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FUTURE APPLICATIONS OF BURNING WOOD WASTES IN THE EXAMPLE OF MOSCOW REGION

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ABSTRACT

This article describes the methods of disposal of wood wastes. The technology of preparation of the waste for burning is described. Storage of wastes by the closed method is proposed. Calorific characteristics of different species of wood are given. Moscow region is considered in terms of development of bio-energy.

Key words: wood residues, wood chips, humidity, energy wood, bio-energy, Moscow region

1. INTRODUCTION

Nowadays, huge amounts of wood are felled down and processed into wood chips. Raw material for wood chips are: logging residues (tops, small trees, big branches, twigs), low quality wood (rotten, cracked, hollowed, curved), wood processing residues (various wood pieces) and aged wood, like boxes, pallets, old logs from houses, old doors and windows.

By mechanical processing of wood, enormous amounts of wood wastes are produced. Wood wastes from cutting on the slashers are about 1,0 – 1,5%; 3,0 – 7,0% obtained by debarking with drums and also bark 9,0 – 11,0%. Relative volume of bark on a trunk is shown in table 1. The amount of the wastes depends on:

- amount of processed wood
- wood species
- state of bark on the trunk
- processed wood quality
- year, season
- equipment state. (*Bacherikov, Lokshtanov, Rzhavtsev, 2013*)

***Table 1**. Relative volume of bark on a trunk*

Species	Pine	Spruce	Aspen	Birch
Volume of bark, %	10 – 16	6 – 13	11 – 20	13 – 15

2. METHODS OF WOOD RESIDUES RECYCLING

Various methods of recycling and disposal of wood wastes are known: production of wood chips for pulp and paper mills and wood-based materials, production of fertilizers and extractives, dumping on landfills and burning.

In this paper, we describe the perspectives of application of wood wastes burning in Moscow region as an example.

Preparation of wood residues for burning

Wood wastes can be used for heating and energy production, for heating of plants and houses, and also for drying wood products so that they would reach the required humidity. For efficient use of wood waste as fuel, they should be prepared. Wood waste must have a uniform size of particles, humidity of wood wastes should not exceed permitted values and they must be free from metallic and mineral inclusions.

The greatest difficulties arise when dealing with wood waste from debarking. The factor that causes greatest difficulties is the large amounts of wood waste. Debarked wastes have different fractional composition and humidity reaching 83%. Preparation of wood waste for burning must include the following operations:

- Primary dehydration of waste for separation of water present on the surface of the waste and free fluid in the capillaries
- Sorting the waste for separation the big wood waste from fine waste
- Shredding of waste to the desired fractional composition
- Pressing shredded waste to reduce the size and to ease transportation
- Efficient burning of wood waste

Table 2. *Calorific values of various species of wood*

Humidity of waste		**Calorific value, kcal / kg**			
Relative, %	**Absolute, %**	**Pine**	**Spruce**	**Aspen**	**Birch**
85	567	127	153	129	160
75	300	700	830	650	850
65	186	1550	1650	1500	1750
55	120	2000	2200	2100	2400
50	100	2400	2600	2500	2800
44	80	2700	3000	2800	3300
38	60	3200	3500	3400	3800
29	40	3600	3900	3800	4300
23	30	3800	4200	4000	4500
9	10	4800	5000	4900	5200

Wood wastes prepared for burning are usually stored in piles. When stored in piles, wood wastes are exposed to atmospheric impact and their humidity increases, reducing the calorific value. To prevent this, it is necessary to store wastes in bunkers and silos.

Moscow region conditions

All forests of Moscow region have protection category meaning that, under the current Forest Code, logging is restricted. In this type of forests, only sanitary felling is allowed. Forests of Moscow region have large amounts of timber which requires felling, so Moscow region forests have good perspectives as energy source.

Forest Plan of Moscow region was analyzed with the purpose of evaluating the volume of damaged forests and ways of using the wood harvested by sanitary felling of timber. The forest area of Moscow region measures 2179,4 thousand hectares, the average species composition of the forest fund of Moscow region is: 40% Birch, 20% Aspen, 20% Pine, 20% Spruce; the average age is 65 years, the average stock on 1 ha of mature and old growth stands amounts 265 m^3. Annual growth in the forests of Moscow region is 6,6 million m^3, which is a safe withdrawal rate. Accurate data about the area damaged by bark beetle spruce forests is not currently available, as the last forest inventory data for most forest areas of Moscow region is outdated and sanitary felling in the forests is already underway. Supply of spruce forests, since ripening age (based on the forest plan of Moscow Region, 2010),

amounts more than 64 million m^3. This amount is 43% of the timber volume, which is necessary to prepare the woods to perform the tasks of forest management in the region.

Due to low efficiency of use of harvested wood and infestation of a great deal of wood with bark beetles, the amount of wood waste after production of finished products can be greatly enhanced. In addition, due to the condition of forest roads, harvested wood is not always timely removed, due to which part of it loses its quality and is left on the cutting area as large forest residues, thereby increasing danger of fires in the forest. Current version of the Forest Code secures a ban on use of any chemicals in protected forests, which does not allow reduction in loss of commercial timber, increases in terms of timber storage. This provides an additional level of resources from which to produce energy wood.

Currently, in the west of the Moscow region there are a lot of old growth spruce forests which are to varying degrees affected by bark beetle (*Ips typographus*). Wood which is affected by beetle to a less degree is used for lumber, and the rest is used as energy wood.

Figure 1. *Aerial view of the affected spruce by European spruce bark beetle (Ips typographus)*

Figure 2. *Old spruce forest, infested by bark beetle (Ips typographus)*

Figure 3. *Fragment of spruce bark, populated by bark beetle (Ips typographus)*

Depending on the extent of destruction of trees, some of the harvested wood remains on the cutting areas as forest residues and it is burnt in a fire-safe period. This amount of wood is possible to use as a source of bio-energy.

Timber production in Moscow region was insignificant since the adoption of the current Forest Code. This situation led to destruction of the timber industry in the region and reduction in its production capacity in logging and wood processing. Increased logging occurred in 2013, when the situation took a catastrophic scale. Joint efforts achieved recession of outbreaks of bark beetles, and the situation is currently being developed in the remaining cutting areas.

Wood harvested as a result of sanitary felling, can not boast a large market demand. To increase the income from forest management, it is necessary to ensure its being more fully recyclable. It should be noted that some of the unused wood remains in the woods for optimal amount of food resources and secure balance of saprophytes in the forest ecosystem.

It includes within its scope the timber provided by the old and the windfall, old natural losses, thin twigs and branches, old needles and foliage. Phytomass volume left on the cutting area after collecting forest residues is enough to maintain forest bio-cenosis in balance and prevent further unfavorable situations in recent years, as well as to protect skid trails on soil erosion.

Conducting sanitary cuttings also requires separation of cargo flows on round wood and energy wood, and in the case of production of wood chips – bio-fuels. In addition, the bark beetle which affected wood must be considered and sent to the power of company.

3. CONCLUSIONS

1. Large amounts of wood of Moscow region are infested by European spruce bark beetle.
2. Wood harvested in the sanitary felling sees no great demand and can be used for energy.
3. Infested timber requires consideration and control.
4. Burning of wood wastes should be carried without loss of efficiency.

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