MOGUĆNOST KORIŠĆENJA KOŠTICA VIŠNJE KAO BIOGORIVA ZA DOBIJANJE TOPLOTNE ENERGIJE

POSSIBILITY OF USING SOUR CHERRY PITS AS BIOFUEL FOR OBTAINING THERMAL ENERGY

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Višnje se u Republici Srbiji uzgajaju na oko 14000 hektara i predstavljaju četvrtu voćnu vrstu po površini. Koštice koje ostaju nakon prerade višnje predstavljaju nus-proizvod koji opterećuje poslovanje prerađivača ovog voća. Količine koštica koje se godišnje proizvedu se procenjuju na oko 7000 tona. Ovo predstavlja dobar energetski potencijal imajući u vidu da je kalorična vrednost koštica višnje oko 22 MJ/kg suve materije. Dodatna pogodnost koštica višnje je u njihovim dimenzijama koje ih čine pogodnim za direktno korišćenje u kotlovima za pelet, bez ikakvog predtretmana. Jedan od kotlova u kome je moguće vršiti sagorevanje suvih koštica višnje u cilju dobijanja toplotne energije, je Šukoplam VENT, proizvođača kotlova Šukom iz Knjaževca. Ovaj kotao se po svojim karakteristikama odlikuje visokim stepenom korisnosti (do 94 %), kvalitetom materijala i izrade, mogućnošću upotrebe više vrsta biogoriva i njihovog kvalitetnog sagorevanja, na osnovu kojih je ispunio uslove za dobijanje Klase 5 (Ecodesing) vezano za emisije zagađujćih materija po najnovijim evropskim standardima.

Ključne reči: *biomasa; koštice višnje; toplotna energija; kotao; Šukoplam VENT.*

In the Republic of Serbia, sour cherries are grown on approximately 14,000 hectares and represent the fourth fruit species in terms of area. The pits that remain after the processing of sour cherries are a by-product that burdens the business of the processors of this fruit. The quantities of pits that are produced annually are estimated at around 7,000 tons. This represents a good energy potential, bearing in mind that the calorific value of sour cherry pits is around 22 MJ / kg of dry matter. An additional convenience of sour cherry pits is in their dimensions that make them suitable for direct use in pellet boilers, without any pre-treatment. One of the boilers in which it is possible to burn dried sour cherry pits in order to obtain thermal energy, is Šukoplam VENT, a manufacturer of boilers Šukom from Knjaževac. This boiler has good characteristics such as: high efficiency (up to 94%), quality of materials and workmanship, the possibility of using several types of biofuels and their quality combustion, based on which it met the requirements for Class 5 (Ecodesing) related to pollutant emissions by the latest European standards.

Key words: *biomass; sour cherry pits; thermal energy; boiler; Šukoplam VENT.*

1 Introduction

Energy production and consumption all over the world are continuously increasing. Traditional energy sources are limited so there are always demands for new alternative and renewable energy sources. Electrical energy production in the Republic of Serbia is mostly dependent on coal combustion (over 60%), some comes from hydro power and very little from renewable energy resources. Despite that it is being very little used, potentials in renewable energy resources, especially in biomass, in the Republic of Serbia are significant. According to the analysis done in 2016 by the

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Department for strategic planning in energy sector in the Ministry of Mining and Energy of the Republic of Serbia, biomass potential in Serbia is estimated at 3.448 million toe and in the total potential of renewable energy participates with 61% [1]. The largest potential has wood biomass with 1.53 million toe and agricultural biomass with 1.67 million toe (including crop farming, cattle breeding, food growing, wine growing and primary fruit processing) [1]. There are also potentials of biodegradable municipal waste with estimated 205 thousand of toe and biodegradable waste, except municipal waste, (waste cooking oils and animal waste - slaughterhouse waste) with total amount of 0.043 million toe/per year [1].

While the use of wood biomass potential is relatively high (66.7%), agricultural biomass potential is used very little (about 2%) and the biodegradable municipal waste potential is not used at all [1]. It is very important to use agricultural biomass and biodegradable municipal waste instead of wood biomass because for the growth of a tree it takes years and agricultural biomass and biodegradable municipal waste are produced annually or daily.

2 Agricultural biomass in the Republic of Serbia

Serbia is an agricultural country with approximately 5 million ha of agricultural land, out of which 70% is arable [2]. Cereals (mainly maize and wheat) are grown on approximately 2 million ha, oilseeds on 300 thousand ha, fruits on 250 thousand ha, roots and tubers on 150 thousand ha, vegetables on 140 thousand ha, etc. [2].

The most of arable land in the Republic of Serbia is located in the northern province of Vojvodina, which is mostly known for crop production. In Figure 1 are shown arable lands in the Republic of Serbia. As can be seen most of arable lands are located in the north and smaller amounts in central, east and south, while in west there are very few.

Other areas of Serbia also have some potential in agriculture production, especially in fruit and wine production and processing, cattle breeding, etc. Figure 2 shows areas under orchards in Serbia.

As it can be seen from Figure 2, fruit production is mostly represented in western Serbia, central and some in the south also. Fruit cultures that are being grown the most are plums, apples, sour cherries, peaches, raspberries, etc.

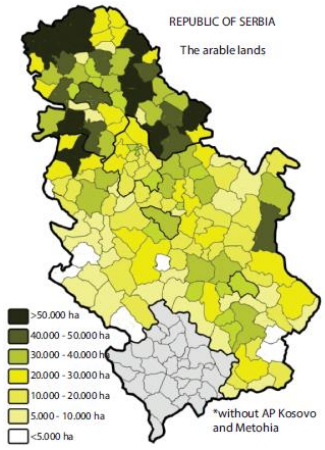

Figure 1 The arable lands on the territory of Serbia [3]

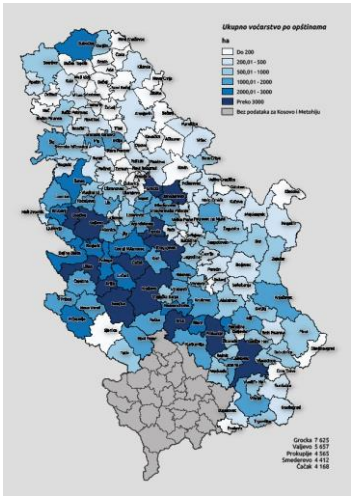

Figure 2 Areas under orchards in Serbia [4]

There are a lot of by-products from agricultural production such as harvest residues, fruit and vine cutting residues, manure, etc. that can be used as biomass for energy production. As it was said earlier, the Republic of Serbia has great potentials in agricultural biomass with 1.67 million toe. Figure 1 shows the structure of the real energy potential of agricultural biomass in Serbia.

From the graph shown in Figure 3 can be seen that 68% of all energy potential in agricultural biomass is from harvest residues, 11% manure, 9% each are cutting residues and biofuels, while 3% is from processing industry and biodegradable communal waste. It cannot be expected all of these

potentials to be used, especially harvest residues, because it is necessary to plow into ground some of amounts, but the others could be used.

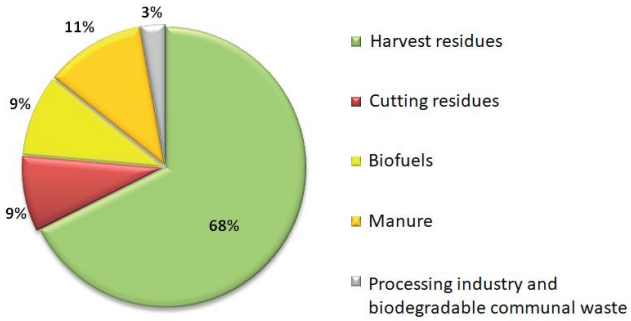

Figure 3 The structure of the real energy potential of agricultural biomass in Serbia [5]

3 Sour cherry pits as biofuel for thermal energy production

Sour cherries are grown on 13,990 ha in Serbia and represent the fourth fruit species in terms of area used for its growing [6]. Sour cherries are mainly grown in south, east and central parts of Serbia, and very little in the west and north. In Figure 4 are shown areas under sour cherry plantations in the Republic of Serbia.

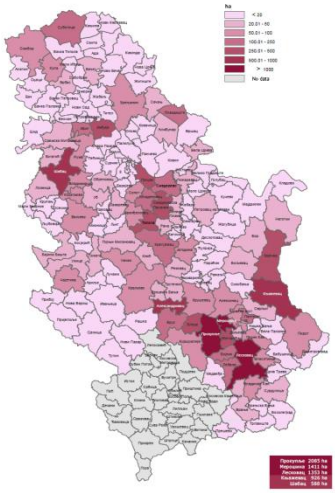

Figure 4 Areas under sour cherry plantations in Serbia [7]

Table1 Sour cherry production statistics in period 2002-2006 [8]

	2002	2003	2004	2005	2006	Average
Average fruit yield (t)	48900	86200	112300	63900	80500	78360
Average fruit processing residues (t)	4401	7758	10107	5751	7245	7052,4

Perennial average production of sour cherries around 78000 tons (Table 1), on the basis of which Serbia is in fourth place in Europe by the production of this fruit. Most of the production of cherries is used primarily as frozen (with or without pits), canned, and a lot is related to the production of juices. The pits that remain after the processing of sour cherries are a by-product that burdens the business of the processors of this fruit. The quantities of pits that are produced annually are estimated at around 7,000 tons (Table 1). This represents a good energy potential, bearing in mind that the calorific value of sour cherry pits is 21,75 MJ / kg of dry matter (Table 2).

Table2 Calorific values for fruit processing residues [8]

Type of biomass	Calorific value (MJ / kg of dry matter)		Approximate analysis (Mass %)	
	Higher	Lower	Volatile	Ash
Sour cherry pits	21,75		84,20	1,00
Peach pits	20,82	19,60	79,12	1,03
Plum pits	21,14		58,30	0,10
Walnut shells	20,18	18,99	78,28	0,56

As it can be seen from Table 2, sour cherry pits have the highest calorific value of dry matter compared to peach pits, plum pits and walnut shells. On the other side, mass fraction of volatile is also highest in sour cherry pits and the ash content is the second highest after the peach pits.

An additional convenience of sour cherry pits is in their shape and size that make them suitable for direct use in pellet boilers, without any pre-treatment. One of the boilers in which it is possible to burn dried sour cherry pits in order to obtain thermal energy, is Šukoplam VENT, a manufacturer of boilers Šukom from Knjaževac. This boiler has good characteristics such as: high efficiency (up to 94%), quality of materials and workmanship, the possibility of using several types of biofuels and their quality combustion, based on which it met the requirements for Class 5 (Ecodesing) related to pollutant emissions by the latest European standards.

Figure 5 Šukoplam VENT boiler

Šukoplam VENT boilers are mainly used for wood pellet, but they can also be used for other kinds of biomass and coal too. They are made with fuel bunkers from 0,43 m^3 up to 2,25 m^3 in volume. The size of the boiler can also differ depending on a need. Technical characteristics of Šukoplam VENT boilers are given in Table 3.

Table3 Technical characteristics of Šukoplam VENT boilers

Boiler	Operating pressure	Measuring pressure	Temperature of exhausted gasses	Efficiency rate
Šukoplam Vent 100÷1000	3 bar	4,3 bar	max 180ºC	up to 94,4%

4 Conclusion

The Republic of Serbia has great potential in agricultural biomass with 1.67 million toe, but it is not used enough. The most of electrical energy in Serbia (over 60%) is being generated by coal combustion. Coal is also often being used as a fuel for household heating, so the air in Serbia is much polluted especially in the winter season. Using renewable energy resources like biomass instead of coal can contribute to improving air quality and also preservation natural resources of coal.

Residues from fruit processing such as plum pits, peach pits, sour cherry pits, walnut shells, etc. can be used for heating instead of wood or coal. Serbia has significant resources in fruit production which could be used. Sour cherry is fourth fruit specie in Serbia, in terms of area that it is being cultivated on. Average annual production of sour cherry in Serbia is approximately 80000 tons, and 7000 tons represents residue from processing industry. Sour cherry pits have good calorific value (21,75 MJ / kg of dry matter) and their shape and size are convenient for using in wood pellet boilers. Company Šukom from Knjaževac produces wood pellet boilers Šukoplam VENT, which is distinguished with high efficiency (up to 94%), quality of materials and workmanship and the possibility of using several types of biofuels and their quality combustion.

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