Feasibility of grass co-digestion in an agricultural digester

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Introduction

The European Union has set a goal to reach a share of **20% renewable energy by 2020**. First generation energy crops evoke ethical concerns because of the **competition with food** production. **Low impact biomass** are all types of biomass that do not entail competition with food production when used for the production of renewable energy. Examples of low impact biomass are: crop residues, organic waste streams (kitchen, garden, agriculture, industry…), biomass from marginal or residual land, greenery cuttings, but also **grass**. Grass is often an **unwanted side product** from maintenance of **permanent grasslands** or **roadside verges**. Vast quantities are available in all European countries, and are already used by some countries in the production of renewable energy. As anaerobic digestion is already a well established process, **anaerobic co-digestion of grass** could be a good strategy for densely populated regions like Flanders, which has no capacity to enlarge its agricultural areal, to achieve the 2020 goal. In this study, the **feasibility** of using grass (from roadside verges or grassland) as a partial feedstock in an agricultural digester is investigated. **10 to 20% grass** was added to test reactors and the influence on **process parameters** and **residue composition** was studied.

Experimental set-up

- **4 test reactors** were run in parallel for **17 weeks**.
- Each reactor had a volume of 50 l with an active content of **20-25 kg**. Temperature was kept constant at **37 ± 2°C**.
- Feeding was done **semi-continuous**ly, 3 times a week (25 kg/m^3.d).
- This resulted in a retention time of 50 days.
- **Reactor 1** (R1) had an input mix of 30% pig manure, 30% maize silage and 40% side streams and served as **'blank'**.
- Side streams consisted of 50% Biomix, 25% Biograanmix, 12.5% glycerin and 12.5% rapeseed press cake.
- In **week 1 to 8**, **10%** of the maize input was replaced by **grass** in R2 to R4.
- From **week 10 to 17**, **20%** of **grass** was added.
- The reactor feeds were composed of:
  R1: no grass
  R2: roadside grass
  R3: grassland grass
  R4: grassland grass + enzyme mixture (MethaPlus L100), started in week 6

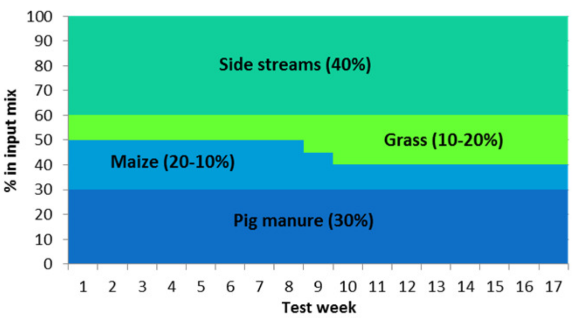

Figure 1. Input mix evolution during 17 test weeks

- Studied parameters:
  - **Biogas yield** and **composition**
  - **Residue properties** and **composition**

Results

- All studied process parameters (pH, EC, FOS/TAC, VFA, ammonium, biogas production, CH4 % of the biogas) indicated a stable digestion.
- **Biogas production** was higher than what was expected from batch tests for biogas potential of the input streams (Figure 2).
- This result indicates a **synergistic effect** of the **input streams** (Figure 1).
- No different trends for different input mixes were observed.

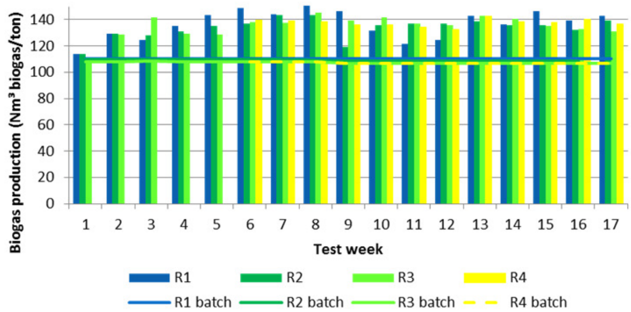

Figure 2. Biogas production of the different test reactors (batch tests for biogas potential of input streams given as horizontal lines)

- All reactors, including the blank needed addition of **0.4%** $\mathbf{FeCl_2 . 4\,H_2O}$ to avoid excess H_2S in the biogas.
- The **biogas composition** (CH_4 and H_2S) did **not change** because of grass addition.
- 10% grass addition had no effect on the residue, while **20% grass** caused a significant **increase** of the **viscosity**, resulting in a higher mixing energy demand and a lower mixing efficiency.
- The **enzyme mixture** in R4 **lowered the viscosity** to an acceptable level, but it was still higher than the blank (21,5 vs 9,5).
- The **residue composition** (nutrient and contaminant level) was **not negatively affected** by the addition of grass in the feed.

Conclusions

- The use of up to **20% grass** in the input mix of a typical Flemish agricultural digester **does not cause any problems** for the **biology** of the reactor, nor does it influence the **gas yield** or composition.
- **Viscosity** of the reactor content **increases**, but this effect can be kept in an acceptable range by the addition of 100 mg/kg DM of the **enzyme mixture** MethaPlus L100.
- With respect to the composition of the **residue**, **no influence** of the grass in the input could be determined. The fertilizer value of the residue was not endangered.
- No differences were found between the use of roadside grass and grass from grassland.

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