Biogas tests with Euphorbia tirucalli, sugar filter mud, coffee husk and a banana skin, grass, manure and maize mixture

Date: 02 April 2012

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Introduction

For several years, FACT Foundation has been working in the field of biogas production and use. Biogas is a highly relevant form of bioenergy for communities in developing countries: it is a relatively uncomplicated technology that can be applied from very small (household) to very large (industrial) scales. The biogas can be used for the production of electrical or mechanical power, or for cooking or chilling. A wide range of feedstocks can be used, including agricultural residues and energy crops. In order to add to the existing knowledge on suitable biogas feedstocks, and to support its partners in developing countries with new knowledge, FACT has been commissioning tests with different types of biomass. It concerns tests on potential biogas yields, but also of the composition of materials.

Methodology

Underlying report concerns the results of biogas yield tests of several materials that were carried out by DUMEA in Wijhe, The Netherlands:

- Euphorbia tirucalli, a tropical plant that was identified as a promising feedstock for bioenergy and that was subject for an earlier biogas test by FACT Foundation (see http://www.fact-foundation.com/media_en/FACT_Euphorbia_tirucalli_biogas_study). A sample was taken from a houseplant bought in the Netherlands.
- Sugar Filter Mud, a residue from (cane) sugar production. A sample was brought from a sugar factory in Indonesia.
- Coffee Husk, a residue from coffee production. A sample was taken from Peru.
- Mixture of banana skin (30%), verge grass (48%), cow dung (7%) and maize silage (15%). This mixture was prepared by FACT staff; the digestion test was caried out in duplo.

Dry solids content and organic solids content were measured. Samples were added to a sewage sludge inoculum, and maintained at 30°C throughout the test. Both biogas and methane content were measured over time.

Results

Table 1 below gives an overview of the (organic) solids content analyses of the samples.

Table 1 Total solids content and organic solids contents of the different samples

Sample	Total solids content (ts)	Organic solids content (os)	Organic solids content (os)
	g/kg product	g/kg product	%ts
Euphorbia tirucalli	105.6	87.3	82.7%
Sugar Filter Mud	208.7	163.8	78.5%
Coffee Husk	895.5	882.1	98.5%
Mixture	39.8	35.4	88.9%

The cumulative gas production of the samples is shown in figures 1 and 2 below.

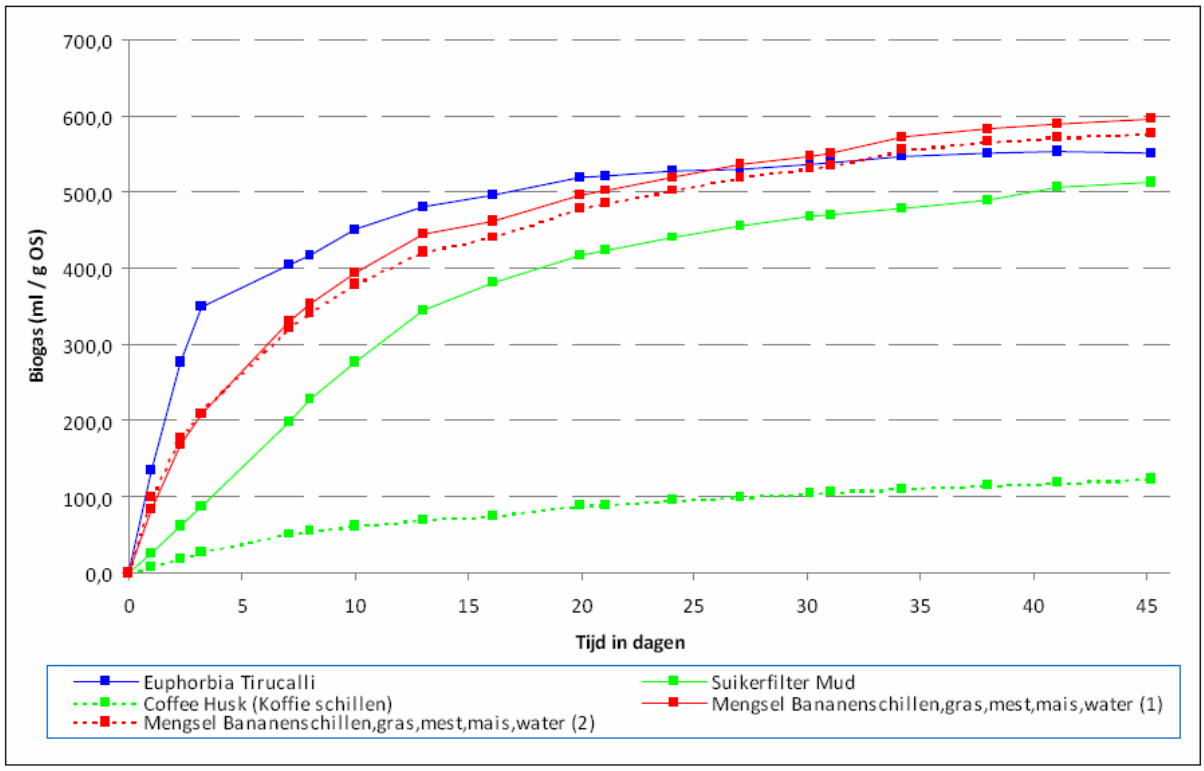

Figure 1 Cumulative gas production of samples (ml/g organic substance)

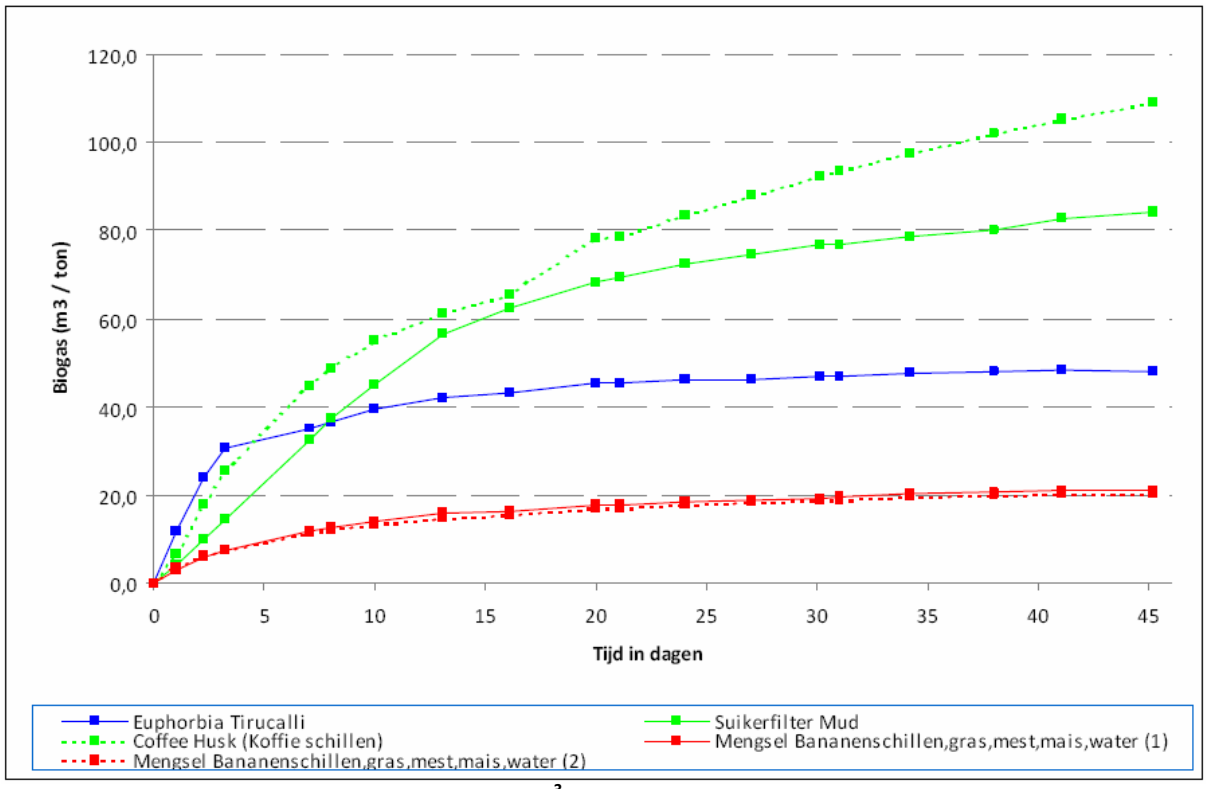

Figure 2 Cumulative gas production of samples (m^3 biogas / tonne of product)

Table 2 below gives an overview of the biogas production tests after 45 days.

Table 2 Results of the biogas production tests after 45 days

Sample	Biogas production		CH_4	Methane production		pH	
	ml/g os	m^3/t product	%	ml/g os	m^3/t product	Begin	End
Euphorbia tirucalli	551.8	48.2	61.5%	339.4	29.6	7.2	7.1
Sugar Filter Mud	513.5	84.1	61.4%	315.3	51.6	7.4	7.0
Coffee Husk	123.4	108.9	64.8%	80.0	70.6	7.4	7.0
Mixture (1)	596.5	21.1	59.8%	356.7	12.6	7.1	6.7
Mixture (2)	576.5	20.4	59.6%	343.6	12.2	7.2	6.8

Conclusions

- The Euphorbia tirucalli biogas yields are quite high, in comparison to earlier test results (456 l/kg DM and 218 l/kg, respectively). The difference could be in the feedstock (origin, type, freshness).
- The sugar filter mud biogas yield is considerable, and is considerably higher than other values found in literature[1] (402 l/kg DM and 241 l/kg DM, respectively).
- The coffee husk biogas yield is very limited; it should be disregarded as a feedstock for biogas production.
- The gas yield of the banana skin, grass, manure and maize mixture (528 l/kgDM) is somewhat above what would have been predicted from typical material properties of the individual components (DM content, OS content, biogas yield) as found in literature (approx 470 l/kgDM).

[1] M. A. Rouf, P. K. Bajpai and C. K. Jotshi (2010) Optimization of Biogas Generation from Press Mud in Batch Reactor. In: Bangladesh J. Sci. Ind. Res. 45(4), 371-376, 2010