UDC 674.81:662.638 ***Assoc. prof. S.V. Gayda – UNFU***

TECHNIQUES FOR RECYCLED OF POST-CONSUMER WOOD IN THE PRODUCTION OF QUALITY PARTICLEBOARD

Summary. It is found that post-consumer wood (PCW) is as yet non utilized resource of wood waste that is suitable for manufacturing wood particleboards (PB). The study reveals a problem the point of which is the absence of resource-saving and environmentally benign technologies; also practical recommendations have been given as to the use of PCW in woodworking industry. It has been suggested that the given problem could be solved in several steps: evaluation of the current state of the problem; justification of PCW classification and estimation of its potential; development of the procedure for conducting experimental investigations; modelling technological processes; analysing results of the experimental investigations; development of technological processes and practical recommendations as to the PCW utilization; implementation of the investigation results into practice. A system approach to PCW recycling was used. Investigated was the influence of the PCW and binder contents in each of the layers on physical and mechanical properties of three-layer particleboards: bending strength, tensile strength perpendicular to plane, and thickness swelling. Obtained were adequate mathematical models of dependence of WPB physical and mechanical properties on the PCW contents in each layer and the binder. It was proposed to establish an area for PCW preparation. Production techniques for PCW-containing three-layer particleboards were developed.

Keywords: post-consumer wood, PCW potential, particleboard, chips, physical and mechanical properties of panels, mechanical models, woodworking techniques, practical recommendations.

Introduction. The demand for wood composites from waste wood has been increasing as timber resources in natural forests decline. The use of renewable biomass as a raw material in composites production was one approach and the use of renewable biomass may result in several benefits such as environmental and socioeconomic. Today renewable biomass are mostly accepted as waste materials and are mostly ploughed into the soil or burnt in the field. According to the end uses of wood-wastes and their possible reuse products, PB has found typical applications as flooring, wall and ceiling panels, office dividers, bulletin boards, furniture, cabinets, counter tops, and desk tops, and it seems that the manufacture of PB from recycled wood-based wastes is the most common way to reuse such waste materials [10]. The PB is a panel product manufactured under pressure from particles of wood or other lignocelluloses materials and an adhesive. PB has been widely used throughout the world for furniture manufacture and house construction, including flooring systems, etc. Recently, the demand for the PB has continued to increase for housing construction and furniture manufacturing.

Large-scale cutting down of forests and the resulting environmental impacts, wood resource scarcity – all these force the woodworking industry to seek for alternative sources of raw material. The prospective resource that could be used as the raw material base for wood PB manufacture, is PCW. This category of wood waste has been making successfully a sort of «career» over the last several decades, especially in West European countries. PCW includes all kinds of wooden material that is available at the end of its use as a wooden product. Such wood mainly comprises demolition wood, packaging material, used furniture. PCW may contain fire retardant material, wood preservatives, paints, varnishes, glues, artificial films, metal, and even glass. Because of its very different composition, the presence of various kinds of impurity as well as the lack of appropriate machines for its conversion into valuable raw material, the industries of many countries do not always display great interest in this promising source of wood raw material. That is why, PCW, like other industrial wood waste is mainly landfilled.

Millions of tons of wood waste have accumulated on the long-standing refuse dumps. The amount of the accumulated waste is too large to be naturally decomposed.

Thus, the present study is devoted to solving the problem which is important and pressing both for industry and the environment: replenishment of the raw material base.

Topicality of the study – provision of woodworking industry with alternative additional resource by away of recycling and utilization of post-consumer wood (PCW) to manufacture products such as PB from disintegrated wood.

Problem formulation. This paper covers the issues of generating energy from additional wood resources, in particular PCW, by way of converting this into PB. As of now, the problems of raw material and waste are sure to remain the "hottest" problems in the woodworking industry all over the world and in Ukraine [1-8].

At least partial solution of the latter problem is a rational and holistic approach to settle the first problem – the problem of raw material. PCW reserves are potential resources and untapped base for wood raw material whose supplies are in-creasing with the development of wood-processing industry and the economy as a whole.

The problem of the study – the absence of resource-saving and environmentally benign technologies with practical recommendation as to PCW utilization in woodworking industry.

The objective of the study: investigation on technological capability and studying the peculiarities of PCW utilization in woodworking production processes; to develop production techniques and improve the existing equipment for manufacturing PB from PCW; to develop a science-based, technical-and-technological, basis for effective prediction of the PB properties as well as to work out hands-on guidelines for quality assurance of PCW-produced PB.

The object of the study: resource-saving technologies of PCW utilization; the production process of PB from PCW by using upgraded and improved equipment.

The subject of the study: the patterns of technological parameters influence on the properties of PCW-produced PB in terms of predicting and quality assurance; physical-and-mathematical models and practical recommendations on PCW utilization in woodworking production techniques

The methods of the study. Theoretical and experimental investigation were carried out with the application of a system approach involving computer engineering.

The study of potential of PCW. The determination of potential for wood biomass was done on the basis of statistical data from the state agency of forest resources in Ukraine concerning timber harvest (12.76 million tonnes (18.23 million m^3)) in 2013 (Table 1). Taking into account that the level of wood consumption is dependent on export-import, which compensate each other in the total balance of raw materials, the level of available PCW was calculated as 13% of the total harvested volume, which made up 1.659 million tonnes in 2013.

In addition, an average of 50 to 60 million tonnes of solid residential waste (SRW) is available in Ukraine each year, in which the share of PCW amounts to 2 to 4%. According to the data from the ministry of regional development, housing construction, residential and public utility services, about 13 million tonnes of SRW was available in 2013, of which 0.441 million tonnes (3,4%) was PCW.

Available quantity of PCW per capita in Ukraine amounts to 49 kg (with Ukraine's population of 43 million people, as of 01.06.2014).

Table 1. The potential of PCW in Ukraine in 2013

Wood biomass	W-%	PCW, million tons	Energy potential / year		
			million t f.e.	PJ	billion kWh
Commerce (package)	15	0,315	0,173	5,077	1,410
Construction waste	18	0,483	0,255	7,482	2,078
Wood-processing industry	20	0,126	0,065	1,899	0,528
Furniture	10	0,273	0,160	4,686	1,302
Municipal waste	40	0,357	0,121	3,542	0,984
Solid residential waste	35	0,441	0,164	4,800	1,333
Other	30	0,105	0,043	1,262	0,350
Total used wood mixtures	25	**2,100**	**0,981**	**28,749**	**7,986**

PCW utilization technologies according to the objective of the paper: investigations on technological capability and studying the peculiarities of PCW utilization in woodworking production processes, on the basis of a system analysis, it has been proposed to use PCW: (1) in the solid form for manufacturing curved blanks, batten blocks, and furniture panels; (2) in the form of chipped wood for manufacturing PBs, and fuel pellets and briquettes (Fig. 1). In order to prepare PCW for resource-saving production processes to manufacture the abovementioned products, the following technological flow diagram has been developed: for the use in the solid form-a layout of the workshop for sorting, segregation and cleaning; for the use in the clipped-wood from-a layout of the workshop for chipping, stepwise cleaning, and crushing (re-chipping).

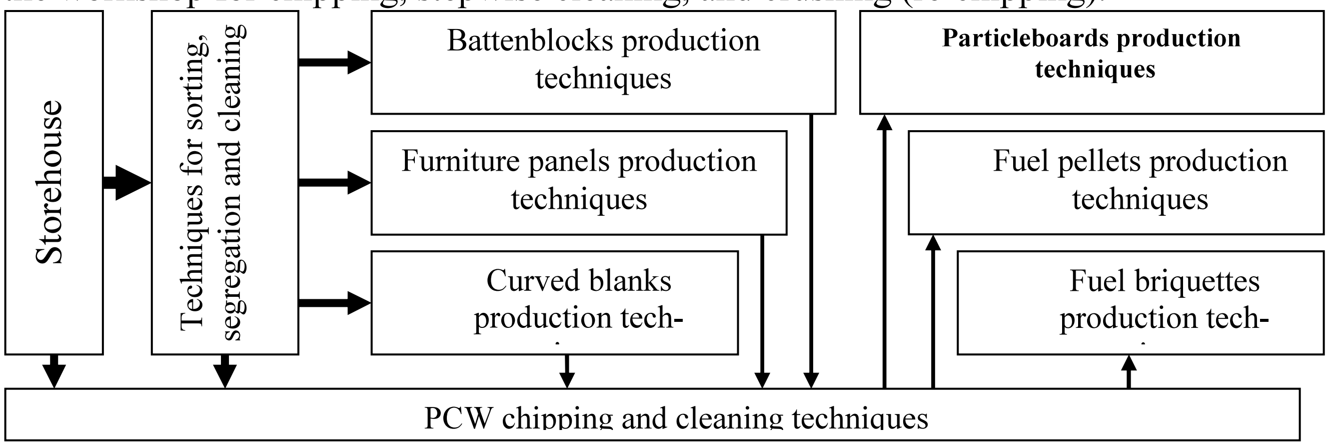

Fig. 1. System approach to PCW utilization [6]

Methods of study. A number of methods were used in the study, namely, experiments, measuring and comparison. The wood particles from conventional wood and PCW were obtained by way of cutting and chipping. The test specimens of panels from PCW were made by way of flat pressing in the hydraulic press. In order to reduce the number of systematic errors during the experiments, the method of randomization was used. During the determination of wood particles from green wood and PCW, the following research methods were applied: physical research methods to determine fractional composition of the particle, the particles moisture content, density, and thickness swelling; mechanical methods to determine the bending strength and tensile strength perpendicular to plane. The experimental data were processed by method of statistical analysis. Also, a comparison was made between the panels made from PCW and the panels made from conventional wood to check the conformity to the standards.

Scientific novelty of the findings. On the basis of the experimental results obtained, the feasibility of PCW utilization for manufacturing flat-pressed PBs with adequate physical and mechanical qualities was substantiated.

The optimal ratio of the components of the chips-glue furnish with the addition of PCW was developed, which ensures the production of P-A type of WPB according to DSTU 10632:2009 [9]. Regression dependences were obtained for bending strength, tensile strength perpendicular to plane, thickness swelling versus PCW content in the face layers and the core, various glue consumption as well as pressing parameters (temperature, pressing time, and pressure); these can be used for calculating technological parameters of PB manufacture.

Comparative analysis of chips. Depending on the factor of cutting and the degree of its effect, the process of wood chipping is characterized by the quality of chips obtained and the operating parameters of chipping. The shape of PCW particles should be characterized above all qualitatively (pin-shaped, twisted, cube-shaped, fibrous particles) rather than quantitatively (PCW species, density, bulk density, size distribution curve, etc). There are methods of screen analysis for measuring sample particle size and calculation of arithmetical mean length, width and thickness. However, in actual practice, the methods of qualitative estimate of wood particles are dominant.

The parameters that provide quantitative characteristics (particles size, their ratio, specific surface, "ends area") are not controlled accurately and are not related to each other, the methods of measuring them do not allow for accurate quantitative values that could be used to calculate composite material composition and to develop techniques for manufacturing panels with prescribed qualities with a minimum of glue and energy consumption. Therefore, the critical characteristics of PCW particles are the chips fractional size and composition. In order to compare the geometry and fractional composition of chips, we used primary conventional wood and PCW.

On a 5-minute sifting, the material obtained was divided into eight fractions: –/10, 10/7, 7/5, 5/3, 3/2, 2/1, 1/0.5, 0.5/0. The results of the study of wood particles geometric dimensions show that fraction content practically does not vary with respect to wood particles from conventional wood (Table 2), although the amount of fine fraction (fraction content 1/0) is two time as much.

Table 2. Comparative analysis of chip fractional composition

Type of wood	Fraction content, %							
	–/10	10/7	7/5	5/3	3/2	2/1	1/0,5	0,5/0
Conventional wood	0,5	2,3	2,6	32,1	28,9	20,6	10,6	2,4
PCW	0,4	1,0	1,8	28,3	25,2	19,3	19,1	4,9

The impact of structural and technological parameters on panels' strength values is demonstrated through the mediation of dimension less geometrical characteristic of chip formation: degree of contact area. It was found that the degree of contact area is dependent on the size of wood particles, namely, the values of bending strength and tensile strength perpendicular to plane as chip fractional composition changes from fraction 5/3 to fraction 10/7. Wood particles from conventional wood and PCW do not have a significant deviation of the fractional content.

Investigation planning. Since the process of manufacturing and testing WPB made from PCW was investigated under laboratory conditions, multifactor planning was applied: full-factorial plan. During the experiments, the following factors were taken as variable factors: the contents of the binder and PCW particles both in the core (P_c) and the face layers (P_f). The values for PCW chips content for each layer varied from 20 to 100 % – the rest were standard technological chips; the binder content in each layer was within the average consumption norm ranging from 7 to 16 % (K).

For the purpose of reducing the number of systematic errors, the method of randomization was applied which allowed for establishing random sequence of the experiments conducting. The following factors characteristic of panel manufacture, were noted at the fixed levels: density – 700 kg/m; specific pressure – 2.5 MPa; press temperature – 200 ºC; pressing time – 0.35 min/mm moistures content of the particles for the core – 2 %; moistures content for the face layers – 4 %; the ratio of the layers – 50/50; three-layer panels of 16 mm thick.

Physical and mechanical testing. The determination of the WPB physical and mechanical properties was carried out 5 days after the panels were pressed. The PCW-made panels were cut on the circular saw bench to size specified for specimens testing according to GOSTs 10634-88; 10635-88; 10636-90. The tests for the bending strength and the tensile strength perpendicular to plane were conducted on the WOLPERT machine according to GOST 7855-84. The motion speed of the load-carrying head – 60 mm/min, the scale division – 1 kg/sm^2; deviation from the actual value made up – 1%.

The results of experimental investigation. A thorough study has been conducted on the biomass raw material base including PCW for manufacturing PB. A multifactorial experiment has been performed according to the procedure of the study. The data obtained from physical and mechanical testing of pilot PCW-containing PB for bending strength (**σ_b**), tensile strength perpendicular to plane (**σ_t**), and thickness swelling (**Δh**) are shown in Fig. 2-4.

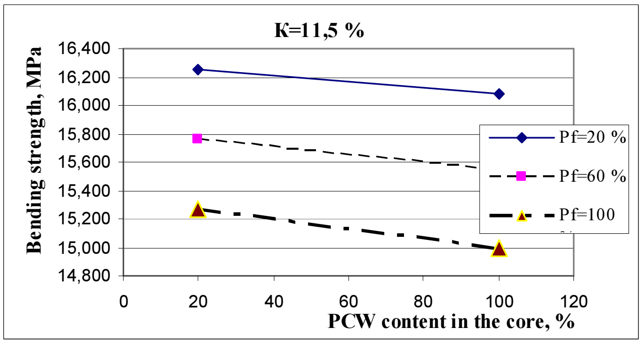

Fig. 2. Relationship between panel's bending strength and the content of PCW both in the core and face layers as well as the binder content: К=11,5 %

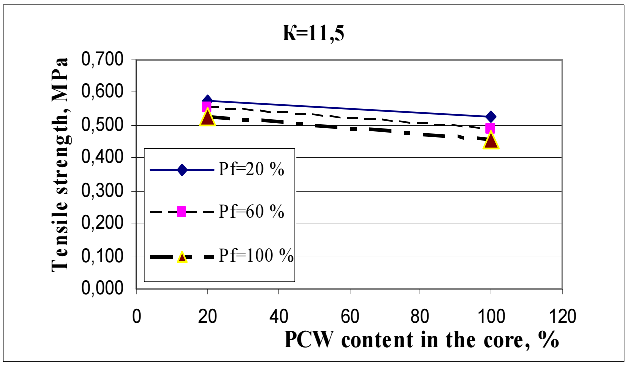

Fig. 3. Relationship between panel's tensile strength and PCW content both in the core and face layers as well as the binder content: К=11,5 %

Graphical representation of the relationships obtained allows for revealing character of variable factors influence on the properties of the resulting PB, since the full-factorial plan was realized here, all the dependences have linear character. As is seen from the diagrams, the PCW content in the PB behaves equally at different binder content levels that is the bending strength is decreasing within from 19.469 to 12.030 MPa range, the tensile strength is decreasing within the range of 0.646 to 0.344 MPa, while the thickness swelling is also decreasing from 17.22 to 13.93 %. The diagrams also show that the lines do not run parallel to one another, and the angle of their slope varies as certain variable factors change. This points to the fact that the influence of factors interaction is just as significant as the influence of the individual factors.

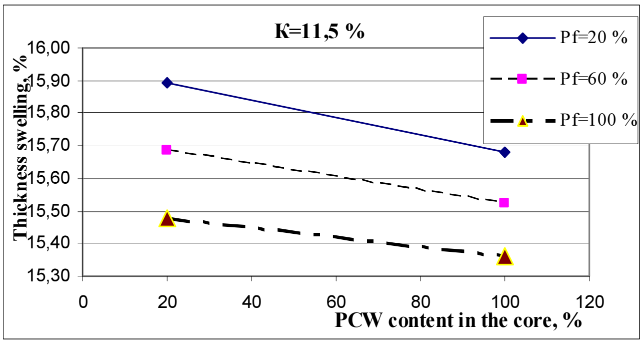

Fig. 4. Relationship between panel's strength at swelling and PCW content both in the core and the face layers as well as the binder content: *К=11,5 %*

Our study has demonstrated that for a given 700 kg/m^3 PB density and an average glue consumption of 11.5 %, an increase in PCW chips content in the face layers from 20 to 100 % results in decreased bending strength by 6 % while the same increase in PCW content in the core makes up only 1 %. The use of a 100 % PCW particles content and glue consumption of 11.5 % both in the core and the face layers results in the bending strength of 15 MPa, which is 8 % smaller than for the case of a 20 % PCW content.

The conditions being the same, it was found that the tensile strength is essentially influenced by the increased content of PCW particles in the core an decrease in the tensile strength amounted to 9 %. The physical and mechanical properties of the PB are most influenced by the glue content. With increasing the glue content, the strength is also increasing (by 30 %) while the thickness swelling is decreasing (by 15 %). The reason for this lies in the fact that there is a greater amount of adhesive spread per unit surface area of the wood particles, and this glue film prevents the water from penetration into the interior of wood particles. Also, due to the absence of bark from PCW particles, there is an increase in the strength by 2 to 5 % in the PCW-containing PB compared to panels made from conventional wood.

Thus, WPB that has a 60 % PCW particles content and the glue consumption of 11.5 % produces composite materials that meet the requirements for the P-A type of PB according to DSTU 10632:2009 [9]. Thus, the calculations done made it possible to obtain the following regression equations of the full-factorial plan with actual factor values for physical and mechanical properties:

$$\boldsymbol{\sigma_b} = 8{,}145 - 0{,}00039 \cdot P_c - 0{,}0053 \cdot P_f + 0{,}729 \cdot К;$$

$$\boldsymbol{\sigma_t} = 0{,}442 - 0{,}00088 \cdot P_c - 0{,}0015 \cdot P_f + 0{,}0136 \cdot К - 0{,}000083 \cdot P_f \cdot К;$$

$$\boldsymbol{\Delta h} = 19{,}37 - 0{,}0021 \cdot P_c - 0{,}0031 \cdot P_f + 0{,}288 \cdot К.$$

A standard layout of the workshop for sorting, segregation and cleaning of PCW. Once the PCW is delivered and accumulated in adequate quantities at the plant (factory), the following operations are to be conducted: identification according to the categories; sorting according to the type of materials, species etc.; segregation according to moisture content, impurities etc.; revealing possible toxic chemicals. A standard layout of the workshop measuring 36×24 m has been designed where PCW sorting is to be done according to 4 categories: the type of material – solid wood, panels; segregation according to moisture content, impurities and toxic chemicals (Fig. 5). A special feature of the workshop is its division into four lines. The first and the second lines deal with solid PCW (according to the categories): clean PCW-I and contaminated PCW-IV. The other part of the shop deals with panel materials. The third line deals with PCW-II that is coated with finishing, chemically untreated and without halogenated organic compounds; the fourth line deals with PCW-III which is coated with finishing, chemically untreated but containing halogenated organic compounds in the coating. After sorting according to the type of material and quality statement the PCW is segregated from foreign materials such as tramp metal and other impurities. The detection of metal particles is done by means of metal detectors which are installed for each type of material at the both sides of the entrance to the workshop. The impurity-contained spots are sawn out of the PCW and removed from the workshop by side belt conveyors to be farther transported by traversing carriages to the other area for chipping and cleaning. The main feature of this area are machine tools for longitudinal surface treatment (cleaning). In particular, a four-sided grinding machine is used for PCW-I; a two-sided grinding machine is used for PCW-II; a two-sided needle milling machine is used for PCW-III; a four-sided needle milling machine is used for PCW-IV. After surface treatment operation, the PCW is re-inspected for possible detecting metal impurities by means of metal detectors which are installed at each of the four lines. Defect-free PCW becomes suitable for obtaining blanks by means of secondary machining. The PCW so treated (Table 3, 4) is an additional source of raw material for manufacturing fuel pellets and briquettes.

Table. 3. Recommendations on techniques for PCW sorting and segregation

№	Stages and operations	Equipment
1	Collection, accumulation according to the type	Place of origin, the plant
2	Delivery to the plant	Transportation facilities
3	PCW identification according to the category	Visual inspection, instruments
4	Sorting according to the type of material and species	By hand, automatically
5	Segregation according to moisture content	Visual inspection, instruments
6	Revealing possible toxic chemicals	Indicator, testing
7	Removal of foreign inclusions	With tools, physically
8	Removal of visible metal particles	Metal detector, physically
9	Removal of coatings (films)	Machine tools for cleaning
10	Distribution according to technology	Recycling process

Table 4. Recommendations on techniques for chipping and cleaning of PCW

№	Stages and operations	Equipment
1	Chipping, particles	Chipper, shredder
2	Transportation	Belt conveyor
3	Removal of metal inclusions	Suspended magnetic conveyor
4	Removal of coarse inclusions	Disc separator
5	Repeat removal of metal	Suspended magnetic conveyor
6	Separation of fane fraction	Swinging sieve
7	Sucktion of foil, films etc.	Aspiration system
8	Removal of non-ferrous metals	Non-ferrous metals separator
9	Separation of flow into fractions	Mehanical classifier
10	Pneumatic sorting	Inertial separator
11	Gravimetric cleaning	Bunker, collector cyclone
12	Crushing	Hammer mill
13	Removal of sand particles from fine fraction	Vibrating sieve
14	Mehanical cleaning of chips	Disc separator
15	Transportation to bunker	Pneumatic transport, proportioned

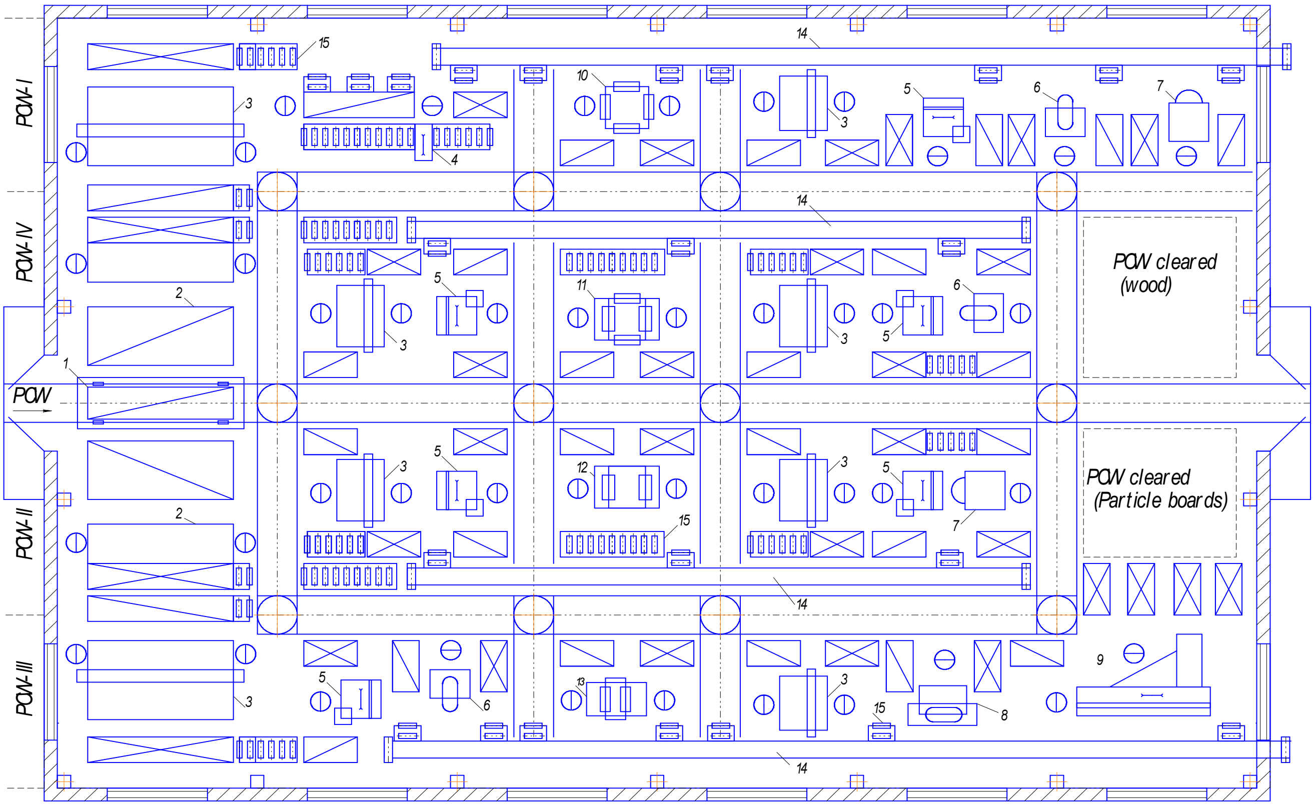

Fig. 5. Equipment for PCW preparation – sorting, segregation and cleaning: *1 – traversing carriage; 2 – bench, worktable; 3 – metal detector; 4 – trimmer; 5 – circular saw; 6 – band mill; 7 – milling machine; 8 – enge sander; 9 – sizing machine; 10 – four-sided sander; 11 – four-sided needle milling machine; 12 – double-needle milling machine; 13 – double milling machine; 14 – conveyor; 15 – roller conveyor sections*

Project PB plant with PCW. “PCW” mills based on recycled wood have had varying success. However there is apparently a growing market from some who want to make an environmental point. Described PCW Panels, as the project PB plant to operate successfully with 100 % recycled post-consumer waste wood. Annual input is 35,000 tons. The mill uses pallets, crates, cable reels, construction and industrial wood. One of the keys is compaction of the residues, such as pallets and reels, to allow more material per truck load and consequent lower raw material transportation costs. Pallets come from within a 150-200 km radius. Another key is a stringent cleaning process with nine points where debris and metal are removed from the raw material.

Fig. 6 shows the project designed and engineered the plant. Crushing, cleaning, metal and debris removal were by Pal of Italy. Drying, conveying, blending and pressing with continuous Berndorf bands and sanding were by Module System of Germany. Drying is fairly conventional except for two more wind sifters after drying – one for core and the other for surface. Drying costs are lower because the wood is generally at or below 20 % moisture content. The objective is to remove the last bit of ash and other contaminants from the furnish. However, the material requires about 1 % higher resin content. New researches was to separate the dirty steam coming from the refiner, together with most of the volatiles from fiber processing. The dirty steam is condensed and treated in a conventional water treatment plant. The fibers are then conveyed from the steam separator, helped by fresh steam to allow for conventional blow line blending in a secondary blow line ahead of the dryer. Dryer emissions are mainly volatiles from the resin added in the blow line and are managed by control devices such as RTOs.

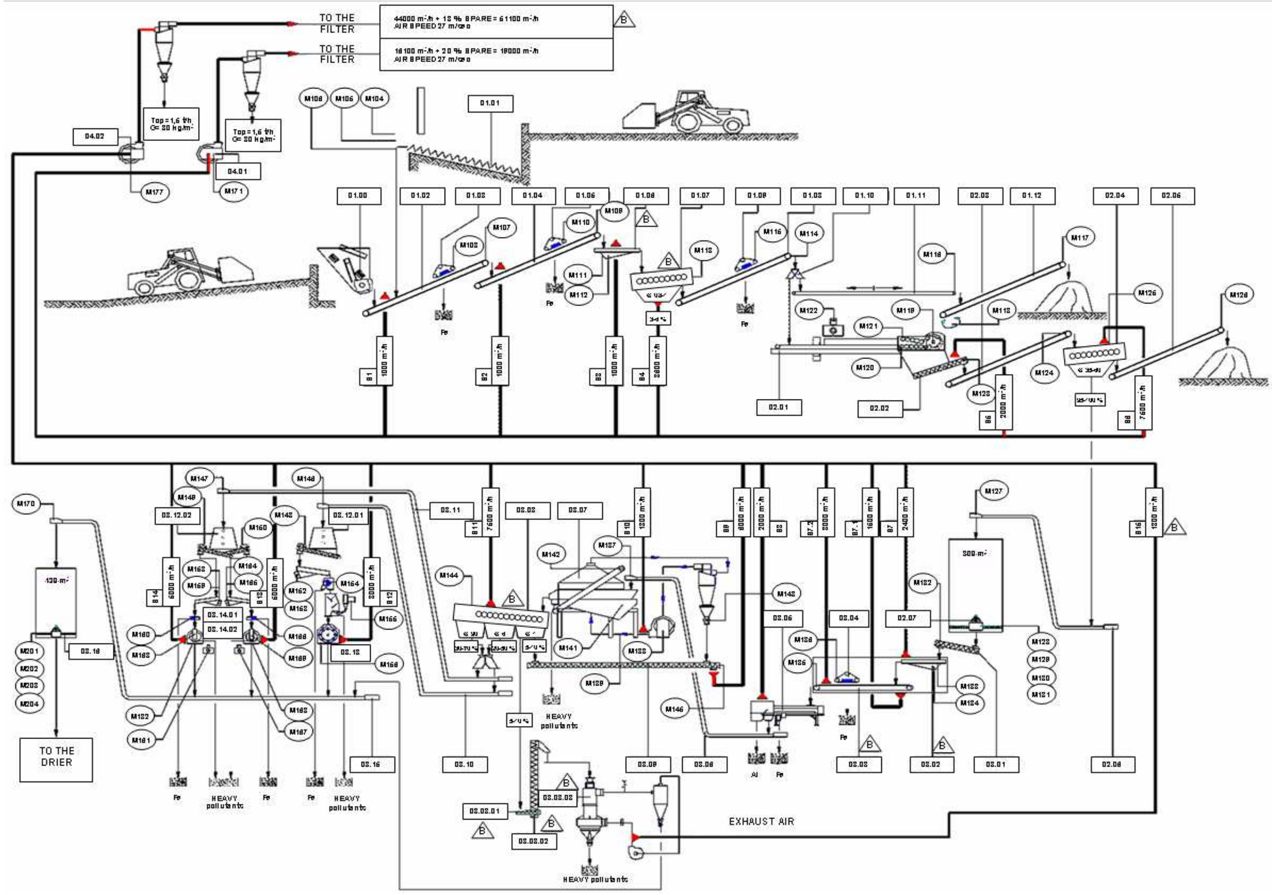

Fig. 6. Flow of wood preparation area of post-consumer wood

Conclusions and Recommendations:

1. Monitoring of PCW in Ukraine has been fulfilled. It has been estimated that about 2,1 million tonnes of PCW was produced in 2013 in Ukraine.
2. A thorough study has been conducted on the biomass raw material base including PCW for manufacturing PB. The sources and PCW origin have been examined: solid domestic waste, municipal waste, commerce (package, pallets), construction waste, wood-processing industry by-products and residue, and others.
3. The rising cost of raw materials, ever tighter legislation about waste disposal, and the fierce competition between PB manufacturers has led to the increasing use of recycled wood. It is possible to use any source of recycled wood to reduce raw material costs by between 40-70 % and the resulting boards will have even surfaces and post-soft formable core layers. There are advantages apart from the obvious one of being a sustainable alternative to using virgin timber. Recycled wood has a moisture content of around 20 % compared to the 60-70 % moisture in virgin wood, so it makes economic sense to buy recycled wood chip; it also lasts longer and utilizes less energy during processing.
4. Obtained are adequate mathematical models of the PB parameters depending on the three variable factors: PCW content and binder content.
5. The PCW suitable for PB manufacturing should be cleaned by one of the following ways: surface cleaning (for solid PCW) on machine tools such as brushing machine, milling machine, grinding machine, sandblast machine and other; internal cleaning (for chipped PCW) by equipment such as air separator, vibratory feeder, air cleaner, magnetic strip, metal detector, swinging sieve.

6. The development of the technological process for converting PCW into PB. Accordingly, it was proposed to establish an area for PCW preparation which will involve: PCW sorting for contamination, wood species, the type of the used construction material, etc.; removal of impurities and various foreign material; removal of plastics, non-ferrous and ferrous metals from both solid (unshipped) and chipped PCW.

7. It has been found that the optimum conditions for manufacturing boards of standard quality (DSTU 10632:2009) are as follows: for P-A type (13 MPa) – PCW particles content in the core and the face layers may amount to 60 % with an average glue consumption of 11.5 %; for P-B type of boards (11.5 MPa) – PCW particles content in the core amounts to 100 % and 80 to 100 % in the face layers with glue consumption in the core being 7 to 8 % and 10 to 11 % in the face layers.

8. An estimation has been made for socio-economic efficiency resulting from the implementation of the practical recommendations for manufacturing PB from PCW. Estimated was the effect of introducing the results obtained in practice at the Swisspan Ltd. Enterprise, which lies in the fact that the use of PCW in the PB manufacture leads' to the reduction of costs for conventional wood by 9.4 % [2].

9. Future Ukraine and Europe should focus on efficient recovery of recovered wood.

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Технології перероблення вживаної деревини для виробництва якісних деревинностружкових плит

Обґрунтовано, що вживана деревина (ВЖД), як додатковий ресурс деревної маси, через відсутність технологічних розробок та практичних рекомендацій не знайшла ще належного використання деревообробними підприємствами України. А також ВЖД поки що, не ефективно використовується для виготовлення деревинностружкових плит (ДСП). Розроблено практичні рекомендації щодо використання ВЖД у виробництві ДСП. Досліджено проблему, вирішення якої забезпечить утворення ресурсозберігаючих та екологічно безпечних технологій на основі використання ВЖД. Встановлено, що дана проблема може бути вирішена в кілька етапів: оцінка поточного стану проблеми; обґрунтування класифікації ВЖД та оцінки її потенціалу; розроблення методики для проведення експериментальних досліджень; моделювання технологічних процесів; аналіз результатів експериментальних досліджень; розроблення технологічних процесів і практичних рекомендацій щодо використання ВЖД; здійснення досліджень у виробничих умовах. Використано системний підхід і до утилізації ВЖД. Досліджено вплив вмісту ВЖД у кожному із шарів та в'яжучого на фізико-механічні властивості тришарових ДСП – міцність при статичному згині, розтягу перпендикулярно до площини плити та набрякання. Отримано адекватні математичні моделі залежності фізико-механічних властивостей ДСП від вмісту ВЖД в кожному шарі і в'яжучого. Було запропоновано створити дільницю для підготовки ВЖД. розроблено методику виробництва тришарових ДСП із ВЖД.

Ключові слова: вживана деревина, потенціал ВЖД, ДСП, стружка, властивості плит, математичні моделі, дерево оброблювальні технології, практичні рекомендації.

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LOCATION OF SAWING PATTERN ON THE COVERING WORKING ZONE OF SEGMENT AND SECTOR WITH CONSIDERATION OF THEIR REAL SHAPE

The simulation method for variants of location of sawing pattern on the working zone covering by sawing pattern of segment and sector was considered. Consideration of real shape for log (segment) based on results of scanning for shape surface of log cross sections was provided for simulation process.

Keywords: log, segment, sector, covering working zone, location of sawing pattern, real shape, simulation, volume, log rotation.

Statement of problems and research currency. During the work [1] the topicality of research is proven and the simulation method for variants of location of sawing pattern on the working coverage zone of log is developed with the consideration of natural fluctuations of its real size characteristics, the usage of which will provide the lumber sawing of minimally acceptable and larger sizes. Given method is mathematically proven, experimentally confirmed and applicable to the determination of all possible variants of location of sawing pattern on the working coverage zone of log. It is also applicable to the determining of optimal variant which is characterized by the dimension of step displacement of working coverage zone and turn angle of log around the linear regressive axis. Instead, a similar problem on simulation of variants of location of sawing pattern on the working coverage zone of segments and sector with the consideration of natural fluctuations of its real size characteristics is almost undiscovered. Therefore, it is actual line of research, which requires scientific argumentation and solution.

The analysis of existing researches. It is important to mention that despite the detailed researches in the sawmill technology that were carried out in order to solve the problem of rational sawing of logs (cants, segments) on sawn timber by sawing process simulation, this issue is not fully solved [1-3]. Therefore, in the present paper the development of theoretical and practical approach to the process of log sawing is suggested, in particular the method of simulation of variants of location of sawing pattern on the working coverage zone of segment and sector with the consideration of its real size.