Potentials of Biowaste Recovery in the Czech Republic

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Annotation

The matter of biological byproducts exploitation is discussed in the Czech Republic for several reasons. One of them is a necessity to reduce the amount of biodegradable waste dumped in a disposal site and another one is an effort to increase the exploitation of renewable energy sources for both electric and heat energy production.

1. Byproducts in the Czech Republic

As the Czech Republic was integrated into EU, it accepted the commitment to increase the rate of renewable sources (RS). One of these possibilities to fulfill it is biomass, eventually agricultural and food processing waste, exploitation. Nowadays, biomass (especially wood cuttings) is burnt in larger energy sources with little rate on electricity and heat generation (KVET). Biogas plants have been mostly constructed for electricity generation. In the worldwide point of view, some procedures have not been found as efficient ones.

The pressure to exploit the dumped bio waste has brought a new strategy in the field of municipal solid waste treatment (MSW), e.g. separation of organic fraction (EU Directive 1999/31/EC, EU Directive 2008/98/EC) and reduction in biodegradable substances MSW in the dumped waste (EU Directive 2003/33/EC) resulted in preferences of composting such as a suitable biotechnology for organic waste conversion into exploitable agricultural product. In the Czech Republic is currently MSW production about 306 kg/person/year, which is the least of all EU countries. The estimation of generated biodegradable MSW is 3,174 tons in 2013.

EU Directive 2003/33/EC has supported the biggest construction of biogas plants. At the beginning of 2012 (data in 15. 2.) in the Czech Republic there were 327 biogas power station with the output 224 MW. The rate of biogas on renewable sources (RS) in 2011 reached 11,1 %, which is about 0,9 % more than it was in 2010. The total electricity generation from biogas in 2011 was 868 GWh. According to the information of regional distributive companies, the output at the end of 2012 will be 423 MW. This output overtakes the value established by National Action Plan for RS for 2020.

Within the national energy concept, there are kept stimulating conditions for both cultivated and waste biomass. There is a definition used as a formula – Support of development and RS exploitation in agreement with economic possibilities and natural geo-climate conditions in the Czech Republic. The cogeneration of heat and electricity is preferred. In the respect of local energy sources, higher waste exploitation as a challenging material is assumed.

2. Some interesting materials for power processing

Nowadays, the most often exploitable material in the Czech Republic is both directly cultivated and waste biomass from agricultural production and food processing industry, including municipal green vegetation, submontane grass, biodegradable waste (biologically degradable MSW), water sewage sludge and compost.

The total estimation of energy biomass potential was in Action Plan calculated about 168 – 226 PJ excluding fuel wood for households estimated about 17 PJ. It is relevant to agricultural area of 680 thousand ha of arable soil and 440 thousand ha of grass vegetation. Energy biomass potential is in the range reflecting future uncertainty in the field of biomass generation, new technologies of biomass utilization and possible climate changes. The depicted range of biomass potential enables to define biomass as a significant energy source with mid – term, slightly increasing potential of development up 2020.

Although the total production potential of the Czech Republic has not been fully exploited yet, it is necessary to make biomass utilization more effective using various kinds of agro technical, technological and organizing arrangements in the level of production, logistics, biomass store and pretreatment, generation and consumption of energy. At the same time, the biomass exploitation has to be sustainable and stable in the context of valid requirements of Czech Republic and EU.

As there is lack of the pure and high quality biomass on base of dendromass (forest biomass), it is necessary to focus on waste biomass exploitation. Regarding this fact, the quality and quantity indicators, including their time and geographic stability, will be important.

3. Some energy conversions – examples of technology

3.1. Biogas

The development of biogas plants in the Czech Republic has brought some factors, electricity generation from RS has been increasing, but the heat is not mostly exploited and the shortage of standard quality substrates has been noticed. The higher efficient units and costs decrease support the effort to spread exploited substrates, including waste.

3.2. Combustion and Co-combustion

Combined and monoburning belong to the widest used procedures in the Czech Republic. Especially biofuels exploitation in large burning facilities has significantly contributed to

an intense increase in RS exploitation, as well as, neutral CO_2 production. Biomass co-burning has brought several technical tasks relating to biomass treatment or old facility transformation which have been already solved. Biomasses' co-burning in a fireplace, especially modified burning facility, has been solved for many years and many achievements have been reached in the field of wood burning facilities. These facilities are unique ones and it is necessary to consider their payback period (wooden waste availability, costs for its transport, briquettes, etd.)

Possibilities of biomass co-burning and coal powder in fireplaces of current boilers have many advantages. Moreover, it is cheaper. At the same time, there are some problems such as fuel transport to the disposal site, fuel stock, fuel transport into the boiler, biomass and coal powder mixing, temperature changes in the burning facilities and combustion products content.

3.3. Compost burning

There are two main usages of compost as a product: as a soil improver/organic fertiliser and as a component of growing media (End of waste criteria, 2011). Within activities supported by Ministry of Environment, compost plants have been constructed (in the respect of necessity to separate biologically degradable waste. In some regions is a problem to find purchasers because of default of compost quality parameters (ratio C/N, risk elements content and organic pollutant defined by the Decree No. 341/2008 on Biowaste) or low interest of farmers in these products [8]. Some composting plants have problems to ensure optimal input content to declare required ratio C/N in generated compost. 13 compost samples taken in Moravian Silesian region did not comply with $20 < C/N < 30$. If a composting plant shows a long term problem to ensure an optimal material balance, energetic usage of compost is offered complying with regulation Decree No. 13/2009 Sb. *On the determination of quality fuel requirements for stacionary sources from the point of air protection* – to ensure calorific value 10 MJ/kg. For energetic compost usage, it is necessary to record its quality which is given by carbon, nitrogen concentration, ash content and product humidity. During composting 40 – 60 % of organic matter, 20 – 40 % of carbon content is lost, which substantially affects on the calorific value resulting in 22 % loses [5, 6]. The composts taken in Moravian Silesian region shows calorific value in dry matter between 5,7 – 17 MJ, original samples in the range 1 – 13 MJ. During energy compost production it is necessary to keep hygiene requirements. Another possibility is additive of non waste biomass to the mature compost to supply lost carbon. This procedure of energy properties improvement might be in a disagreement with the act about waste. The composting period reduction would bring ash content reduction in the compost. The biggest problem is still compost humidity caused by free water which is possible to reduce by convenient store from 65 % to 20 % [9].

3.4. Energy recovery from grass

For biomass briquettes production the vegetation of herbal character with high profit of dry matter is cultivated. Some kinds are cultivated just for energy – energetic grass (Bromus carthariticus, Agrostis gigantea, Phalaris arundinacea, Festuca arundinacea, Arrhenatherum elatius a hybrids of Lolium). Energy content of wooden briquettes is in the range between 17-18 MJ/kg and straw briquettes 14-16 MJ/kg. Value of combustion heat is affected by lignin content in biomass [5, 6, 10].

An important factor for determination of optimal time for grass harvest is knowledge of key parameters behavior affecting energy properties of bio fuel in the point of combusting

such as caloric value, ash content, volatile combustible, fixed carbon, nitrogen and alkali content [7]. Some parameters such as nitrogen, alkali ash content are affected by period of harvest. The late harvest results in decrease of most elements useful for combusting (nitrogen, chlor, potassium, sulfur). During the vegetative period more than 50 % alkali infusion occurs (Figure 1). Alkali infusion contributes to temperature increase, increase of ash melting point from 1,070° to 1,400 °C [4]. The melting point of energy grass is between 1,045 and 1,295 °C (Figure 2). The higher melting point of ash is caused by higher content of phosphorus in grass (Figure 3).

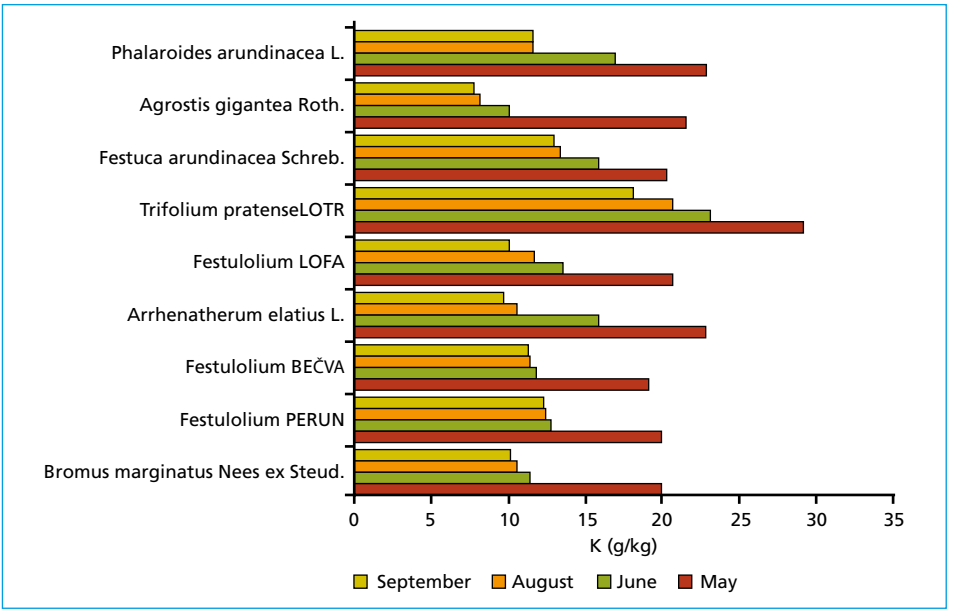


Figure 1: Concentration decrease of water-soluble potassium during vegetative period

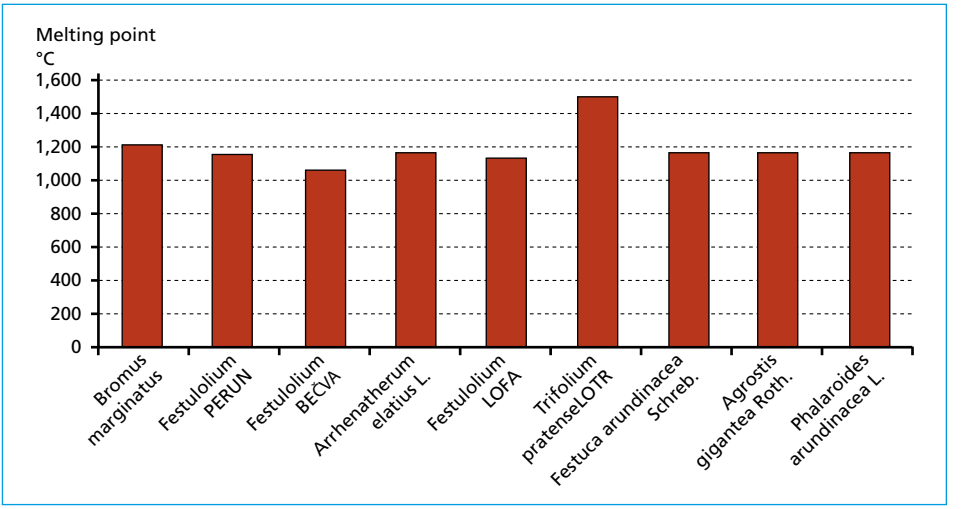


Figure 2: Melting point of grass ash

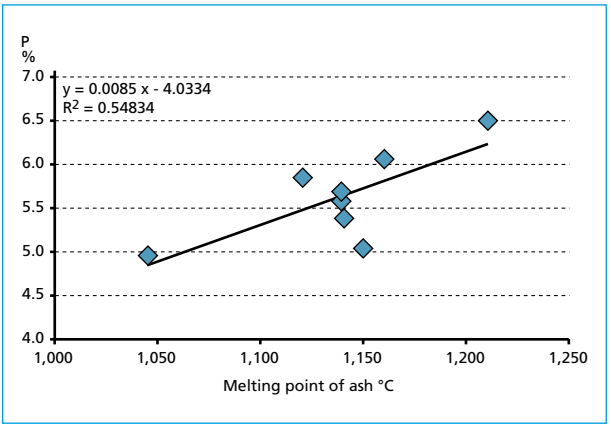
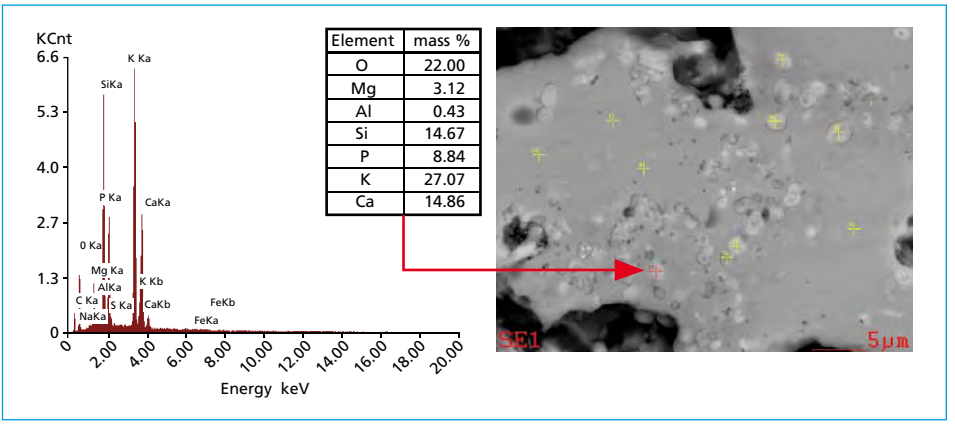


Figure 3:

Correlation between melting point of ash and phosphorus content in grass

Chemical composition of particle with phosphorus content (red mark) is recorded in Figure 4. As it arises from the results, it is obvious that potassium – carbon – phosphates with higher melting point of ash are generated during the combustion [3]. From these results it is obvious, that some grass properties are possible to optimize by suitable period of harvest and additives.



Element	mass %
O	22.00
Mg	3.12
Al	0.43
Si	14.67
P	8.84
K	27.07
Ca	14.86

Figure 4: Particles of ash from grass combustion with the phase of phosphate potassium carbon

3.5. Energy exploitation of biologically degradable municipal solid waste

The content of municipal solid waste varies from place to place in every country. It depends on many factors such as regional differences, climate, frequency of separate gathering, season of the year, culture, trends in society, lifestyle, municipality, kind of heating. The essential problem of effective biologically degradable waste exploitation for their energy usage is the level of sorting for pure biological part. For the reasons of suitable technology evaluation, municipality of Frycovice (district Ostrava, 2,000 inhabitants) and 8 other ones in District Frydek-Mistek were monitored. In Table 1 there are the most significant parameters which describe biodegradable waste (BDMSW) separated from municipal solid waste by hand at the disposal site Frýdek-Místek.

Table 1: Ultimate analysis of biodegradable waste from municipalities below 2,000 inhabitants

	Unit	Frycovice	Landfills Frydek-Mistek	
		Average	Minimum – maximum	Average
Org. dry matter	%	42.33	33.43 – 62.83	55.76
Biomass content*	%	17.80	27.01 – 32.64	
Calorific value	MJ/kg	6.388	9.024 – 25.381	16.23
C/N		16.82	11.02 – 25.12	16.16
C	%	18.40	24.44 – 45.98	40.73
N	%	1.31	1.48 – 3.03	2.73
H	%	2.46	4.65 – 10.48	8.93
S	%	0.12	0.11 – 017	0.14

* Explanation: Determination of biomass content by the selective method of dissolving according to ČSN P CEN/TS15440

4. Summary

Biomass is supposed to be a universal carrier of energy able to accumulate sun energy which is possible to use in various kinds – solid biomass for heat generation, biogas for combined heat and electricity generation, fluid bio-fuels for combustion engines. The production of energy compost seems to be a very challenging way of waste management. Energy compost is possible to be produced from water sewage sludge and biodegradable waste. The composting process is adaptable to decrease calorific value of compost in the comparison with input material just a little. The hygienic requirements would be ensured, suitable additives regulate the humidity, which increases the calorific value.

Biomass has been and will be the most important renewable source in the Czech Republic. Currently, most supported fields of biomass exploitation are biogas technologies, combusting for combined heat and electricity generation, composting plants. Their environmental effects are assessed.

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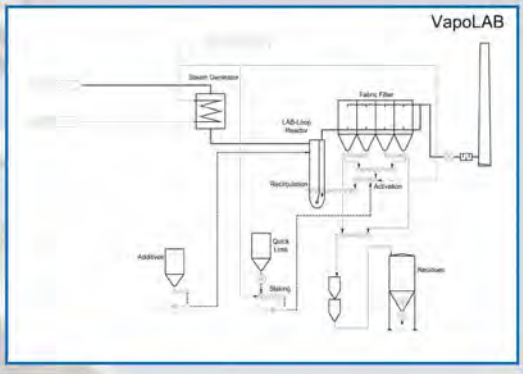

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