Assessing phosphorus recovery potential from ashes: incubation studies of different secondary raw materials after multiple combustion processes

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General Framework
REFLOW & FERTIMANURE H2020 PROJECTS

General Objective
P Valorization opportunities from ashes

Experimental Design
Raw materials and incubation trials

Main Results
Contrasting P Release patterns

Conclusions and discussion
Strengths, gaps and ideas
General Framework
REFLOW & FERTIMANURE H2020 PROJECTS

FERTIMANURE
G.A.: 862849

NEW FARM ACTIVITIES & NEW BUSINESS MODELS

1. FERTIMANURE BIO-BASED FERTILISERS (BBFs) RECOVERY

2. CENTRALISED TAILOR-MADE FERTILISERS (TMFs) PRODUCTION

3. ON-FARM TAILOR-MADE FERTILISERS (TMFs) PRODUCTION

CROP PRODUCTION

LIVESTOCK PRODUCTION

REFLOW
EUROPEAN TRAINING NETWORK
G.A.: 814258

1. DAIRY FARMS

2. FIELD APPLICATION

3. DAIRY INDUSTRY

4. DAIRY PRODUCTS

5. TREATMENT

6. NUTRIENT RECOVERY

7. BBFs

8. USE OF TMFs

9. USE OF TMFs

10. USE OF TMFs

11. USE OF TMFs
General Objective

P Valorization opportunities from ashes

Sludge Origin (Fe/Al)
Plant available ??
Soil pH
Soil P
Slow Release?

Energy

Wet leaching

Acid Energy

Precipitation

Reactives

P rich ingredients

Costs

Heavy Metals
Handling
Energy
Extraction Eff.
Used Ashes

Costs

Heavy Metals
Reactives
Energy
Recovery Eff.
Used Ashes

Bioavailability

Heavy Metals

P rich ash

Phosphoric Acid
Experimental Design

Raw materials and incubation trials
Experimental Design

Raw materials and incubation trials

P RICH SLUDGE
BIOBASED FERTILIZERS
## Experimental Design

### Raw materials and incubation trials

<table>
<thead>
<tr>
<th>BBFs</th>
<th>Type of combustion</th>
<th>Temperature (°C)</th>
<th>% ( \text{P}_2\text{O}_5 ) content (dw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBPR 1</td>
<td>Muffle</td>
<td>550°C</td>
<td>34.47%</td>
</tr>
<tr>
<td>EBPR 2</td>
<td>Muffle</td>
<td>850 °C</td>
<td>39.84%</td>
</tr>
<tr>
<td>EBPR 3</td>
<td>Muffle</td>
<td>550 °C</td>
<td>28.16%</td>
</tr>
<tr>
<td>Combustion</td>
<td>Combustion</td>
<td>550-600 °C</td>
<td>16.25%</td>
</tr>
<tr>
<td>manure ash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“CMA”</td>
<td></td>
<td></td>
<td></td>
</tr>
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</tr>
<tr>
<td>manure ash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hydrated “CMAW”</td>
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</tbody>
</table>
Experimental Design

Raw materials and incubation trials

Unfertilized soil

Mineral fertilizer (TSP)

BBFs

Application rate: 110 kg P₂O₅/ha

P₂O₅ available

CAL method

+ Ascorbic Acid

P Mineralization kinetics

Controlled conditions incubation (22°C, 50% WHC)

\[ P_{rel,net}(\%) = \frac{([P_2O_5 - P, treatment] - [P_2O_5 - P, control])}{P_{total\ applied}} \times 100 \]
Experimental Design

Raw materials and incubation trials
Main Results

Contrasting P Release patterns

No time effect within each treatment
Conclusions and discussion
Strengths, gaps and ideas

~ 50% of the total P being released within the first five days
Primary effect = equilibrium state short after the initial release

Origin and Type of material
EBPR >>>> CMA
EBPR 2 ~ TSP (Control +)
+ P$_2$O$_5$ -> + Release

Type of combustion
Burning Temperature
Burning Time

Waste valorization
P rich materials
BBF formulation
Safety compliance
(STRUBIAS)
Conclusions and discussion
Strengths, gaps and ideas

<table>
<thead>
<tr>
<th>EXPERIMENTAL</th>
<th>PROCESS</th>
<th>FINAL PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete screening</td>
<td>+ Temp = + P Release</td>
<td>Pot &amp; Field tests (FEV)</td>
</tr>
<tr>
<td></td>
<td>+ Temp = + heavy metals</td>
<td>Real P bioavailability</td>
</tr>
<tr>
<td></td>
<td>No need for pre-treatment for P release from ashes</td>
<td>Different soils</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy metals</td>
</tr>
</tbody>
</table>
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