Austro2007/FORMEC´07: Meeting the Needs of Tomorrows´ Forests – New Developments in Forest Engineering, October 7 – 11, 2007, Vienna and Heiligenkreuz – Austria

WOOD BIOMASS IN WOOD HARVESTING AND WASTE WOOD PROCUREMENT IN BULGARIA

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Keywords: forest felling fund, marked mass, lumbering, felling and initial processing, timber, wooden wastes, economic accessibilityp, **:** broad-leaved and coniferous plantings, clear and forest growing fellings, pruning and cutting machines, technological and green splinters, forest felling wastes, technological splinters, wood vegetation, vitamin flour, biologically active preparations, wooden panels

Abstract: *In order to increase productivity and efficiency of timber production in the forests, it is necessary to implement wasteless technologies, secondary processing of utilized timber and complete utilization of the raw material in lumbering by including in use the so called forest felling wastes. Taking away the forest felling wastes, to some extent, defines the direction of the changes occurring at certain ecological factors in the forests.*
The following three methods of processing of felling wastes into splinters are known: processing of forest felling wastes into splinters at the felling or at forest path; processing of forest felling wastes into splinters at temporary storage or at loading point; processing of forest felling wastes into splinters at the consumer's storehouse. Distribution of forest felling wastes examined in connection of the clear fellings or forest growing fellings gives the possibility of implementation of two main technological directions.
Upon complete utilization of the wood biomass, and in particular upon processing of the forest felling wastes in the woods and gas yield: obtaining vitamin flour, biologically active preparations – etherial oils, chlorophyll- carotine paste, etc. of wood vegetation; production of wooden panels, wood particles panels with cement or gypsum, etc.

1. Introduction

With the development of the wood harvesting and processing wood waste is getting more and more largely usable as ecological products. Wood biomass may regenerate by nature. When modern technologies are used, the waste wood biomass becomes an alternative to high environmental pollutants: coal, oil, natural gas and others, as well as products deriving from.

As a raw material for products procurement is being used waste remained from wood harvesting (brushwood, branches, bark, dry and fallen mass, materials obtained from cuttings, and others), wood processing (bran, saw dust, shavings, chip board, covers, cuttings/scrap. small pieces and others).

2. Waste wood quantities in Bulgaria

The largest quantities of waste are being formed within the cutting areas, and, to a less extent, in timber yard. The object of a future potential use can be considered waste wood after cutting, consisting of branches and brushwood which thickness is below 3 cm, being the waste material of a thickness over 3 cm entered the fuel wood standard. Leaves (needles) are comprised therein, considering the recent technologies available for their processing.

Besides, a fact should be taken into account that, due to one or another reason, within the cutting areas also remain standard branched trees belonging to waste wood after cuttings, as well. According to literature sources, that waste wood consists 1,1 – 3,75% of the marked mass. Totally, the relative constant volume of the waste wood is 1186000 m³ approximately (Figure 1).

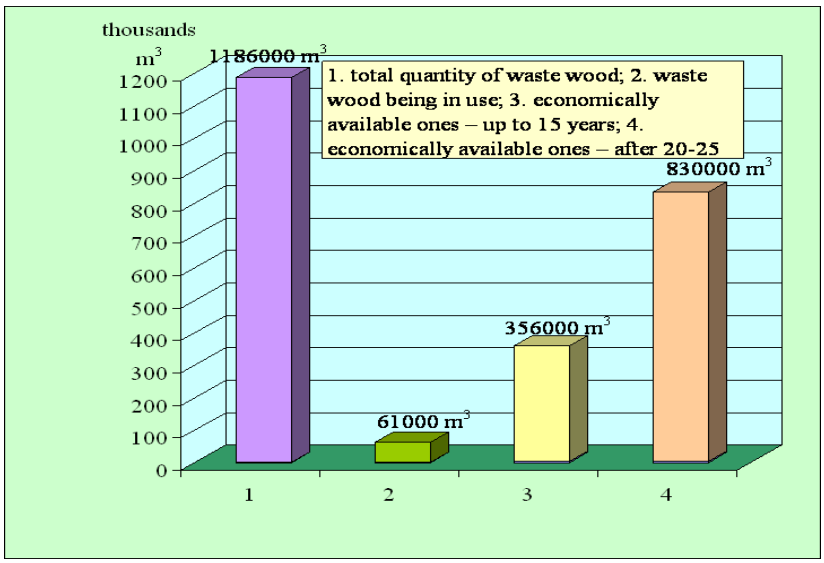

Figure 1: Waste wood and economically available ones

A determination, resulting from literature data analysis, has been made as of that economically available waste wood which can be gathered and brought into a state appropriate to transporting and supplied and processed when expenditure and costs provide such a prime cost of the final product, that results not greater than the prime cost of the same product obtained from normal raw material. The small-sized wood, not usable in the first cuttings, also belongs to the quantities of waste wood (Figure 2).

Figure 2: Wood procured by cutting – for technological processing

Hence, there are some reserves as regards to the achievement of such an extent of wood use which could be provided as according to the foresight reflected in forestry projects, and especially, as regards to cuttings providing predominantly small-sized and average-sized wood. The stimulation of the market demand of such a wood for energetic purposes could support a forestry undertaking like that one to be accomplished, which would be considered determinant, as regards to its significance, for the young forests state and resistibility.

Regardless of the fact that during the last years the forestry projects provide an increase of these cuttings, the share of the really carried out ones amounts about 40%. An increase is also noted as of the use of wood procured from the so called " closed basins ".

When plantations are older than 70-80 years, there is a lower intensity of decrease of waste quantity, which is due to the greater percentage of branches having a thickness over 3 cm, and in plantations aged over 110 years it is due top the decrease of the head development, as well.

Practically applicable by the moment: brushwood and branches of an annual volume as of 61000 m³, approximately or 0, 8-0,95% of the standing wood procurement where deciduous brushwood prevails.
Of all the waste wood, as depending upon the technologies applied to wood harvesting and waste procurement, as well as upon the effect caused by the forest exploiting conditions, there are only 30-40%, in the recent 10-15 years, and no more than 50-70% in further 20-25 years, that may be considered economically available. As for our country, the economically available waste amounts at about 356000 m³ annually (Figure 1).

3. Technologies for waste wood procurement

Procurement and utilization of the non usable part of the trees, i.e. of the waste wood, become possible when the organization, the technology and the machinery, applied to the actual wood harvesting, get improved, or when new technologies and machinery are to be introduced in, being extremely adaptable to procure waste wood from standing wood after cutting. That may be realized by stimulation of forestry activities, utilizing the wood biomass, reducing the hothouse gas emissions and achieving both economical and social effect by changing conventional type of fuels.

The main problems, as regards to waste utilization, result from: the low concentration and spreading along the terrain; the low volume as a mass; the waste heterogeneity; difficulties of use, considering the type that waste is obtained, and so on. Various methods are being used for the purpose as compriming (packaging, baling and others), homogenizing (chops procurement), natural drying/exsiccation (waste wood standing) and others (2,5 ecc.)

It results necessary a previous gathering, compacting and transporting of waste to be provided. Most often, there are full trees or single parts (head) of them, - which assortments are obtained from, - to be transported to the yard, and the waste is cut by big mobile or fixed cutters. The very problem is the transport where it is necessary to reduce the volume, which becomes possible in determined conditions (s. Figure 3).

When a comparison as among the technologies used for waste wood assimilation is made, the technology granting more favorable possibilities to introduction results that one related to such waste wood obtained by cuttings carried out in young plantations. When technologies for waste wood assimilation in wood harvesting are compared, the technology of more favorable possibilities to introduction results that one related to waste wood after cutting, obtained from cuttings carried out in young plantations.

Figure 3: Wood pro procurement where fuel trees are separated or a further technological processing is provided

There are good conditions available, in cuttings carried out in young plantations, as for the introduction of such machines and machinery that correspond to a maximum extent to those same conditions which ones are implied into the technology itself. Moreover, the operations accompanying the wood harvesting activities, from the cutting area to the yard (stumpage), are comparatively fewer, thus requiring a shorter time to be realized, as compared to those ones for waste wood assimilation from the main cuttings. That is why predominance should be given as to the raw material processing in cuttings (Figure 4).

Figure 4: New technologies where wood biomass is cut, applied in our country. This photo is made as an illustration to the Pilot project entitled "Forestry sector: fuel change", by Yenie Katsarska

Another basic reason for waste non utilization within the cutting areas is the unsolved industrial method for that raw material processing, which has already been procured.

A complete wood processing (and more precisely, of its over ground part, above the root) may be realized on that mass which has been obtained in cuttings carried out in young plantations. The effect of that cutting cannot be high if the technology for stalk procurement and processing is developed separately from that one of the waste part procurement and deep processing: that is to say, a common, a general waste less technology shall be provided.

That is why the technologies to be applied to further on are in a direct proportion as to plantation maturity. It is known, there are four undertakings carried out in young plantations: clearance, ride (aisle), thinning out and picking out (selection). Ergo, that raw material procured as regards to trees total volume and size differs; and different machines and machinery available are to be adopted for its processing. In conclusion, the implementation of such machines and machinery will depend upon the kind of that raw material which is to be processed in single workshops or plants. The technological versions, indicated below, are being used (Figure 5) or are to be used during the further 10-15 years (Figure 6).

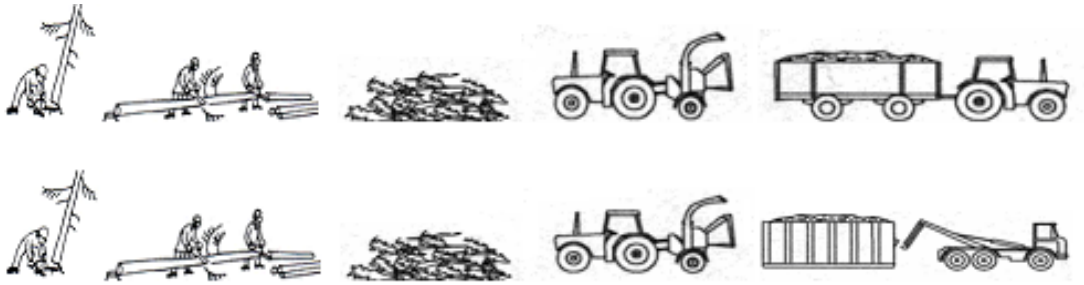

Figure 5: Technologies which are being used for a better waste wood (after cutting) assimilation

Figure 6: Technologies for a better biomass assimilation, which ones are to be introduced during the further 10-15 years

In prospect (or in 20-25 years), such technological processes for biomass assimilation will be considered appropriate in our country, which ones are being used for by the more advanced countries as regards to waste wood processing (Figure 7).

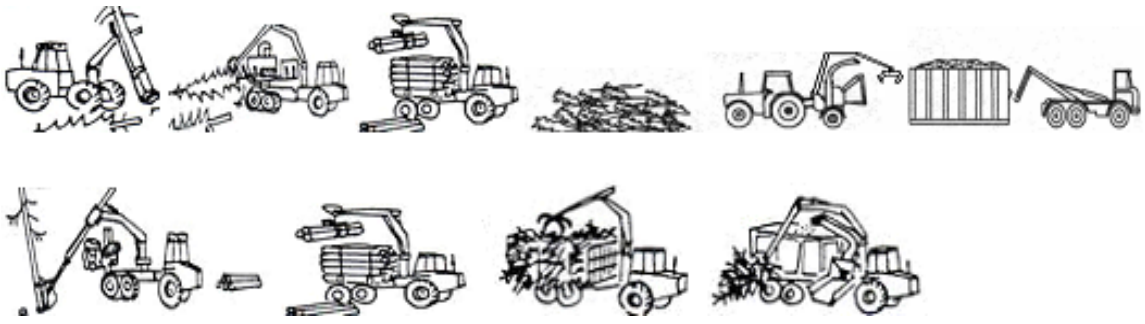

Figure 7: Technologies for a complex utilization of the biomass, which ones are to be introduced in our country in prospect

Note: For the elaboration of the schemes, presentations of that kind as above mentioned, have been used: i.e. as those ones applied by advanced countries as regards to wood harvesting.

4. Possible types of waste wood production

It is the direct burning of the compact wood (used as fire tree, predominantly in everyday life) only, that is well known in Bulgaria. Few efforts are necessary, bur a great effect is to be expected, that the other two schemes for direct burning could be applied to: after chopping (for large-sized installments, combined production comprised) and after a mechanical pressing into briquettes and pellets (for lower heating power and everyday use).

There is some experience, in our country, in a more complex use of wood biomass, waste wood after cutting included, for various products that are obtained from, as are, for example: the vitamin-containing meal used as an additive to combined fodders: spruce pine oak meal and others; ethereal oils and carotene paste produced from coniferous brushwood; chops procurement both for technological purposes and heating ones; new materials as, for example, the " woodlyth " produced from waste wood and polyvinylchloride, and others (Figure 8).

Figure 8: Some of the products obtained from waste wood in Bulgaria: 1. chops; 2. pellets; 3. briquettes; 4. woodlyth; 5. spruce vitamin-containing meal; 6. oak vitamin-containing meal.

A particular advantage as of the product woodlyth is that it results water resisting. It can be used as plates and panels for wall paneling, parquet, doors for bathrooms and laundries or rooms where washing machines are kept; furniture. The technology introduced in, for its production, is based on polyvinylchloride and waste wood (saw dust) use. That plastic material has its own advantages and disadvantages. That is why, an analogical product has been elaborated and developed, being based on another polymers as polyethylene and polypropylene guaranteeing higher quality indices.

Some of the above indicated products are hardly produced, due to missing financial means, difficulties occurring in the market and other factors. All these problems shall be examined more and more, working on and on to solve them, as our country significantly retards in comparison with the advanced states, moreover considering the fact our country has raw material available, and in significant quantities. For example, waste may be utilized for energetic purposes, at a very first time, for heat energy production, and later on in energetic, as that energy which derives from wood biomass results significantly " purer ", " the purest ", as compared to that one where other fuels of common use are utilized.

Waste wood caloricity highly depends upon moisture varying within large limits: from 10% for wood processing waste wood up to 55% for freshly cut wood. Dry wood caloricity is about 18,0 MJ and air-dry wood caloricity is of 6,3 – 7,1 MJ approximately. The ash quantity amounts at 1-1,5 % only.

The advantages of the wood briquettes are that they result cheaper (below 200 levs/t, i.e. 100 €/t) than the pellets, being the investment costs for them lower; they are more widespread in Bulgarian market nowadays; their caloricity results higher as compared to that one of fire wood, and less ash remains after burning. The disadvantages of the briquettes are as following ones: impossibility to fuel automatic alimentation; no quality standards/guarantees available; a higher cost than that one of fire wood. The briquettes can be used both in fireplaces/ tile stoves and in heating systems comprising water heating boilers of different power.

Pellets are still new fuel in Bulgarian market: mainly because of the higher investment costs and lower purchasing power as compared to EC countries. Regardless of that fact, experiences are being carried out by local producers, and it is expected pellet production would pick up speed, along wioth the development of the economics and living standard increase in the next years.

Examining the problem regarding the complete utilization of tree (wood) biomass, what shall be studied in scrupulous details concerns the utilization of wood verdure. Wood verdure in 1 kg of absolutely dry material contains 60-320 mg of carotene, up to 14% of raw protein, as well as raw oils, vitamins C, B1, B2, B6, PP, E, K, D, folic acid, pathotenic acid, a number of other bio-active matters, i.e., it contains, practically, all the micro- and macro elements required for animals. Wood verdure preservation can be carried out using high temperature exsiccation and grinding into vitamin-containing meal.

The vitamin-containing meal is a hard and labor-consuming process. When the raw material is procured and transported, 45% of all the costs are done. The main difficulty consists in missing machinery for wood verdure separation and insufficient quantities ofg aggregates for its processing into vitamin-containing meal.

Wood meal is used as a bio-active additive. Such an additive is usually 3% for poultry and 5-7% for domestic animals (Table 1).

Apart of its agricultural use, wood verdure, after being chemically processed, is successfully utilized in medicine, perfumery and other fields. By water and organic solvents extraction, a part of the soluble matters contained in the coniferous brushwood can be extracted and utilized for ethereal oils production.

Table 1: Comparative characteristics of fodders – in %

Fodder denomination	Moisture	Raw protein	Raw oils	Raw fibers	Raw ash	Calcium	Phosphorus	Carotene
1.wheat herbaceous hay	15.32	6.16	1.77	29.89	6.60			
2. green Lucerne	68.8	3.94	0.90	8.98	2.24			
3. forest combined forage	14.86	2.24	2.25	43.14	6.67			
4. oak meal	7.20	9.57	3.21	29.30	3.43	0.65	0.16	123 mg/kg
5. spruce meal	4.49	5.17	5.78	27.97	3.26	0.61	0.20	
6. white pine meal	7.75	7.80	5.24	31.94	2.26	0.42	0.18	41 mg/kg

As for our countries, more familiar are stationary installations (is stationary equipment). sometimes stationary equipment is not efficient due to the large distances to the cutting areas. To avoid that disadvantage, there are already built semi-stationary plants for production of ethereal oils from all the coniferous specie (Figure 9).

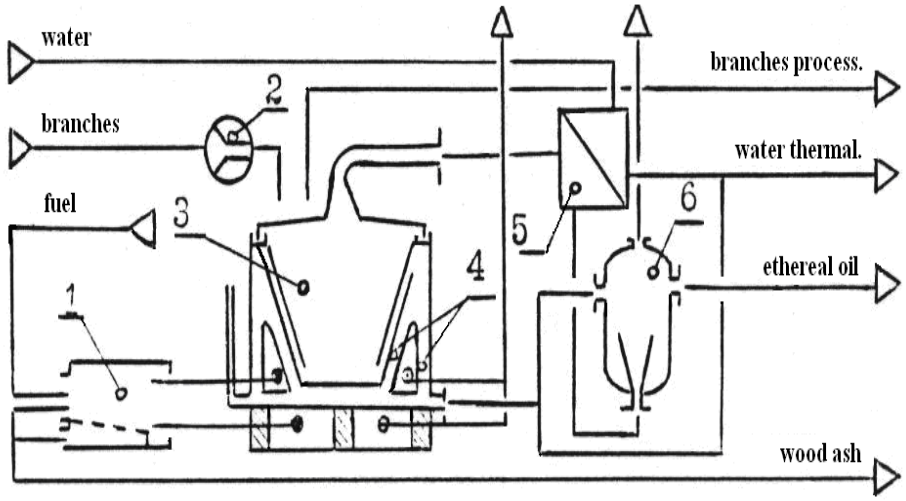

Figure 9: Principal technological scheme of semi-stationary installation for obtaining etherial oils (after Filipov and Kamburova): 1 – furnace; 2 – cutting machine; 3 – distillation pot; 4 – steam generator; 5 – heat exchanger-condenser; 6 – Firenze vessel for etherial oils

Semi-stationary plants are light, transportable, of low energy consumption, ecological, require easy service and maintenance etc. Exploitation of several plants of that kind in proximity to cutting areas significantly increases the economic efficiency as compared to stationary ones.

Experiments have been carried out, in our country, using waste wood after processing into saw dust and small particles for a further production of wood plates, wood particles plates containing cement or plaster (gesso) etc. Bark and leaves (needles) containing has no significant effect onto those plates solidity, the greatest part of which ones has been made of wood. On the contrary: bark and leaves (needles) give a better coloration to mono- and bi-layer plates.

Chops obtained from waste wood only can be used with a good success as an inner layer of the three-layer plates. Wood-cement plates belong to B1 category: hard inflammable, sound insulating, completely resistant to atmosphere events; healthy as do not develop a free formaldehyde; non invaded by fungi, pests, insects. Wood-plaster plates are compatible with carton-plaster and fiber-plaster ones.

In a conclusion, there are about 20% of non utilized wood biomass that remain after wood harvesting in the forest, in Bulgaria. The procurement of the chops, briquettes and pellets is the fastest and the most efficient utilization of waste wood.

The enterprises do not introduce in mass the new technologies: it is due to the high costs of the elaborations and the great expenditure and costs for re-equipment and reconstruction of the actual productions.

New technologies and machinery systems for waste wood processing within the cutting areas and in the yard, into an easy transportable product, shall be introduced in, for the utilization of waste wood after cutting.

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