Thermal and enzymatic treatment of digested manure fibers in the re-injection loop concept to increase biogas yields

Escobar, Esperanza Jurado; Uellendahl, Hinrich Wilhelm; Njoku, Stephen Ikechukwu; Kragelund, C.

Published in:
Poster abstract in the Proceedings of the 14th World Congress on Anaerobic Digestion

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Link to publication from Aalborg University

Citation for published version (APA):
Thermal and enzymatic treatment of digested manure fibers in the re-injection loop concept to increase biogas yields

Esperanza Jurado**, Njoku, S. I. a; C. Kragelundb and Jellendahl, H. a

aSection for Sustainable Biotechnology, Aalborg University Copenhagen (AAU-Cph)  www.sustainablebiotechnology.aau.dk
bDanish Technological Institute, Kongsvang Allé 29, DK-8000 Aarhus C, Denmark.
corresponding author: ejje@bio.aau.dk

The re-injection loop is developed as an alternative to the conventional manure biogas treatment to increase the methane yield of the recalcitrant solid manure fraction and wheat straw (WS). This concept enhance biogas yield per tone of manure by:
1. Digestion of easy degradable compounds by anaerobic digestion.
2. Separation of solid and liquid fraction.
3. Treatment of solid fraction.
4. Reinjection of the treated solid fraction.

### Enzymatic hydrolysis

**Initial screening of enzymes**

![Graph showing initial screening of enzymes](image)

**Testing of potential candidates on WS and digested manure fibers**

![Graph showing testing of potential candidates](image)

**Effect of pH and enzyme dosage**

<table>
<thead>
<tr>
<th>pH</th>
<th>minimized</th>
<th>maximized</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>7</td>
<td>70%</td>
<td>30%</td>
</tr>
</tbody>
</table>

### Thermal treatment

![Graph showing thermal treatment](image)

### Economic analysis

<table>
<thead>
<tr>
<th>VS %</th>
<th>Enzyme dosage (g/kg VS)</th>
<th>Increase of methane yield (m³ CH₄/kg enzyme)</th>
<th>Revenue (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.0</td>
<td>0.10%</td>
<td>10.00</td>
<td>7.50</td>
</tr>
<tr>
<td>75.0</td>
<td>0.10%</td>
<td>15.00</td>
<td>11.25</td>
</tr>
<tr>
<td>75.0</td>
<td>0.10%</td>
<td>20.00</td>
<td>15.00</td>
</tr>
<tr>
<td>75.0</td>
<td>0.10%</td>
<td>25.00</td>
<td>18.75</td>
</tr>
<tr>
<td>75.0</td>
<td>0.10%</td>
<td>30.00</td>
<td>22.50</td>
</tr>
<tr>
<td>75.0</td>
<td>0.10%</td>
<td>35.00</td>
<td>26.25</td>
</tr>
<tr>
<td>50.0</td>
<td>0.10%</td>
<td>35.00</td>
<td>17.50</td>
</tr>
<tr>
<td>75.0</td>
<td>0.50%</td>
<td>35.00</td>
<td>5.25</td>
</tr>
<tr>
<td>50.0</td>
<td>0.50%</td>
<td>35.00</td>
<td>3.50</td>
</tr>
</tbody>
</table>

***The revenue is calculated as € per kg enzyme blend added, based on a revenue for selling electricity from biogas in Denmark of 1.15 kr/kWhₑ = 0.15 €/kWhₑ, equivalent to a price of 0.54 €/m³ CH₄ for the produced methane.

### Conclusion

- Thermal treatment at 105°C for 1 hour showed to increase the methane yield by up to 65% compared to untreated DMF.
- The addition of enzyme blends showed to have no significant effect on increasing the methane yield of DMF, probably due to the high pH of the digested manure fraction, which is unfavorable for the activity of these enzymes.
- Economic evaluation show that the benefit of the treatment is more than 5 € per kg enzymes if an increase in methane yield by more than 12.34 m³ CH₄/kg VS can be achieved with low dosage of 0.1% and a VS/TS ratio of 75%. It also shows that the benefit declines significantly if a higher enzyme dosage is needed and also the VS/TS ratio has quite an impact on the revenue.

### Acknowledgements

The EU BIOBAN project is funded by the European union’s Seventh Framework Program managed by REA under the grant agreement no. FP7-SME-2012, 325164