Sommersymposium 2018
am 28. Juni 2018

» Biokohle für nachhaltige und ökologische Kreisläufe in der Europäischen Landwirtschaft«

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Agenda

- Fertilisers from secondary raw materials in the EU
- TCR process and Biochar
- Biochar modification for nutrient adsorption
- Agronomic performance of Biochar
Sustainable fertilisers in Europe: Actual Situation

- Fertiliser demand will grow as global food production is expected to increase by 70% in 2050
- Mineral-based fertilisers (NPK) are mainly produced from fossil resources with serious drawbacks:
  - losses from 70-80% from farm to fork
  - high energy input for production
  - reliance on imports
  - eutrophication of water bodies
- Unexploited recovery potential of 9.6 Mt of N and 2.3 Mt of P

Nitrogen mineral input in EU15
Grizzetti et al 2007
Sustainable fertilisers in Europe: Our Vision

- Nutrient loop closed by 2050
- Acceleration of market introduction of fertilisers from secondary sources (sewage, manure, food waste) → common European regulation, certification pathways, technological mature
- Optimised nutrient distribution between EU regions → new value chains
- Worldwide use of Biochar as soil amendment, nutrient carrier and stable carbon storage
Sustainable fertilisers: EU Regulation and Certification

- New European Fertiliser Regulation (under revision)
  - 7 Product Function Categories (PFC) including organic fertilisers, inorganic fertilisers, soil improvers and bio-stimulants
  - Shortcomings: exclusion of bio-waste materials as well as garden and park waste; contradictions on definition of waste; limit of 20 mgPb/kg excludes bio-waste and compost

- Certification for new fertilising products
  - Standardisation of European fertilisers through CENs (*Comité Européen de Normalisation*)
  - Joint Research Centres (JRC) working groups on Struvite, Biochar and Ashes (STRUBIAS)
  - International initiative 4 per 1000 for carbon storage in the soil

Source: www.thepairlamentmagazine.eu
TCR Process

Feedstock

Intermediate Pyrolysis

Carbonisate

Catalytic Reforming

Syngas

Oil

Folie 6
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TCR Process: Input materials

- Sewage sludge / Lodo de Tratamiento de Aguas residuales
- Lignin / Lignina
- Bioactivated sludge / Lodo Activo
- Horse manure / Estiércol de Caballo
- MSW/RSU (Residuo Sólido Urbano)
- Chicken manure / Estiércol de Aves
- Paper sludge / Lodos del Papel
- Sieve residues / Residuos de Tamizado
- Digestate / Digestato
- Coffee grounds / Poso del Café
- Nappies / Pañales
- Pruning residues / Residuos de Poda
- Paint sludge / Lodos de la Pintura
- Nutshells / Cáscaras de Nuez
- Mill residues / Residuos del Molido
# TCR-Biochar properties

<table>
<thead>
<tr>
<th>Material</th>
<th>C</th>
<th>H</th>
<th>N</th>
<th>S</th>
<th>O*</th>
<th>Ash</th>
<th>LHV</th>
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<tbody>
<tr>
<td>Sewage sludge</td>
<td>22.1</td>
<td>0.9</td>
<td>2.0</td>
<td>1.0</td>
<td>0.0</td>
<td>74.0</td>
<td>8.2</td>
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<tr>
<td>Digestate</td>
<td>64.0</td>
<td>1.0</td>
<td>1.4</td>
<td>0.5</td>
<td>1.1</td>
<td>32.0</td>
<td>23.0</td>
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<tr>
<td>Brewer’s spent grain</td>
<td>72.6</td>
<td>0.1</td>
<td>4.6</td>
<td>0.4</td>
<td>4.8</td>
<td>17.5</td>
<td>26.0</td>
</tr>
<tr>
<td>Wood</td>
<td>89.8</td>
<td>2.2</td>
<td>0.3</td>
<td>0.1</td>
<td>4.5</td>
<td>3.1</td>
<td>34.4</td>
</tr>
</tbody>
</table>

LHV: Lower Heating Value
TCR-Biochar properties

Van Krevelen Diagram

Source: www.intechopen.com
TCR-Biochar modification for N adsorption

- Goal: adsorption of N-Ions ($\text{NO}_3^-$, $\text{NH}_4^+$) from the aqueous phase
  - Modifications for $\text{NH}_4^+$ adsorption:
    - Acid activation $\text{HNO}_3$
    - Alkaline activation
    - Steam activation
  - Modifications for $\text{NO}_3^-$ adsorption:
    - Thermal activation
    - Impregnation with transition metals (i.e. Zn, La)
- Achieved adsorption performance
  - 1-2 mg/g for both ions $\text{NH}_4^+$ and $\text{NO}_3^-$

Sizmur et al 2017
Agronomic performance of Biochar

- Pot trial equipment with capacity of 96 pots, light system, scaling system, collection of drain/leakage flows. Additional grinders and mixer unit for substrate preparation.
Thank you for your attention!