

## THE SHARE OF BARK IN ENERGY CHIPS FROM SHORT ROTATION COPPICE OF POPLARS AND WILLOWS GROWN ON PLANTATIONS

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### ABSTRACT

In this contribution, the results of experimental works assessing the share of bark in energy chips of selected clones of short rotation coppice of *Salix viminalis* and poplars with 5-year harvesting cycle, grown in the region of Slovakia and Moravia, are shown. Energy chips made of dendromass from fast growing trees grown on plantations is a bio-fuel consisting of juvenile wood and juvenile bark. The share of bark in energy chips influences the environmental properties and ash content of a bio-fuel.

The share of bark in energy chips from clones RAPP, OLM, ULV and Inger of *Salix viminalis* in bio-fuel is  $XB = 16,8 \div 19,7 \%$  and the share of bark in chips from clones Max5, Oxford, AF2 a Monviso of poplars grown on plantations is  $XB = 20,97 \div 26,67 \%$ .

**Key words:** bio-fuel, energy chips, share of bark, fast-growing trees, *Salix viminalis*, *Populus*

### INTRODUCTION

In the last 30 years, plantations of fast-growing trees with minimal yields of dendromass being  $10 \text{ m}^3 \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$  are founded with the interest of increased production of dendromass for energetic purpose. According to works of: *Varga – Godó (2002)*, *Trenčiansky – Lieskovský – Oravec (2007)*, *Jandačka – Malcho – Mikulík (2007)*, *Suchomel – Gejdoš (2007)*, *Malaták – Vaculík (2008)*, *Čížková – Čížek – Bajajová (2010)*, *Varga – Bartko (2010)*, *Liebhart (2010)*, *Otepla – Habán (2011)* appropriate wood species grown on plantations for dendromass production for energetic purposes in central-european area are acacia (*Robinia pseudoacacia L.*), clones of poplar (*Populus sp.*), white willow (*Salix alba L.*) and clones of osier willow (*Salix viminalis L.*).

According to the method of founding of the plantations and the growing period of trees, plantations of fast-growing trees are divided to plantations with harvest time under 5 years (mini rotation), from 5 to 10 years (midi rotation) and from 20 to 30

years (maxi rotation), *Simanov (1995)*. While the goal of dendromass production on plantations with harvest time of 5 years, or acacias with harvest time of 5 to 10 years, is the production of energy chips, the goal of plantations with harvest time of 20 to 30 years is the production of fibre for cellulose and paper industry and branches for chips for energy sector.

Energy chips made of dendromass from coppice of fast-growing trees grown on plantations is a bio-fuel, which consists of juvenile wood and juvenile bark. According to works: *Dzurenda – Zoliak – Malis (2009)*, *Dzurenda – Mačejny (2009)*, *Dzurenda – Jandačka (2010)*, *Dzurenda – Jablonski (2011)*, *Hecl (2011)*, *Dzurenda – Bartko – Ridzik (2012)* aimed at energo-environmental evaluation of energetic properties of bio-fuels, juvenile bark, due to an increased share of nitrogen – exothermic component of the combustible and ashes, negatively influences the lower heating value and production of emissions  $\text{NO}_x$ .

In this contribution, there are presented the results of experimental works carried out

for the purpose of determination of share of bark in energy chips from the coppice of chosen clones of fast-growing willows and poplars with short rotation period grown in Slovakia and Moravia.

### EXPERIMENTAL PART

Samples of energy chips of clones RAPP, ULV and ORM of wood species *Salix viminalis* were taken from a 5-year-old coppice in the Grassland and Mountain Agriculture Research Institute – a research station Krivá in Orava. Samples of energy chips of clone Inger of the same wood species were taken from a 5-year-old coppice of grown on a plantation near Lubica in eastern Slovakia.

Samples of energy chips of *Populus* clones: *Max 5*, *Oxford* were taken from coppice in *Forestry and Game Management Research Institute – research station Kunovice* and clones *AF 2* and *Monviso* from coppice of a firm: *Alesia Franco*, near an austrian municipality Marchegg.

Samples of energy chips of analysed clones of wood species *Salix viminalis*, as

well as of clones of *Populus* were taken during the time of harvest - during winter.

The share of bark in energy chips of individual clones of wood species *Salix viminalis* as well as *Populus* was determined in a laboratory, according to the norm STN 48 0058:2004 Assortments of wood. Chip and sawdust of hardwood. The share of bark is determined on samples with weight  $200 \pm 0,01$  g. Bark was mechanically separated from wood. Bark was then weighted using laboratory scales with precision 0,01g and the share of bark in the sample was calculated using the formula:

$$X_B = \frac{m_B}{m_{CH}} \cdot 100 \quad [\%] \quad (1)$$

where:  $m_B$  – weight of bark in the chips sample [g],  $m_{CH}$  – weight of the chips sample [g].

### RESULTS AND DISCUSSION

A view of the sample of energy chips and individual components of the bio-fuel: wood and bark in the sample of *Salix viminalis* clone *Inger* is in the pic.1.



**Picture 1: Energy chips and its components: juvenile wood and juvenile bark of *Salix viminalis* clone Inger grown on plantation**

The share of bark in samples of energy chips of individual analysed clones of *Salix*

*viminalis* shows table 1 and of clones of *Populus* shows table 2.

**Table 1: The share of bark in energy chips of analysed clones of *Salix viminalis***

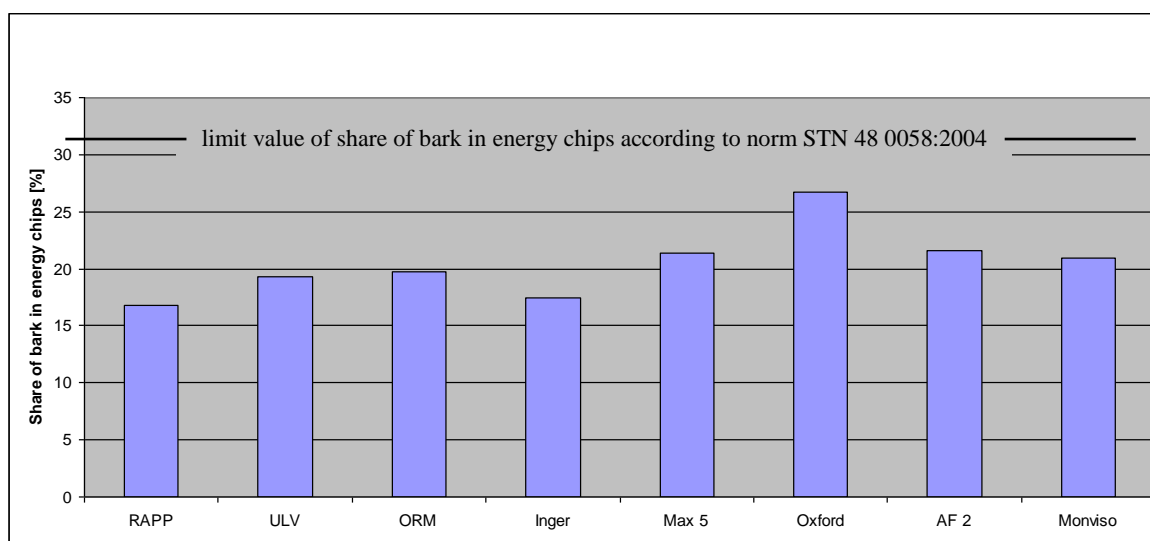
Sample	<i>The share of bark in chips of clones of Salix viminalis[%]</i>			
	<i>RAPP</i>	<i>ULV</i>	<i>ORM</i>	<i>Inger</i>
No 1	16,89	19,57	19,80	18,14
No 2	16,65	19,09	20,34	16,68
No 3	16,85	20,27	19,33	17,54
average	<b>16,79</b>	<b>19,35</b>	<b>19,74</b>	<b>17,45</b>

**Table 2: The share of bark in energy chips of analysed clones of *Populus***

Sample	<i>The share of bark in chips of clones of Populus[%]</i>			
	<i>Max 5</i>	<i>Oxford</i>	<i>AF 2</i>	<i>Monviso</i>
No 1	21,35	27,93	20,05	20,89
No 2	20,08	26,60	22,75	20,61
No 3	22,56	25,48	22,09	21,40
average	<b>21,33</b>	<b>26,67</b>	<b>21,63</b>	<b>20,97</b>

Comparison of shares of bark in energy chips of analysed clones of wood species: *Salix viminalis* and *Populus* with a limit

value of the share of bark in bio-fuel  $X_B \leq 30\%$  set by norm STN 48 0058:2004 is in fig. 1.

**Figure 1: Share of bark in energy chips of wood species *Salix viminalis* and *Populus***

From the comparison of shown values with a limit of accepted share of bark in energy chips  $X_B \leq 30\%$ , according to STN 48 0058:2004, we can conclude, that energy chips of all analysed clones of *Salix viminalis* and *Populus* fulfill the qualitative

criteria determining the accepted share of bark in bio-fuels.

Despite this fact, it is important to point out, that bio-fuel from dendromass grown on plantation with a 5-year harvest period has a higher share of bark, than bio-fuel

from dendromass grown on plantation with a harvest period of 25 to 30 years, or energy chips from dendromass of fully grown trees. This statement is in accord with the knowledge of dependence of the share of bark on the diameter of trees shown in work: *Požgay et al (1988)*, as well as works showing the share of bark in dendromass in dependence on the age of trees: *Golovkov – Koperin – Najdenov (1987)*, *Gelec – Koržickaja (1992)*, *Varga – Bartko (2010)*. For illustration, the share of bark in analysed energy chips of dendromass from poplar plantations is 1,5 to 2,6 times higher, than the share of bark in dendromass of fully grown poplar trees shown in the work : *Hnětkovský et al. (1983)*.

An increased share of juvenile bark in bio-fuel made of dendromass of analysed clones of fast-growing trees *Salix viminalis* and *Populus* grown on plantations with harvest period of 5 years shows, that in comparison with the wood of broad-leaved wood species shown in works: *Dzurenda – Mačejný (2009)*, *Dzurenda – Gefertova – Hecl (2010)*, *Dzurenda – Zoliak (2011)* *Dzurenda – Jablonsky (2011)*, there is a negative impact of 4 to 5 times higher share of nitrogen – exothermic component of the combustible and an increase of ash in bio-fuel by 50 to 80 %, which negatively impacts the lower heating value and production of emission  $\text{NO}_x$ .

### CONCLUSIONS

Based on this work, we can state, that energy chips made of dendromass from clones RAPP, ULV, ORM and Inger of wood species *Salix viminalis* grown on plantations with harvest cycle of 5 years consists of juvenile wood and juvenile bark with the share of bark in the range of values  $X_B = 16,79 \div 19,74 \%$ . The share of bark in energy chips from clones *Max 5*, *Oxford*,

*AF2 a Monviso* of wood species *Populus* grown on plantations with harvest cycle of 5 years is higher by a mean value of 5 %.

Energy chips of analysed clones meet the requirements for share of bark set by the norm STN 48 0058:2004.

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