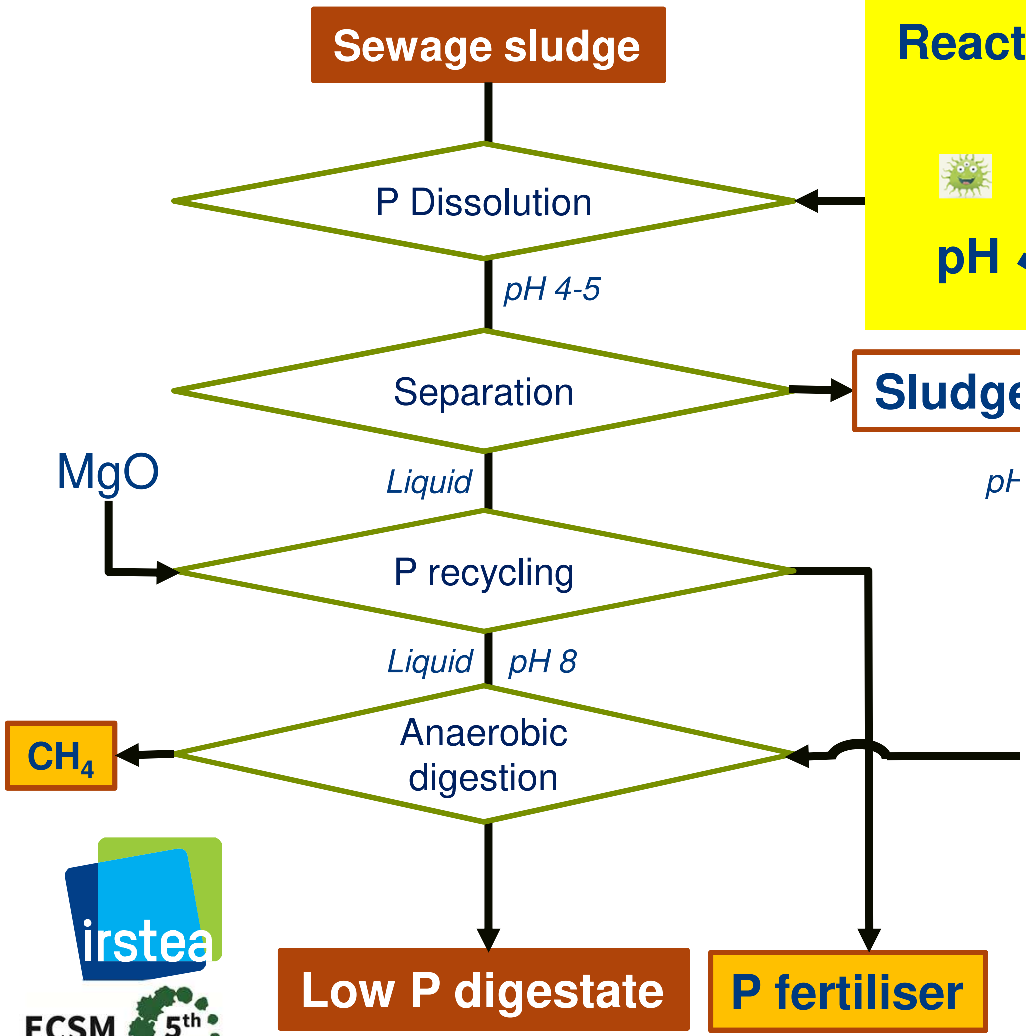
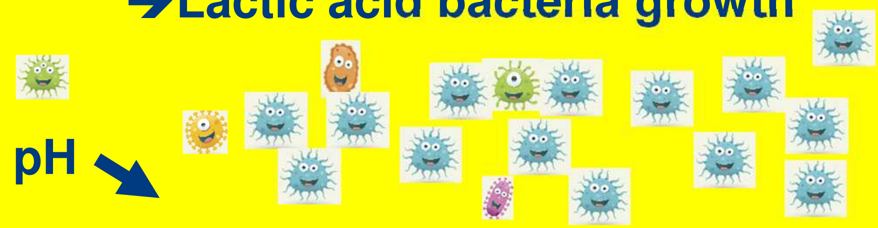
# P recycling processes require soluble P ➔ Increasing P recycling rate presupposes to dissolve more P




**Bio-acidification**

**Reactant = sugar rich waste or by-product**

**➔Lactic acid bacteria growth**




**Up to 75% of P dissolved in previous experiments(>> chemical pH1)**

**Two mechanisms expected**

- P release by PAO thanks to fatty acids
- P salts (Fe or Ca) dissolution by pH decrease thanks to lactic acid production

**One « Bonus » effect**

- Reduction of Fe(III) to Fe(II) more soluble➔FeP dissolution by the Iron Reducing Bacteria

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# Objective



**The biological process is it efficient for**

**dissolving P in all types of sewage sludge ?**

# A test to assess the P dissolution potential in sludge

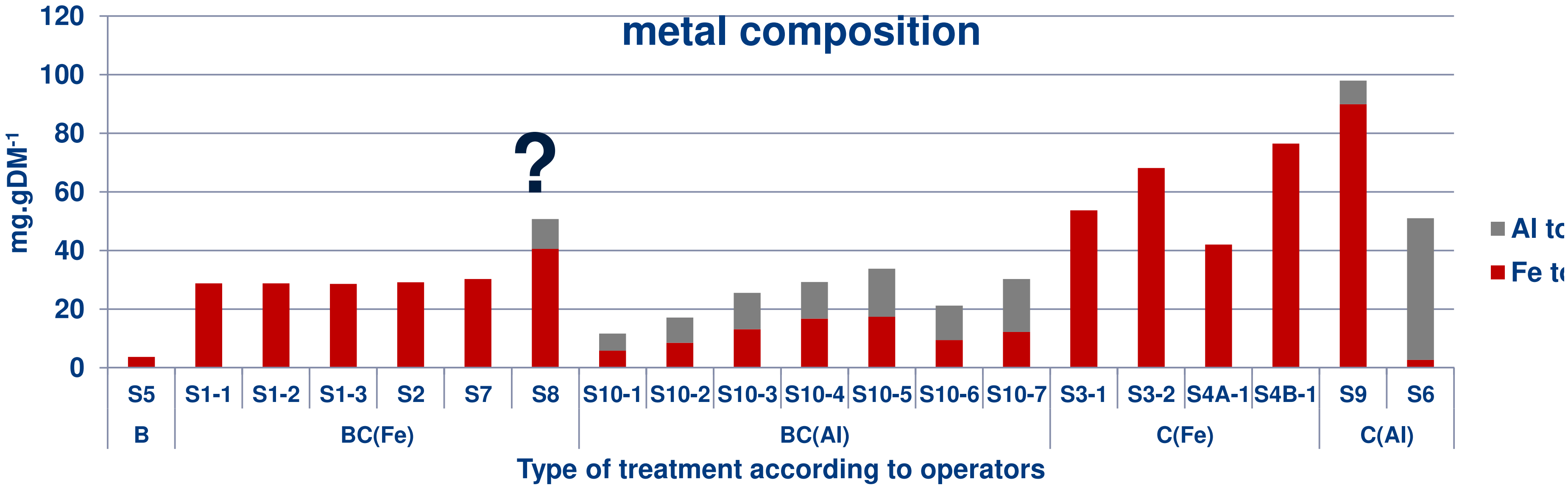
**BPDP test (Braak et al., Environmental Technology, 2015)**

- Co-product = White sugar (0,5gCOD/gVS)
- 48 hours
- Anaerobic conditions (N2 flushing)
- 38°C
- Same mixing in all the bottles

## 20 sludge from 10 WasteWater Treatement Plant (WWTP), 5 P removal technologies, 10 000 – 620 000 p.e.

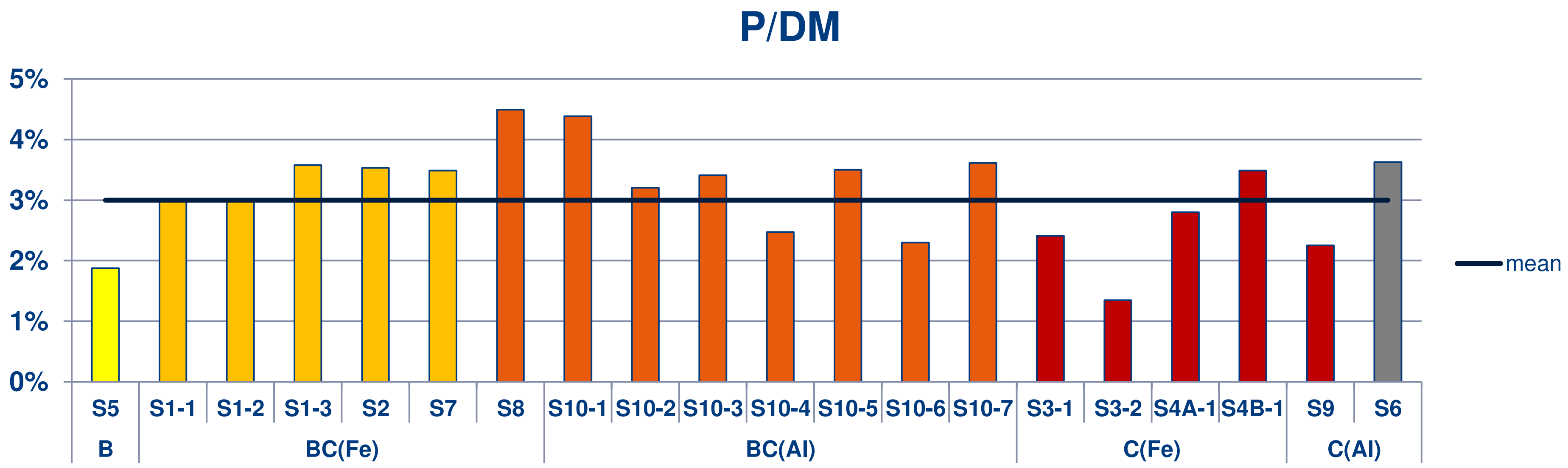
- EBPR-B
- Chemical with Iron salts – C(Fe)
- Chemical with Aluminium salts - C(Al)
- EBPR + Iron - BC(Fe)
- EBPR + Aluminium -BC(Fe+Al)

# The « Enigmatic » metal composition of some sludge



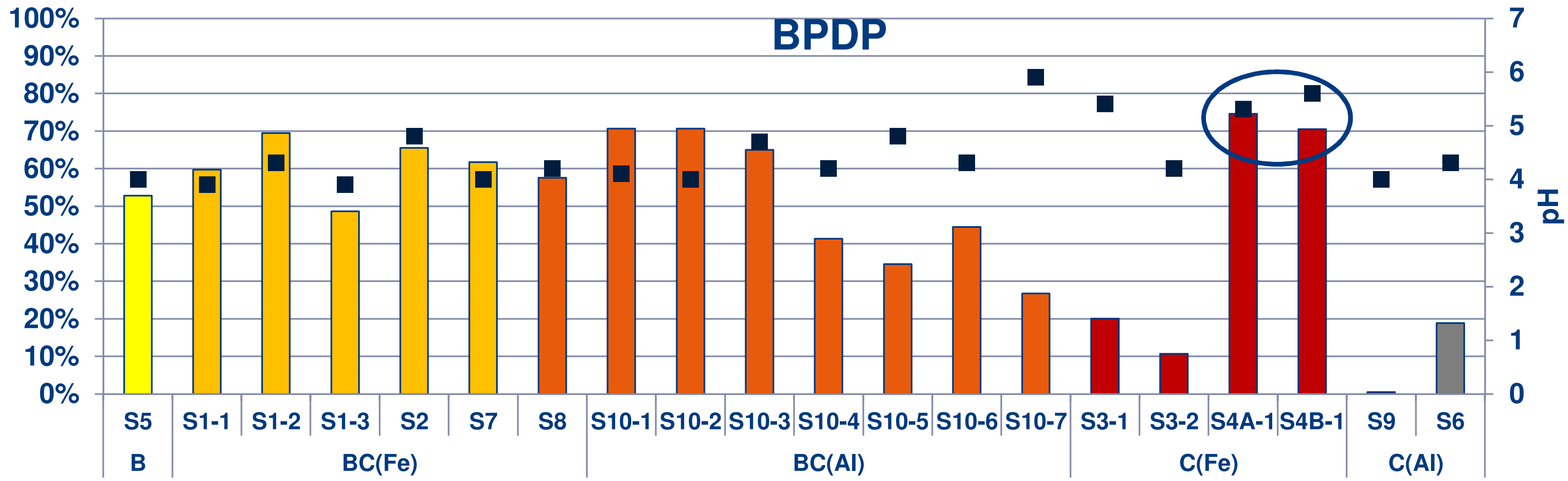

- S10-Iron coming from the network ? (large city)
- S3-Iron brought by sludge from a drinkable water plant?
- Same WWTP same day but S4A: activated sludge,S4B: MBR
- S9-Iron brought by sludge from a drinkable water plant?

# High variability of P content in sludge (1.3 to 4,3%)



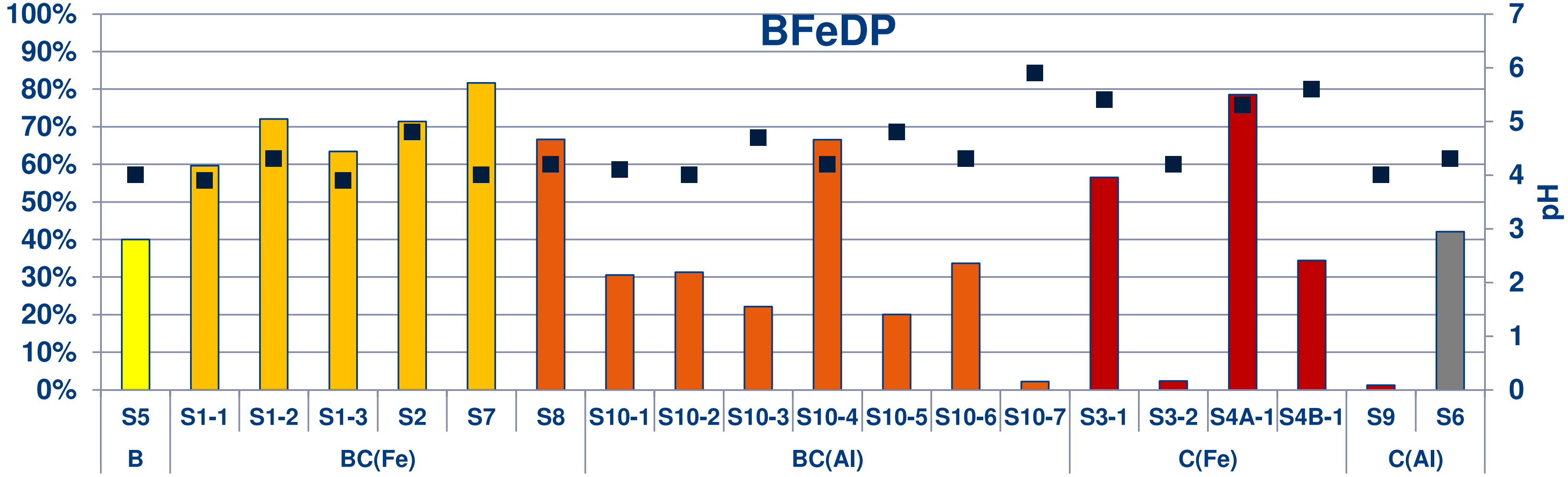

- **Less P content in sludge from EBPR (S1). To be confirmed**
- **High variability when metal salts are used**
- **Lowest value for S3 which doesn't control the input (high Fe and Ca content)**

# Up to 75% of P dissolved by the bio-acidification



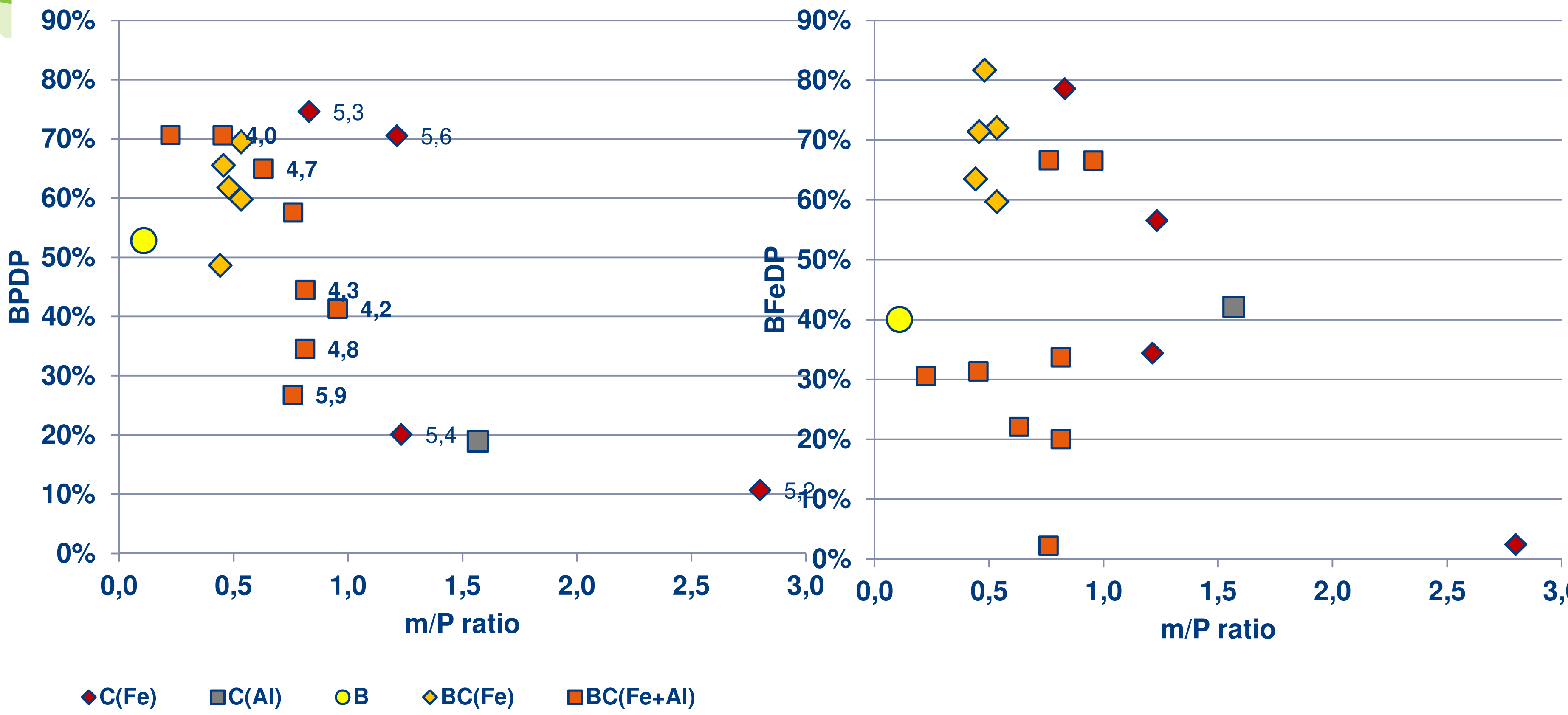

- 50-70% EBPR and EBPR + Fe
- More variability with EBPR+(Fe)+Al
- >70% if chemical P removal with Fe (controlled)
- Not suitable for chemical P removal with Al (to be confirmed)

# Up to 80% of Fe dissolved by the bio-acidification (Patent 17 50608)




- **60-80% EBPR + Fe**
- **More variability with EBPR+(Fe)+Al and C(Fe) even if Iron is controlled (S4A: activated sludge, S4B : MBR)**
- **40% of Iron dissolved with chemical Al P removal(to be confirmed)**

# No clear effect of pH neither m/P ratio




- Only very high level of m/P (not controlled )seems to inhibit the dissolution
- The effect of pH is depending on sludge➔ forms of FeP

- Up to 75% of the total P can be dissolved by bio-acidification
- The efficiency is good for EBPR and EBPR + Fe sludge
- More variability for the other P removal process
- Up to 80% of the total Fe can be dissolved by bio-acidification
- No clear effect of m/P ratio or pH
- Probably several forms of FeP in sludge which have to be known to better understand and improve the bio-acidification

  - Fe recovery is possible but is it possible to recycle it ?
  - Methodology to characterize FeP forms in sludge?
  - What is the impact of the dephosphatation management on the forms of FeP and their solubility during bio-acidification?

# Thank you for your attention

**To learn more about forms of FeP in sludge just wait the next issue…..**

For more information:
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