Biorefinery of Verge Grass to produce Bio-fuel

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As part of the Dutch commitment to the reduction of CO_2 emissions the government has set a goal of producing 10% of the total energy consumption from renewable sources by 2010 up from less than 1 % at the moment. A significant part of the sustainable energy is to be produced from biomass. In a small and densely populated country like the Netherlands this poses quite a challenge. Still quite a variety of biomass streams are available though the quality is often not sufficient to serve as a solid fuel. An answer to this problem may be the use of bio-refinery techniques. Bio-refinery concepts are used to produce a variety of products from biomass, thereby generating products for the food, feed, chemical and energy industries and obtaining the highest added value for the biomass producer. Bio-refinery concepts have been proposed as a way to improve properties of biomass for multifunctional and also for energy purposes. In this project we focus on bio-refining verge grass to produce a solid bio-fuel for renewable energy production in for example gasification plants and as a source of valuable soluble nutrients. The dense infrastructure in the Netherlands consists of a variety of highways and roads with extensive verges that require wide-ranging yearly maintenance. These areas can contribute significantly to the preservation of bio-diversity and have an important function as a corridor in the ecological infrastructure. Harvesting the vegetation is necessary to maintain short vegetation for traffic safety. The mowing results in a reduction of nutrient availability causing a decreased biomass production while simultaneously the ecological value of the infrasturcture is in general increased. The total area of verge grass mown in the Netherlands is approximately 50.000 ha. Some 20% of this grass is used as cattle feed. The remaining 80% is composted at high costs. These costs range from approximately 25 to 50 Euro per tonne fresh weight (approx. 50% DW). Furthermore there are extensive natural areas covered with grass vegetation. Here also removal of the vegetation is part of the necessary maintenance. Depending on the vegetation type and time of year verge grass contains valuable proteins, sugars and minerals, and often more than 50% fibrous material. Using the verge grass for bio-energy production would both contribute to lowering the cost of highway and nature reserve maintenance and contribute to the production of renewable, CO_2 neutral, energy. Several test have shown that the ash agglomeration temperatures of this material is too low to be of use in normal bioenergy plants.

Objective

The objective of this project was to investigate methods to separate verge grass material into a fibre fraction of good quality as a bio-fuel and other fractions for possible use as a protein source and/or fermentation fluid.

Experimental

Grass material was collected from several natural areas in the Netherlands in the fall and winter of 2000. The locations `De Wieden` and `Weerribben` are both natural parks located in the middle of the country. The location Baarle-Nassau is in the south of the country, the grass was collected from a small closed field by using a special wet-land mower. The material was stored under cold conditions (approximately 4° C) for approximately one day and chopped to pieces of 5 cm length, extracted in an extruder and rinsed with water after which the samples were pressed to remove water. The procedure yielded a solid fraction, consisting mainly of fibre with an approximate dry weight content of 50%, and a dilute fluid fraction. The fibre mass was dried at room temperature and standard analyses for composition and ash agglomeration were conducted. Grass material was collected from several natural areas in the Netherlands in the fall and winter of 2000. The material was stored under cold conditions (approximately 4° C) for approximately one day. The samples were then extracted in an extruder and rinsed with water after which the samples

were pressed to remove water. The procedure yielded a solid fraction, consisting mainly of fibre with an approximate dry weight content of 50%, and a dilute fluid fraction. The fibre mass was dried at room temperature and standard analyses for composition and ash agglomeration were conducted.

Results

Ash agglomeration test results (not shown) showed that the ash agglomeration temperatures increased by the treatment to over 850° C, making the verge grass suitable as fuel for gasification systems. The results of sample analysis (Table 1) show that the treatment was effective in reducing some of the most important components responsible for lowering biomass fuel quality, compared to the original material. The Cl content was decreased by 89%, the K content by 84% and the Na content by 72%. The effectiveness in removing N was only 16%.

Table 1. Composition of verge grass samples from different natural areas in the Netherlands before and after extraction, rinsing and pressing.

Component	Unit	Location in the Netherlands					
		De Wieden		Weerribben		Baarle Nassau	
		-- before --	--- after---	--before --	--- after ---	-- before --	--- after---
Ash	wt% dry	6.8	5.8	9.4	14.8	9.6	9.3
Cal. value	kJ/kg dry	18240	19130	18343	17330	20024	18469
C	wt% dry	45.6	46.2	45.7	42.8	45.5	45.7
H	wt% dry	6.1	6.0	5.5	4.8	5.7	5.3
O	wt% dry	39.3	39.0	39.0	36.8	38.5	39.2
N	wt% dry	1.47	1.51	1.32	1.06	2.51	1.67
S	wt% dry	0.188	0.131	0.146	0.088	0.256	0.131
Cl	wt% dry	0.314	0.077	0.278	0.015	0.678	0.021
Ca	mg/kg dry	6611	5292	4055	2888	5901	4514
K	mg/kg dry	5157	1405	3261	465	20707	1253
Na	mg/kg dry	1669	426	902	193	342	126
P	mg/kg dry	1386	732	692	242	3072	481
Si	mg/kg dry	11315	14128	6736	7232	3917	3764

Conclusions

The results show that it is possible to produce a high quality solid bio-fuel from low value verge grass material in the Netherlands. In the full article further data will be presented on extraction and rinsing procedures and on characterisation of the fibre and other fractions.