We deliver Phosphorus made in Europe
A promising process to increase P recovery as mineral fertilizer from sewage sludge by bio-acidification

ENVIRON2018 - 28.03.2017, Cork, IRELAND

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What is Phosphorus ?!

I am the basis of every living thing!

I am UNIQUE !!!
I am irreplaceable !!!

Without me! You will be extinct!

P is just too Arrogant
"peak phosphorus" will occur in 30 years and that "At current rates, reserves will be depleted in the next 50 to 100 years." Lewis, Leo (2008-06-23). "Scientists warn of lack of vital phosphorus as biofuels raise demand". The Times.
What the solution?

P Recycling

Struvite: also known as Magnesium Ammonium Phosphate or MAP

European Sustainable Phosphorus Conference 1, Bruxelles - 2013 & ESPC2, Berlin - 2015
We cooperate to close P-cycle
Phosphorus recovery process in a WWTP (Lille, France)

- Simple standard WWTP with no/low P recovery

Pretreatment  Carbon and Nitrogen removal

Anaerobic Digestion for Biogaz production  Sludge spreading as organic fertilizer

But: Spreading is becoming more and more difficult because of the new legislations
Phosphorus recovery process in a WWTP (Lille, France)

- WWTP with high P recovery
The Targeted effluents for the study of the biological Phosphorus dissolution in Lille WWTP
Characteristics of the targeted WWTP's Effluents

Different sampling period
First Experiment in Summer
Second Experiment in Winter (rainy day)
Characteristics of the targeted Effluents

Note:
The first experiment is carried with the Diluted samples and the second experiment with the Non-Diluted samples
Materials and Methods

- The co-substrate concentration in the sludge is set at 0,5gDCO_{Co-substrate}/gVM
- Co-substrate used is White Sugar (commercial); DCO= 1,17g/g sugar
  - Sugar concentration in the non digested Sludge =

<table>
<thead>
<tr>
<th></th>
<th>First experiment</th>
<th>Second experiment</th>
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<tbody>
<tr>
<td></td>
<td>Diluted</td>
<td>Non-diluted</td>
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<tr>
<td>Thickened sec. sludge (CG11)</td>
<td></td>
<td></td>
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<tr>
<td>Thickened mixed sludge (CG12)</td>
<td></td>
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<tr>
<td>Digested sludge (CG53)</td>
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<td>Thickened mixed sludge (DA16)</td>
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<tr>
<td>Digested sludge (DA17)</td>
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<tr>
<td>gSugar/Kg sludge</td>
<td>9,7</td>
<td>10,3</td>
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<tr>
<td></td>
<td>6,8</td>
<td>11,6</td>
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<td></td>
<td>17,7</td>
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Results

- pH and Concentration of the dissolved P
Results

- Percentage of the dissolved P

![Graph showing percentage of dissolved P in different sludge samples](image)

- Potential presence of Fe-P and Al-P complex formation is difficult to dissolve.

\[ \text{% Dissolution} = \frac{\text{Dissolved P}}{\text{total P}} \times 100 \]

\[ \text{Total P in the Liq} = \text{Dissolved P}_{\text{liq}} + \text{Dissolved P}_{\text{solid}} + \frac{\text{M}_{\text{liq}}}{\text{M}_{\text{solid}}} \times \frac{\text{M}_{\text{liq}} + \text{M}_{\text{solid}}}{\text{total P}} \times 100 \]

Where: M_{\text{liq}} is the mass of the liquid phase and M_{\text{solid}} is the mass of the solid phase.
Results

• Prediction of the Phosphorus' forms recovered by STRUVIA, for each sludge

Ca-P (CDP) Precipitation is favored over Struvite precipitation

<table>
<thead>
<tr>
<th>Molar ratio</th>
<th>N/P</th>
<th>Mg/P</th>
<th>Ca/P</th>
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<td>Thickened mixed sludge (CG12)</td>
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<tr>
<td>Thickened mixed sludge (DA16)</td>
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<tr>
<td>Digested sludge (DA17)</td>
<td>0.0</td>
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Diluted
First experiment

Non-diluted
Second experiment
Conclusion

- Biological acidification (and P release) is a promising way to increase the P recovery of WWTP’s sludge
- The biological P recovery efficiency depends on several factors such as:
  - Effluent nature (Digested or non digested, Alkalinity,...)
  - Fe/P and Al/P Ratio.
  - A mixture of the thickened sludge with a low DM sludge improve the biological acidification i.e. the P dissolution.

Perspectives:

- Do over of both the first and the second experiments with the same samples
- The use of other low cost co-substrat (ideally residues and byproduct near the WWTP area),
- Shift to a continuous mode
- Up scale to semi-industrial pilot.
It's QUESTION TIME!!