



UNIVERSITY OF SOUTHERN DENMARK

Characterisation of the organic pools in biomass and the related biochemical methane potential (BMP)

PhD Description

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1. Summary

In this project the aim is to characterise biomass and study biogas production and biochemical methane potential from animal manure, plant biomass and slaughterhouse waste as related to the biomass characteristic. New and fast analytical methods such as NIR will be used in this investigation for characterisation of biomasses for biochemical methane production (BMP) prediction. BMP are measured using the batch method according to the standard VDI 4630 method. In addition, the biogas production and changes in biomasses characteristic will be examined in laboratory studies using the continuous bioreactors. In the continuous bioreactor study the organic pools will be characterised before and after anaerobic digestion and the kinetics of organic components changes during fermentation will be quantified. This project is carried out in close collaboration with WP2 and WP4 of the BioChain project.

The characterisation of organic wastes is a necessary step before using these in anaerobic digestion. The quantities of different compounds (carbohydrates, proteins, lipids and fibers) and anaerobic biodegradability are important information required to be characterised. The BMP test is one of the most relevant tests for assessing the biodegradability of waste biomass. However, unfortunately the BMP test is very time-consuming, i.e. it requires at least one month for BMP determination. Using alternative methods for determining the anaerobic biodegradability of biomass must be cost-effective and time-saving. Models using physicochemical characteristics as input data (total carbohydrate, total nitrogen, fiber, etc.) can predict BMP, and Thermo gravimetric analysis could be an alternative method to characterise biomass and to predict BMP. Spectroscopy techniques has been reported to be useful for determining BMP, in particular by taking into account the interaction between different molecules in the organic matter.

2. Objectives

This study will be carried out with the specific objective of:

- Developing a method/instrument that in real time assess biochemical methane potential (BMP) of agricultural biomass
- Developing a method to characterise the most important organic carbon pools and the change in pool size during anaerobic digestion.

3. Activities

The PhD study is divided into four activities according to the substrate, type of process, physical and chemical characterisation which is elaborate below.

- Activity 1: Ensilage effect on beet root pulp characteristics and BMP in various depths of closed and open storage
- Activity 2: Industrial, slaughterhouse and plant biomass biogas production, and the change in content of organic components and defining carbon pools in relation to degradability. Test carried out using pilot-scale continuous stirred tank reactor (CSTR) and measuring: biogas production, degradation of organic components, change in carbon pools affected by retention time and pretreatment.
- Activity 3: Biomass characterisation and physicochemical characteristics related to BMP and development of fast analytical methods to predict biogas production potential.
- Activity 4: Effect of vegetation age of plant biomass on lignification and additional factors such as cellulose crystallization. Assess if these factors are the reason why BMP of old plant-biomass is low.

