Sanering van diffuus verontreinigde bodems gekoppeld aan de productie van biobrandstoffen

A. Peene (OWS)
L. Van Ginneken and W. Dejonghe (VITO)
Aim MIP-project

• Use of phytoremediation for two purposes:
  – Remediate soils that are diffusively polluted with heavy metals
  – Production of bio-energy

• Used plants:
  • Rapeseed
  • Maize
  • Wheat

• Planten gegroeid in Kempen gebied vnl. gepollueerd met Zn, Cd en Pb
## Partners: 8

<table>
<thead>
<tr>
<th>Company</th>
<th>Task</th>
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<tbody>
<tr>
<td>OWS (A. Peene, J. Smis)</td>
<td>Anaerobic digestion</td>
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<tr>
<td>Vyncke (H. Fastenaekels)</td>
<td>Incineration</td>
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<td>EnviTech NV (E. Beeckman)</td>
<td>Plasmagasification</td>
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<td>INDINOX (S. De Schepper)</td>
<td>Biodiesel production</td>
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<td>Umicore (J. Kegels)</td>
<td>Energy and metal reduction in a melter</td>
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</table>
| UHasselt (J. Vangronsveld, A. Ruttens) (T. Thewys, N. Witters) | - Biological stimulation phyto-extraction  
                          |   - Economical analysis industrial application                        
                          |   - Phytoremediation – production bio-fuels                                |
| UG (E. Meers, S. Vanslycken, F. Tack) | - Physico-chemical stimulation phytoextraction                       |
| VITO (W. Dejonghe, L. Van Ginneken, R. Guisson) | - Biodiesel production  
                          |   - Massbalances heavy metals and energy in energy                     
                          |   - Massbalances heavy metals in soil, plant, energy                    
                          |   - Production processes                                                |

- **Biological** stimulation phyto-extraction
- **Physico-chemical** stimulation phytoextraction
Effect heavy metals on performance
two energy-production processes

• Biodiesel production from heavy metal polluted rapeseed: Luc Van Ginneken (VITO)

• Biogas production from heavy metal polluted maize: Andy Peene (OWS)
Effect heavy metals on performance two energy-production processes

• Biodiesel production from heavy metal polluted rapeseed: Luc Van Ginneken (VITO)

• Biogas production from heavy metal polluted maize: Andy Peene (OWS)
Digestion

- **OWS:**
  - Engineering department
  - Lab department

- **DRANCO - process**
  - Dry, thermophilic
  - Inputs: waste, energy crops → phytoremediation crops?
  - More than 20 full-scale DRANCO-plants worldwide

- **Digestability tests:**
  - Phase 1: Batch tests: Determination of substrate
  - Phase 2: Semi-continuous: Long-term effects?
Batch tests

• Contaminated versus clean maize:
  – Difference in biogas production
    • Dependant on species
    • No influence of heavy metals
  – Heavy metal analyses by UGent

• Influence of harvesting time
  – Total plant: optimal harvesting time?
  – Grains: the later, the better
  – Rest of plant? Different parts of plant?
Batch tests

• Parts of maize plant
  – Weight fraction
  – Biogas production
  – Further split-up:
    • Grain
    • Corncob
    • Flyleafs
    • Stalk and leaves
    • 0-30 cm, just above soil level
  – Heavy metal analyses: UGent
Batch tests

- Preliminary results:
  - Very low concentration of heavy metals in grain (UGent)
  - Influence of harvesting time:
    - Grain: Biogas productivity increases
    - 0-30 cm: Biogas productivity decreases

- Future research:
  - Digestion of maize without grain: interesting?
Continuous tests

- Digestion of maize silage
- Contaminated maize versus Clean maize
- Questions:
  - Heavy metal concentration?
  - Influence at long term?
  - Post-treatment of digestate:
    - Heavy metals in press liquid or press cake?
    - Press cake: next phase? Incineration, pyrolysis, ...?
Continuous tests

• Preliminary results:
  – No influence of heavy metals on digestion process
  – Definitive evaluation:
    • Dependant on retention time (RT)
    • Test duration = minimum 3 or 4 times the RT
  – UGent: preliminary heavy metal analysis
Continuous tests

% Total Solids (TS)

0 5 10 15 20 25 30 35

Contaminated  Clean

Silage  Digestate
Continuous tests

![Graph showing total N (g/kg TS) for contaminated and clean samples with silage and digestate categories.](image-url)
Continuous tests

![Bar chart showing zinc levels in Contaminated and Clean samples.](chart.png)

- Contaminated:
  - Silage: 267 mg/kg TS
  - Digestate: 458 mg/kg TS

- Clean:
  - Silage: 19 mg/kg TS
  - Digestate: 116 mg/kg TS
Continuous tests

Contaminated Clean Cadmium (mg/kg TS)

- Silage: 0.00, 0.25, 0.50, 0.75, 1.00, 1.25, 1.50, 1.75, 2.00
- Digestate: 1.07, 1.49, 0.08, 0.29
Conclusions

- Presence of heavy metals in plants
  - Stimulates HTPM biodiesel production process
  - Seems to have no influence on the digestion process

- Evaluate the effect of the plant material and heavy metals in the plasmagasification and incineration processes

- Compare the energy performance of the 5 studied energy production processes