BIOMETHANE PRODUCTION FROM PHYTOREMEDIATION DERIVED MAIZE BIOMASS VIA ANAEROBIC DIGESTION

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1. Keywords
Soil contamination, phytoremediation, heavy metals, methane production, anaerobic digestion

2. Highlights

- Plants growing on metal contaminated soils can represente an opporftunity for energy production
- It was possible to produce biomethane via anaerobic digestion using such biomass
- There were generally no signifficant differences between methane yield for different soil exposures.

3. Purpose

Maize is an energetic plant with ability for heavy metals removal from contaminated soil. The growth and ability for heavy metals removal by this energetic culture was tested using a contaminated soil from an industrialised soil vs. a non-contaminated agricultural (used as control). After soil remediation, plants can be used for producing biomethane. This report shows the first results obtained from the anaerobic digestion of corn stalks, after growth on contaminated and non-contaminated soils.

4. Materials and methods

Stalks from maize plants grown (5 months) exposed to contaminated and non contaminated soils were dried and grinded and were used as carbon and energy source for the biomethane assays (BMP). Biomethane assays were performed according to Angelidaki et al. (2009). Different inoculum to substrate ratios (VS based) were tested, namely 1:1, 1:2 and 1:4. Anaerobic granular sludge from a full scale EGSB (Expanded Granular Sludge Bed) reactor, treating wastewater from a beverage company was used as inoculum. Acetate was used as acetoclastic activity control, while microcrystalline was used as positive control for cellulose degradation and a set of blanks (only with inoculum) as a negative control.
The biogas produced during the anaerobic digestion of the stalks was monitored until stable production and its composition was analysed through gas-chromatography.

5. Results and discussion

The maximum methane production was obtained before 8 days of incubation, for all assays. Methane production decreased with decreasing amount of substrate, indicating that methane production increased with the amount of corn stalk, not being limited by the activity of the anaerobic granular sludge. When comparing the conversion of corn stalk grown in control and contaminated soil, the obtained results were similar indicating that the metals present in the soil were not detrimental to the anaerobic biodegradation of the biomass.

The initial methane production rate (mmol/L) was calculated for the initial incubation days (between days 1 and 2). During this incubation period, it was observed that the corn stalks were biodegraded with an initial methane production rate which increased with increased substrate amount, independently from the soil condition. Similar values were obtained between corn stalks grown in contaminated and control soils.

Methane yield was not significantly different between ratios 1:1, 1:2 and 1:4, for corn stalk in control soil, indicating that the maximum methane production is possibly proportional to the amount of anaerobically degradable substrate. When comparing the results between control and contaminated soil, the corn stalk generally presented no signifficant differences methane yield when grown in the control soil.

6. Conclusions and perspectives

The production of biomethane from metal contaminated soils' phytoremediation derived maize biomass appears as a possibility.

7. References

(1) Angelidaki I, Alves M, Bolzonella D, Borzacconi L, Campos JL, Guwy AJ, Kalyuzhnyi S, Jenicek P, van Lier JB. Defining the biomethane potential (BMP) of solid organic wastes and energy crops: a proposed protocol for batch assays. Water Sci Technol. 2009;59(5):927-34. doi: 10.2166/wst.2009.040. PMID: 19273891.