



BOOK OF ABSTRACTS

**3rd International Scientific
Conference
WOOD TECHNOLOGY &
PRODUCT DESIGN**

**11th September – 14th September, 2017
University Congress Centre,
OHRID, Republic of MACEDONIA**

**Ss. Cyril and Methodius University in Skopje
Faculty of Design and Technologies of Furniture
and Interior – Skopje, Republic of Macedonia**





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WOOD TECHNOLOGY & PRODUCT DESIGN

**11– 14 SEPTEMBER, 2017
UNIVERSITY CONGRESS CENTRE – OHRID,
REPUBLIC OF MACEDONIA**

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COSTS OF OCCUPATIONAL ACCIDENTS IN THE BULGARIAN WOODWORKING AND FURNITURE INDUSTRY

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ABSTRACT

Despite the considerable improvements of working conditions in most of the European countries, the rate of occupational accidents has remained persistently high. These work-related injuries not only cause human suffering for workers and their families but also result in significant economic costs to individuals, businesses and society as a whole. Other potential negative effects include early retirements, loss of skilled personnel, increased productivity, medical, administrative and insurance costs. The net effect of occupational accidents represents a significant national economic loss. Depending on the country, the costs may vary from 1-4% of the gross domestic product. These enormous economic costs of occupational accidents inhibit the economic growth and affect the competitiveness of companies, particularly of micro, small and medium-sized enterprises.

An efficient way to convince both employers and decision-makers about the importance and profitability of improving the working conditions and the potential benefits of preventing work-related accidents is to determine their economic costs. In this respect, analysis and estimation of the costs of occupational accidents in the Bulgarian woodworking and furniture industry have been carried out on the basis of the officially published statistical data.

Key words: occupational accidents, health and safety at work, woodworking and furniture industry

COMPRESSIVE STRENGTH OF PLYWOOD MADE FROM BEECH AND BLACK PINE VENEERS

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ABSTRACT

The research presented in this paper includes the study of compressive strength of plywood made from beech and black pine veneers. For this purpose, four experimental models of plywood were made. The models were made from peeled beech and black pine veneers. The modeling was made on the basis of changing the number and type of the veneers used for plywood manufacturing. Water-soluble phenol-formaldehyde resin was used as plywood binder. The in-plane compressive strength of the experimental plywood panels was tested in two directions, parallel and perpendicular to the face grain. According to the values of compressive strength plywood models can be used as structural panels in construction. Production of plywood with different number of veneers in panel structure, as well as plywood with the same number of the veneers but from different wood specie, gives opportunities for production of panels that can meet the different application requirements.

Key words: compressive strength, plywood, veneer, beech, black pine, phenol formaldehyde resin

SCREW WITHDRAWAL RESISTANCE OF COMPOSITE WOOD-BASED PANELS MADE FROM PARTICLEBOARD CORE AND PEELED TWO-PLY CROSS-LAMINATED VENEERS

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ABSTRACT

The research presented in this paper includes the study of screw withdrawal resistance of composite wood-based panels for use in construction.

Three experimental wood composite panels were made by combining particleboards and peeled beech, black pine and poplar veneers with thickness of 1,5 and 3,2 mm. The core layer of the composite panels was made of single-layer particleboard with thickness of 16 mm, which was overlaid on both sides with two-ply cross-laminated veneers.

Water-soluble phenol-formaldehyde resin was used for particle bonding and veneering.

The results from the research showed that the different veneer species used for particleboard overlay significantly impact the screw withdrawal resistance perpendicular to the plain of the composite panels.

According to the obtained values of the screw withdrawal resistance, composite panels can be used in construction.

Key words: composite wood-based panels, particleboard, veneer, beech, black pine, poplar, phenol formaldehyde resin, screw withdrawal resistance.

EFFECT OF DRILLING DIAMETER ON SCREW WITHDRAWAL RESISTANCE OF WOOD

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ABSTRACT

This study investigates the effect of three different drilling diameters on screw withdrawal resistance of beech wood. Specimens were divided into three groups with the following different drilling diameters: 5.0 mm, 5.55 mm and 6.0 mm. Two-threaded “Hanger” screws M8 x 90 mm were used in the experiment. Screw withdrawal resistance was carried out in tangential direction on specimens which were conditioned on moisture content of 7.2%. Density of specimens was also examined. A one-way repeated measures ANOVA were conducted to compare experimental results of the screw withdrawal resistance between the three groups of specimens. According to the test results, it was found that there were statistically significant differences among the three sets of scores.

Key words: screw withdrawal resistance, beech wood, drilling diameter, two-threaded screw, density

WOOD DRYING QUALITY OF PINEWOOD

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ABSTRACT

In order to develop optimized drying schedules, a series of experimental schedules of convective kiln drying of pinewood has been performed. Boards, 50,0 mm thick have been used as testing materials. The boards have been kiln dried from initial moisture content of 50,0 % to final moisture content of 10,0 % for a period of 15 days. In a drying schedule there were four stages: heating, active drying, equalizing and conditioning. The moisture content difference i.e. moisture content gradient between core and surface of the boards after drying is 2,4 %.

Key words: pine, convective drying, drying quality

INFLUENCE OF THE NUMBER OF BELTS OVER THE PERFORMANCE OF THE CUTTING MECHANISM IN A WOODWORKING SHAPER

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ABSTRACT

This study presents the influence of the number of belts over the performance of the cutting mechanism in a woodworking shaper. The motion of the cutting mechanism was investigated by means of one and two V-belts. The vibration speed (r.m.s.) of the cutting mechanism was measured in three directions both empty and in stroke. The conducted experimental research provides a comparative analysis of the impact of the numbers of belts over the performance of the cutting mechanism. The obtained results can be used to optimize the number of the belts used to drive the cutting mechanism of the woodworking shapers.

Key words: Woodworking shaper, number of V-belts, vibration

STUDY ON THE VIBRATION SEVERITY GENERATED BY WOODWORKING SPINDEL MOULDER MACHINE

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ABSTRACT

The aim of this study was to investigate and determine the vibration severity, generated by a woodworking spindle moulder machine at different rotation frequencies and with different cutting tools. The assessment was based on the root mean square value of the vibration velocity (v) $\text{mm}\cdot\text{s}^{-1}$ (r.m.s.) measured in two mutually perpendicular radial directions in each of the bearing housings of the driving shaft of the machine (four measuring points).

Key words: wood shaper, vibration severity, vibration velocity

COMPUTATION OF THE ENERGY AND HEAT FLUX NEEDED FOR COVERING OF THE EMISSION IN THE SURROUNDING AIR OF SUBJECTED TO UNILATERAL CONVECTIVE HEATING WOOD DETAILS BEFORE LACQUERING

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ABSTRACT

An approach for the computation of the specific (for 1 m²) energy consumption, q_e , and the specific heat flux, $dq_e/d\tau$, needed for covering of the emission in the surrounding environment of the subjected to unilateral convective heating flat wood details before lacquering, has been suggested in the present paper. The approach is based on the use of numerical solutions of the second from two mutually connected 1D linear mathematical models, which has been suggested by the authors earlier. The first model allows the computation of the non-stationary temperature distribution along the thickness of subjected to unilateral convective heating wood details before their subsequent lacquer coating. The second model, whose solutions are used for determination of q_e and $dq_e/d\tau$, allows the computation of the non-stationary distribution of the temperature along the thickness of the carrying rubber band, on which the non-heated surface of the wood details lies. For simultaneously numerical solution of the both models aimed at the determination of q_e and $dq_e/d\tau$ software program has been prepared, which was input in the calculation environment of Visual Fortran Professional. Using the program, computations have been carried out for the determination of the change in the heat energy q_e and in the flux $dq_e/d\tau$, which are consumed by oak details with an initial temperature of 20 °C, moisture content of 8 %, thickness of 16 mm, width of 0.6 m, and length of 1.2 m during their 10 min unilateral convective heating by hot air with temperature of 100 °C, which circulates above the details with a velocity of 2 m.s⁻¹, 5 m.s⁻¹, and 8 m.s⁻¹ aimed at improvement of the conditions for the subsequent lacquering. The rubber band had thickness of 4 mm, width of 0.8 m, initial temperature of 20 °C, and the temperature of the surrounding air from the non-heated surface of the band was 20 °C. The obtained results are graphically presented and analyzed.

Key words: oak details, convective heating, lacquering, heat emission, specific heat energy, heat flux

REGIMES FOR AUTOCLAVE STEAMING OF NON-FROZEN BEECH VENEER PRISMS WITH A LIMITED POWER OF THE HEAT GENERATOR

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ABSTRACT

An approach for the computation of the processing medium temperature of the steaming process of wood prisms in autoclave, depending on the available limited power of the heat generator has been suggested. The approach is based on the use of the optimized method called “variable return step”, together with own summarized 2-dimensional mathematical model for the transient non-linear heat conduction and energy consumption in non-frozen prismatic wood materials at arbitrary, encountered in the practice initial and boundary conditions, which has been created by the first co-author earlier.

An application of the suggested approach is presented in the present paper for the case of scientifically based computation of regimes for autoclave steaming of non-frozen beech veneer prisms with different thicknesses and moisture content of 0.6 kg·kg⁻¹ aimed at their plasticizing in the production of veneer, when the power of the steam generator is equal to 500 kW. The obtained results can be used for the creation of a system for optimized model based automatic control of the duration and energy consumption of the steaming process of wood materials.

Key words: autoclave steaming, wood materials, limited power, heat generator, optimization

COMPUTATION OF THE ICING DEGREE OF LOGS DURING MELTING OF THE FROZEN FREE WATER IN THEM

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ABSTRACT

An approach for the computation of the relative icing degree of frozen logs during their heating until reaching of temperatures, at which the melting of the frozen free water in them occurs, has been suggested in the present paper. The approach is based on the use of numerical solutions of personal mathematical model of the logs' defrosting process, which consist of non-linear differential equation of the thermo-conductivity and of equations of the initial and boundary conditions of this process.

For numerical solution of the model an explicit form of the finite-difference method in the computing medium of Visual Fortran Professional has been used. After application of this method, the temperature distribution in the nods of the calculation mesh is obtained, which is built on the longitudinal section of the logs. Synchronously with the computation of the change in the temperature field in logs during their heating, a count of the nods of the calculation mesh is carried out, in which the temperature above -1 °C is already increased and a melting of the frozen free water in them occurred. The current relationship between these "defrosted" nods and the whole nods' number of the calculation mesh gives the current icing degree of the logs for each moment of the defrosting process.

The information about the relative logs' icing degree is needed for the computation of the energy consumption of the defrosting of logs aimed at their plasticizing in the production of veneer.

Key words: logs, modelling, defrosting, frozen free water, computation, relative icing degree

INFLUENCE OF THE DOWEL WITHOUT ADHESIVE ON STRENGTH OF INSERT FITTINGS

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ABSTRACT

Tests were carried out in order to determine influence of the number of dowels without adhesive on strength of insert fittings of cabinet furniture. Minifix fitting, produced by Hafele, was used for joining. Testing was conducted on seven groups of samples. Within all groups position and number of insert fitting remained unchanged but number of dry dowels was varied. The effects of number of dowels, their position in joint, and its distance were investigated. The results indicated that moment capacity increased as number of dry dowels increased. The results also indicated that position of dry dowel has no impact on bending moment capacity.

Key words: cabinet furniture, ready to assemble construction, eccentric insert fitting, dowel without adhesive, strength, durability

NORMS FOR DESTRUCTIVE BENDING MOMENTS OF END CORNER OPEN MORTISE AND TENON JOINTS OF FRAME STRUCTURAL ELEMENTS MADE OF SOLID SPRUCE WOOD WITH A CROSS SECTION OF 50 x 30 mm

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ABSTRACT

In the presented research are established the normative values for the destructive bending moments of the end corner open mortise and tenon joints of frame structural elements made of solid spruce wood with a cross section of 50 x 30 mm in arm opening and arm compression bending load.

The normative values of the tested end corner joints follow the same dependencies as the experimental data.

The normative values for the destructive bending moments of the joints in arm opening bending test are at an average 68,6 % from the experimentally established values, and in the arm compression bending test – 68,7 %.

The established normative values for the destructive bending moments of the end corner open mortise and tenon joints of frame structural elements made of solid spruce wood with a cross section of 50 x 30 mm can be used for the needs of the preventive quality control of furniture production as well as for the strength design of the sitting furniture, tables and beds. For that purpose it is recommended to draw up these normative values as a normative document which to use in the inner factory control of furniture quality.

Key words: end corner joints of frame structural elements, destructive bending moments, solid spruce wood, norms for destructive bending moments of corner joints

A JUSTIFICATION OF THE USE OF SPECIALIZED CIRCULAR SAWS FOR WOOD

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ABSTRACT

The aim of the research presented in this paper was to establish a justification of the use of the specialized circular saws for wood cross cutting. This estimation is made on the base of machinability investigation of beech solid wood panel. The criteria for the assessment of the machinability of wood were cutting power and the roughness of the machined surface. The basic hypothesis was that different technological parameters of processing result in different quantities of energy needed for cutting, as well as different surface qualities in the case where the same cutting speed and feed rate were applied. The investigations were carried out for a variety of circular saw types (with different teeth number and tool geometries).

Key words: circular saws, machinability, cutting power, surface quality

THE INDUSTRY LOBBYING IN BRUSSELS

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ABSTRACT

This work introduces the lobbying procedure related to the most powerful industrial associations' players in the EU capital, Brussels, home to one of the highest concentrations of political power in the world. This work also explains the EU lobbying process, the multiple ways – some controversial - in which the lobbyists work to steer decisions to their advantage, and the often-serious impacts this has on people across Europe and in the rest of the world. As the power of the EU institutions has grown, Brussels has become a magnet for lobbyists, with the latest estimates ranging between 15,000 and 30,000 professionals representing companies, industry sectors, farmers, civil society groups, unions and others, along with those representing big business. Some areas of industrial activity are very well represented, such as environmental protection, agriculture and forestry, the energy and automotive industries.

Key words: lobbying, EU Transparency Register, forestry, wood Processing, RES

INFLUENCE OF ROUGHNESS OF WOOD ON ADHESION OF POLYURETHANE WOOD FINISH

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ABSTRACT

Surface properties of wood such as color, texture, unevenness, they all condition its application in many fields. Color and texture can be controlled by selecting kind of wood and its cross-section (radial, tangential and transversal). Surface unevenness (roughness) is determined by factors which can be controlled - by a processing method, processing mode, tools and some factors related to a workpiece, such as moisture content and fiber direction, as well as by factors which cannot be controlled, such as wood structure.

Surface unevenness is described as emboss, roughness or unevenness of border surface between material and surrounding area. For porous materials, such as wood, it is hard to define surface and hence the surface unevenness (roughness). In this case, surface can be considered as a combination of several surface roughness modes. First degree roughness is determined by anatomical wood structure; second degree roughness is processing method characteristic (controlled factors) and third degree roughness is a consequence of variations in some processing method, such as uncontrolled machine vibrations, damaged tools, variations in wood density, reaction wood and extracts.

Key words: roughness, adhesion, sanding, surface, polyurethane wood lacquer

WOODEN LOW-ENERGY WINDOWS

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ABSTRACT

Wooden windows to be installed in low-energy buildings must have certain insulating properties. This requirement affects the choice of the type of windows, materials, construction of windows, but also on the technological process of production of the window.

Today, except for energy efficiency building great attention is given also to sustainable building houses or green buildings.

Wooden windows have been installed in these buildings (low energy houses and passive houses) have to fulfill the requests related to energy efficiency and specific requirements of green building.

The paper will be presented to the essential requirements for the production of low-energy wooden windows, standards and certifications, especially DGNB certifications (certification of green buildings) that prove the fulfillment of the essential requirements.

Key words: wooden windows, energy efficiency, green building, certificate

CURRENT CONDITION INDICATORS OF WOOD INDUSTRY IN THE REPUBLIC OF MACEDONIA

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ABSTRACT

The wood industry represents as one of the oldest sectors of the manufacturing in the Republic of Macedonia. It is a strategic branch of the Macedonian economy.

The condition with the wood industry is shown through the current indicators such as: number of active business entities, number of employees, average paid monthly net salary per employee, industrial production, export and import, i.e. foreign trade. The data were obtained from the State Statistical Office of the Republic of Macedonia for the period 2011-2016.

The business entities in the wood industry in the number of business entities from the manufacturing participate with approximately 14% on average for the period 2011-2015. The average share of the number of employees in the wood industry in the total number of employees in the manufacturing is about 6% in the period 2011-2016. The value of net wages, on average, in the manufacture of wood and wood products and furniture production are lower compared to the average net salary in the manufacturing and at the same time below the national average.

In the wood industry, after all analyzed production we have a tendency for production growth except for the production of sawn lumber from pine and beech, parquet and production of the category other which includes the production of pallets, crates and boxes in the period 2011-2016.

The total export and import of wood industry products has increased in the studied period. The products from the furniture production are increasingly exported, and the products from the manufacture of wood and wood products have higher import. The total balance of wood industrial production has a positive sign in the last two years of the analyzed period (2011-2016).

Key words: current indicators, condition, wood industry

WOOD SHRINKAGE OF AUTOCHTHON AND ALLOCHTONE WOOD SPECIES IN THE REPUBLIC OF MACEDONIA

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ABSTRACT

Wood shrinkage of the following wood species was studied: *Fagus moesiaca*, *Quercus sessilis*, *Quercus conferta*, *Robinia pseudoacacia*, *Pinus nigra*, *Pinus silvestris*, *Abies alba*, *Picea excelsa*, *Pseudotsuga menziesii*, *Cupressus arizonica*, *Sequoiadendron giganteum*, *Pinus strobus* and *Larix decidua*.

The material used for investigation was collected from twenty-eight methodologically selected localities in the Republic of Macedonia.

The applied methodology of the experimental work is in accordance with the standard for wood investigation.

Generally, the mean values of the wood shrinkage of the tested autochthon and allochthon species are in the limits of the values for the species that have been systematized by Ugrenović (1950), Horvat (1980) and Enchev (1989).

Within the same deciduous specie, shrinkage of wood from the vegetative origin is higher than shrinking of the wood from generative origin.

Among coniferous species form artificial afforestation, within the same specie, wood shrinkage is increased by the aging of the tested stand from 26 to 58 years.

Key words: wood shrinkage, deciduous species, coniferous species, generative origin, vegetative origin, natural stands, afforested plantations.

COMPARISON OF RESISTANCE OF SOME WATER BASED ACRYLIC RESIN BASED WOOD COATING SYSTEMS AGAINST OUTDOOR CONDITIONS

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ABSTRACT

In this study, panels of pine and beech sapwood coated with 12 different coating systems were exposed to artificial weathering using fluorescent UV-lamps and water during 2016 hours. In these coating systems, water in different proportions, boric acid, two different acrylic resins and three different UV absorbers supplied by BASF were used. The aim was to compare durability of different coating systems in artificial weathering in terms of the color change, surface roughness, and adhesion strength. These test methods were used to evaluate the appearance and physical properties of the coatings after artificial weathering test. The results lead to the selection of the best coatings formulation for the wood durability in outdoor condition usage. The appearance and physical values after 2016 hours of weathering test showed that boric acid increases adhesion of the varnish for usage in outdoor conditions. In addition to, the varnish formulation containing especially acrylic resin and Tinuvin 400 DW provided the highest resistance against outdoor conditions.

Key words: Acrylic resin, artificial weathering, boric acid, UV absorber, wood coating, wood durability

ADHESION OF GLUING AND FINISHING FILMS TO CHESTNUT SOLID WOOD

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ABSTRACT

This report refers to the experimental examination of the adhesion of gluing and finishing films. The gluing films are formed by reactive acid-curing urea-formaldehyde resin: Prefere 4114 and acetate polymer adhesive: Jowacoll 124. The Strength of adhesion of gluing films is determined under regulations BDS EN 302 and BDS EN 205 (ASTM D 905). Protective-decorative films was formed with acrylic water-deluted varnish and Deva D3 reactive acid-curing varnish (butanolysis melamine-urea- formaldehyde resin). For this aim are used test samples from of chestnut (*Castanea sativa L.*) solid wood. The purpose of research is to study the influence of surface roughness on the adhesion. The Strength of adhesion of finishing films was determined by methods of pull out of glued metallic-stem under regulation BDS EN ISO 4624(BDS 13088). The obtained results indicate, that the surface roughness influence on the strength of adhesion of gluing and finishing films on chestnut solid wood. The coarser grind surface generally had the best adhesion. The highest adhesion strength of gluing was obtained with 40-grit sandpaper (6.34 N/mm^2 for PVA glue and 8.88 N/mm^2 for MUFR glue). For varnishes, the maximum adhesion strength was obtained for Deva D3 varnish (4.49 N/mm^2), followed by acrylic (2.64 N/mm^2) and water-based (1.87 N/mm^2).

Key words: chestnut; adhesion; reactive glues; acrylic varnish; reactive acid-curing lacquer

STREET FURNITURE IN CROATIA – PARK USERS REQUIREMENTS FOR (WOOD) URBAN EQUIPMENT

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ABSTRACT

Urban equipment, in generally, with an accent to street (wood) furniture creates the settings for resting, sitting and eating, but also for socializing, playing, and talking. Such settings may be of great importance to the elderly people, those with limited mobility, adults who have small children, but also to a young people (students and/or scholars) and on the other hand, also to business people. In the context of urban equipment, wood is a very usual choice of materials for street furniture, because it is a natural friendly material, it has lots of visual, functional, and design advantages.

The aim of the paper was to find out the opinions of urban equipment users with an accent to park wood furniture. The street (wood) furniture analyzed in this paper was related to tables, benches, and dust bins.

Key words: wood furniture, urban equipment, street furniture, Croatia

YIELD OF CUTTING OF EDGED BEECH TIMBER INTO ELEMENTS FOR DECKCHAIRS

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ABSTRACT

Goal of this research was to determine quantitative yield of short (1,2 – 1,6 m) beech timber in production of elements for deckchairs. Edged beech timber was divided into four groups, by quality (classes “1” and “2”) and by length (1.2–1.3 m and 1.4–1.6 m). Technological process of cutting of elements for deckchair consisted of planing, ripping and crosscutting. Needed elements were planned out by quantity, i.e. the goal was to construct complete deckchairs with as few leftover parts as possible.

Quantitative yield was between 42.62% and 55.62%. Timber of class “1” had a higher yield than class “2” timber, as was expected. However, it was not expected that shorter boards would have higher quantitative yield than longer ones. This can be explained by the fact that lengths of shorter boards fitted the lengths of longest elements produced.

By analyzing the value of timber on the market, it was determined that the least amount of material per unit of product would be sawn by cutting quality “2” timber that is 1.2–1.3 m long.

Key words: beech, timber, cutting, elements for deckchairs

INFLUENCE OF CONDITIONING PHASE AT THE END OF CONVENTIONAL DRYING ON DRYING QUALITY OF OAK TIMBER

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ABSTRACT

This study aimed to investigate the influence of different climates in the conditioning phase of conventional drying on drying quality of oak timber. The results of drying cycle with “traditional” conditioning were compared with results of the drying cycle where the equilibrium moisture content was higher (by 2%), while the duration of the conditioning phase was shortened by 24 hours. At the end of drying the final moisture content, moisture content difference across thickness and case-hardening were determined. The examined boards from drying cycle with modified conditioning phase had higher final moisture content (but still below target value) and higher moisture content gradient. Gap values – which are a measure of case-hardening – were significantly lower in this drying cycle. This confirms that applying higher EMC value during conditioning phase, even with shorter time, gives better results in reducing case-hardening. It can be expected that timber after modified conditioning phase has lower internal stresses, i.e. that it is more stable during further processing. No direct relationship between gap values and final moisture content, nor between gap values and moisture content difference across thickness was found.

Key words: conventional drying, conditioning phase, oak timber, drying quality

THE PROBLEM OF THE CONSTRUCTION BY DESIGNING PRODUCTS

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ABSTRACT

Product design represents an element of differentiation in relation to the products of the competition, so in this way it's becoming a significant source for the acquisition and maintenance of the company's competitive advantage in the market. The paper presents the problem of development of wooden products from the initial idea to the constructional solution.

Key words: design, constructional solution

DETERMINATION OF LEACH RESISTANT AND LIMITED OXYGEN INDEX LEVELS OF DIFFERENT WATER BASED ACRYLIC WOOD-CLEAR COATING SYSTEMS

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ABSTRACT

In this study, the limited oxygen index levels (ASTM D 2863-76) were investigated to obtain an indication of the relative flammability of fire retardant and leaching resistant for wood-clear coating systems containing different water based acrylic with UV absorber. Six different wood-clear coating were used, two of which were synthesized in laboratories and others were commercial. These wood clear-coating systems were applied on the scots pine and oriental beech woods samples. The amount of clear-coat in the leaching water was determined by UV spectrophotometer at the intervals of 2, 4 and 8 hours during the leaching test. The results show that the limited oxygen index (LOI) of the wood-clear coating systems synthesized in the laboratory and commercial coatings were close values. However, as compared to uncoated and clear-coated beech samples; the (LOI) values of the uncoated and clear-coated scots pine were found to be low. While smoke formation was not observed in beech samples, it was observed in pine specimens. The leaching rates of all coating systems were obtained to be quite high.

Key words: Acrylic resin, beech, clear-coat, fire retardancy, leach retardancy, oxygen index, scots pine

THE INFLUENCE OF WOOD DENSITY UPON MASS LOSS DURING ABRASIVE WATER JET CUTTING

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ABSTRACT

Obvious advantages of Abrasive Water Jet Cutting (AWJC) lead to inevitable process analysis by means of multifactor experiment layout. Input variables of the AWJC chosen for this research were: jet pressure (p), feed rate (u) and nozzle distance (h), while the observed output variable was mass loss (Δm), all in respect to observed oak wood density. However some other process characteristics such as deposited mass of abrasive particles, kerf width and visual surface appearance were also taken into consideration. Comparing results obtained from previous researches with those regarding the influence of wood density differences were found, but not enough significant to improve prior mathematical models in the terms of parameter significance for chosen values.

Key words: abrasive water jet cutting, particleboard, oak wood, mass loss, orthogonal plan matrix, electronic microscopy, abrasive particles, mathematical model

THE IMPACT OF TEMPERATURE OF COATING AND UV LAMP POSITION ON THE GLOSS OF UV ACRYLIC COATING ON WOOD

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ABSTRACT

This paper investigates the gloss of UV transparent coating applied on wood on the finishing line in the real industrial conditions. The samples of three-layer wood engineered flooring with upper (visible) layer made of oak (*Quercus robur L.*) were used. Five layers of UV acrylic transparent coating was applied by roller coaters and cured by ultraviolet (UV) lamps in a flow. The gloss of the coated samples was observed in terms of parameters of the top coating (temperature and viscosity) and the parameter of the curing process (distance of the last UV lamp from the substrate). Higher gloss of coated wood was achieved by lowering the position of the last UV lamp from the wood surface (from 250 to 210 cm), when the temperature of top coating was 24.8 °C. The increase of temperature of the top coating (from 23.1 to 24.8 °C) resulted in increase of the gloss of coated wood when the last UV lamp was in higher position (250 cm from wood surface). For lower position of the last UV lamp (210 cm from wood surface) the increase of temperature of top coating (from 24.8 to 25.3 °C) did not significantly affect gloss of coated samples. Results had shown that by adjusting the temperature of top coating and the distance of the last UV lamp from the substrate small variation of gloss of the coated surface can be achieved.

Key words: gloss of coating, temperature of coating, dry film thickness, UV lamp position, wood, UV acrylic coating

THE GLUE STRENGTH OF BENT FURNITURE BOARDS LAMINATED WITH FOILS BY A VARIOUS TECHNOLOGICAL REGIME

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ABSTRACT

This article is about the process of lining bent furniture boards with foils. The used foils are with thickness of 0,25 mm, 0,4 mm and 0,5 mm. For making of the multi-layer furniture panels are made of 3.2 mm MDF and PVA adhesive. The test samples are bent glued with a laboratory vacuum press and have the following dimensions: 9.6-16 mm thick, 100 mm wide and 100 mm internal radius of curvature. They are made in laboratory vacuum press with PVA glue. A two-factor experiment was carried out with the following variables of the laminating: the duration of the vacuum pressure and the amount of applied adhesive per layer. The laminated test samples are visually evaluated and the strength of the foil adhesion to the substrate (MDF) is determined. The results are analyzed and presented graphically.

Key words: foils, bent furniture panels, MDF, PVA, vacuum press

THE FOREST FIRES IMPACT ON BARK CHEMICAL COMPOSITION OF THE ALEPPO PINE (*Pinus halepensis* Mill.)

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ABSTRACT

Forest fires occur with uncontrolled fire in the forests. They are causing great damage, which depends on the age of the forest, the types of trees, the vegetation and the type of fire and its intensity, which are less common with natural causes and most often by human activity. In the Republic of Croatia fires occur most commonly in Dalmatia, the islands and the Dalmatian Zagora. Since in the mentioned areas after the fire, significant quantities of fire burnt trees have been left behind, the question arises as to what degree they are chemically degraded or whether they still possess all the properties for further application in mechanical or chemical processing.

The basic objective of this paper was to research the group chemical composition and CHNSO of the Aleppo pine (*Pinus halepensis* Mill.) bark before and after the impact of low ground fire and high fire of the treetops at the height of the trees of 0, 2 and 4 m. The obtained results showed significant differences in the group chemical composition, as well as in CHNSO of the bark between nonburned and burned wood resulting from the direct contact of the mentioned fire with the bark.

Key words: aleppo pine (*Pinus halepensis* Mill.), bark group chemical composition, forest fires, nonburned wood, burned wood

COMPARATIVE GLUE JOINT SHEAR STRENGTH TESTING OF SOLID WOOD PANELS COMPOSED OF NO TREATED AND THERMALLY TREATED ASH BOARDS

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ABSTRACT

The aim of this research was to establish the influence of thermal treatment temperature on glue joint shear strength of edge glued solid wood panels.

Five different 32mm thick solid ash wood panels were prepared for this research: a) panel composed of all no treated boards-as control; b) panel composed of alternately stacked no treated and thermally treated boards at 190°C; c) panel composed of alternately stacked no treated and thermally treated boards at 200°C; d) panel composed of alternately stacked thermally treated boards at temperatures of 190°C and 200°C; e) panel composed of all thermally treated boards at temperature of 200°C.

All solid wood panels have been processed at the same circumstances: same joint preparation, same PU one component adhesive spread, same pressure applied at clamp carrier and the same way of testing samples preparation.

The glue joint shear strength tests were conducted on computer controlled testing machine according EN13354 procedure.

Although the standard deviations within each of the five runs were not the same at the 95.0% confidence level, one way ANOVA analysis have been proceeded only to indicate relationships of glue joint shear strength between pairs of tested panels. Other appropriate Kruskal-Wallis test also showed that there were no statistically significant differences between pairs of results, but these analyses indicated directions for further investigations.

Key words: solid wood panel, glue joint shear strength, PU adhesive, thermally treated boards

AUTOMATION STRATEGIES IN WOOD ENGINEERING INDUSTRY IN ALBANIA

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ABSTRACT

In our days the wood engineering industry faces a developed reality of modern production. Globalization, external resources, contractual production, tendency towards the service sector are some of the important factors that push the wood industry towards modern manufacturing approaches and technologies.

The aim of this topic is to identify the ways of approaching automation in woodworking technology in Albania. A study undertaken in 10 major wood processing enterprises in Albania identified the progress of these companies within the framework of automation strategies.

The study was carried out through field visits for each enterprise as well as filling in questionnaires by key stakeholders in each company.

The database serves as a comparative basis of the two methods, respectively “The USA Principle” and “The Strategy of Automation Migration”, which provide an overview of the approaches undertaken with regard to the implementation of automation in woodworking engineering in Albania.

The study showed that the automation migration strategy finds widespread exploitation in the wood processing industry in Albania. Technology transfer from manual production to the other two automated and integrated levels is used by some of the companies in the study. Regarding to implementation of USA principle, the study shows some weakness regarding to understanding the process, lack of mathematical models for carried out processes, as well lack of study how to simplify and automate the process.

Key words: principle USA, migration of automation, job shop, fixed position layout, process layout, products layout

MEDIEVAL INTERIOR DESIGN FEATURES IN THE WOMAN MONASTERY COMPLEX OF BEROVO (CHURCH † ST. ARCHANGEL MICHAEL)

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ABSTRACT

This paper presents the analyses of the architectural features and values implemented in traditional Macedonian medieval monastery architecture in the Maleshevo region of Macedonia (the monastery complex includes the Church †St.Arhangel Mihail Berovo) in order to valorize the values that are not sufficiently explored and preserved in this region. The research is focused on this precise location, the interior design decoration and ethnological value, also the anthropological influence development of the Macedonian people tied directly to the architecture and furniture. This medieval monastery interior has shown us that an important part of the material culture development is given with the emphasis on the fine arts representations using wood for furniture manufacturing. The traditional medieval Macedonian architecture, as a part of the material culture is not researched enough. Taking into consideration the style unity ruling in the medieval Europe regarding church and profane furniture as well as the results obtained by comparing with the material issue from the fine arts sources, and the originals issued from the neighboring countries, it is possible to conclude that the interior decoration and furniture built in and free standing in the monastery of Berovo (church †Sv.Arhangel Mihail Berovo) are real example of traditional Macedonian decoration from the 19th century. The masters of that period were primarily good experts for construction and decoration (carving, engraving, intarsia) of moving and built in wooden furniture and all wooden objects.

Key words: Tradition, ecclesiastical Slavic concept, monastery, interior, architecture, wooden built in furniture, wood carving, integrality

APPLYING THE IGES GRAPHICS FORMAT FOR CONNECTING CAD/CAM SYSTEMS

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ABSTRACT

Very important parts of a CAD/CAM system for woodprocessing are the methods and procedures for connecting designprocess and manufacturing process. For that purpose, we developed a CNC editor for creating NC part programs using a CAD system for defining the workpiece geometry. The main possibilities of the CNC editor are to generate NC part program from an IGES file, make presentation of the tool path and transfer the NC part program to the NC unit of the machine. The software was developed using Microsoft Visual Basic programming language.

Key words: CAD/CAM system, numerical control, woodprocessing, IGES, NC part program

THE IMPORTANCE OF THE MINORITY TREE SPECIES IN THE WOOD PROCESSING: A CASE STUDY OF LONG-TERM CONSERVATION OF EUROPEAN CRAB APPLE (*Malus Sylvestris* Mill.)

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ABSTRACT

Minority tree species provide high quality wood for many purposes. Wood has certain features and desirable characteristics and consequently achieves a relatively high price at timber market. Minority tree species need specific ecological conditions and this is the reason why they are so rare in the forests. These species need a lot of foresters attention to grow successfully in competition with other common species. Minority tree species in Europe are for example European crab apple, wild pear, wild cherry, sycamore, mountain ash and another species from genus *Sorbus*, *Tilia*, *Juglans*,... All these species are important for ecology of forest ecosystems. These species are mainly fruitful, which is important for forest animals. They are also important for biodiversity of the forests. Less known is the usefulness of its timber. The products from it could have a high added value due to autochthonous and rarity of the wood. Frequent use of wood from these species in small quantities could help to preserve natural forests and their biodiversity which is important specially in the times of climate changes. The cooperation of forestry and production of wooden products has rather large indirect influence on forest silviculture. Minority tree species with interesting, rare and useful wood can improve financial income from forests and this may be an additional motive for more intensive management with minority tree species. This paper is focused on rare and neglected minority tree species - European crab apple (*Malus sylvestris* Mill.). The study explains different reasons for endangerment of this species, the possible uses of its wood and necessary conservation measures which could help to maintain these tree species in European forests. The use of wood in the production of wooden products make an important contribution to the fact that forest owners and foresters have extra motivation and financial incentives for more intensive management with this tree species.

Key words: minority tree species, european crab apple, wood processing, rare wood

CREEP BEHAVIOUR OF REINFORCED PARTICLEBOARD

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ABSTRACT

Particleboards are versatile material, which can be used for different applications. Although they have relatively good mechanical properties its behaviour during long time exposure to load has been often criticized. During long time exposure micro and macro rupture between constituents (failure of adhesive bond) and in constituents occur. One possibility to improve the creep behaviour of particleboard is reinforcement of later. For this purpose we investigate several different reinforcement options. For reinforcement hemp fibres, glass fibres and carbon fibres were used. Reinforcement was glued on the surface using two component epoxy resin. Boards were afterwards exposed to static load, which was 30 and 60% of break load determined by four-point bending test. It was determined that creep behaviour depends on the load and on the material used for reinforcement.

Key words: particleboard, reinforcement, carbon fibre, hemp fibre, glass fibre

THE GLUE STRENGTH OF VENEERED BENT FURNITURE BOARDS LAMINATED BY A VARIOUS TECHNOLOGICAL REGIME

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ABSTRACT

This article is about the process of lining bent furniture boards with beech veneer. The used veneers are with thicknesses of 0,55mm and 2,5mm, which are oriented longitudinally and transversely to the curvature. For making of the multi-layered furniture panels are used 3.2 mm MDF panels and PVA adhesive. The test samples are bent glued with a laboratory vacuum press and have the following parameters: 9.6-16 mm thick, 100 mm wide and 100 mm internal radius of curvature. They are made in a laboratory vacuum press with PVA glue. A two-factor experiment was carried out with the following variables of the veneering: the duration of the vacuum pressure and the amount of applied adhesive per layer. The veneered test samples are visually evaluated and the adhesion of the veneer to the substrate (MDF) is determined. The results are analyzed and presented graphically.

Key words: veneer, bent furniture panels, MDF, PVA, vacuum press

REGIMES FOR PRODUCING OF FURNITURE BENT PANEL BOARDS WITH A LABORATORY VACUUM PRESS

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ABSTRACT

By the manufacturing of curved furniture constructive elements of bent laminated furniture boards (arches, doors, drawer fronts etc.), it is important to be establish a technological regime for faultless bending of furniture panels and to know their limit bending radius. The aim of the study is to compile a rational technological regime for faultless production of layered bent glued fibreboard with high density (HDF). The test samples are made from three layers lamellas of HDF with dimensions 260/100/2.8 mm. For gluing them was used a standard polyvinyl acetate adhesive 25 min open time (Protovil WR / P, Collanti Concorde Italy). Bending and forming layer boards was done in a laboratory vacuum press with templates with the following radius of curvature: 50, 100 and 150 mm. To realize this it is determined the time to reach minimum technological strength of the adhesion, the speed of the suction and the boundary minimum bending radius. The results obtained are analyzed and presented graphically.

Key words: Bent glued furniture boards, HDF, polyvinyl acetate glue, vacuum presses

CONSTRUCTION DETAILS OF YACHT FURNITURES

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ABSTRACT

In general, yacht interior production is a project based manufacturing. And it can be divided into three; mass, semi custom and custom. Interior of a yacht consists of movable and built-in furnitures. According to some classification regulations, interiors have to fulfill some requirements according to yacht classification. Labelled doors, furnishing, painting or etc. that have fire retardant are one of the best examples of these regulations. Also, vibration sources such as engine, generators, or etc. can damage the yacht furnitures even if damping and absorbing equipments are used. Especially waves are a big matter for built-in joints when structural rigidity is considered. Also, comfort level is an indicator of a yacht quality or luxury and depends on some criteria such as allowable maximum noise level when harbored or under sailing and whole body limitations according to yacht length and locations such as cabins, public places or open recreation decks.

Yacht interior production is a less know issue not only by Turkish Furniture Manufacturing Society but also by other societies. According to some literature, share of material cost is about 60% of a yacht and interior cost share is the second material cost after the engine with 20%. That's why yacht interior or furniture production is an important issue in yacht building.

From this point of view, remarking the importance of yacht interior was the main aim of this study. And, to achieve this goal, construction details of yacht furniture were presented over a few manufactured ones for mega yacht that built in Turkey.

Key words: yacht interior, yacht furniture, built-in furniture, portable furniture

INTERIOR DESIGN AND FURNITURE PRODUCTION OF YACHTS THAT BUILT IN TURKEY

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ABSTRACT

Turkey is one of the global partners of the yacht building industry all over the world. Especially for semi-custom and custom yachts, Turkey was located at the top 5 for last years according to total length of built yachts. Yacht building can be performed as mass, semi-custom and custom productions. Mass production of yachts is dissimilar with other industries such as automotive or electronic. Volume of the mass production is measurable in yacht building instead of millions. May be it is due to being a high-end sector. It's not a vital need but is a social or economic indicator that shows wealth, especially for luxury yachts instead of small and cheap ones.

Design is infacy of all activities. Determination of needs, requirements and limitations, volume planning, conceptual design, determination of materials, fittings and accessories, detailed design and design management are the phase of interior design. And lots of them depend on the project or potential clients' budget. Also, location of builder or shipyard can affect the budget of projects for all activies. Labor cost is one of the most important competitive advantages of Turkish Yacht Building Industry. A strong and big Furniture Industry is another competitive advantage of Turkey.

But, yacht building and related activies or sectors such as design and furniture production are supposed to be import oriented when value-added activies such as desing origin of yachts or material and accessories usage in furniture production are considered. In this sense, this study aims to present interior design and furniture production of yachts that built in Turkey.

Key words: yacht, boat, interior design, furniture production

SCREW WITHDRAWAL RESISTANCE OF BEECH WOOD

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ABSTRACT

In this paper, screw withdrawal resistance of beech wood (*Fagus moesiaca* C.) was investigated. The results were obtained by testing of withdrawal resistance of two-threaded “Hanger“ screws M8 x 90 mm. Screw withdrawal resistance was carried out in two anatomical directions, radial and tangential. Specimens were divided in two groups. The first group was conditioned to moisture content of 8.5% (temperature: 23 ± 2 °C; relative humidity: $46 \pm 3\%$) and specimens of the other group were oven-dried. Wood properties, such as moisture content, shrinking, density, hardness and compression strength parallel to the grain were also examined. According to the test results, it was found that there were significant statistical differences of screw withdrawal resistance between samples in radial and tangential anatomical directions, with both moisture contents. On the other hand, there were no significant statistical differences of screw withdrawal resistance between specimens at moisture content of 8,5% and oven-dried specimens, observed in both anatomical directions.

Key words: withdrawal resistance, beech, two-threaded screw, density, hardness, compression strength parallel to the grain

CHANGE IN MASS, VOLUME AND DENSITY OF EUROPEAN BEECH (*FAGUS SYLVATICA* L.) FIREWOOD DUE TO AIR DRYING

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ABSTRACT

In this research experimental and theoretical parameters of moisture, mass, volume and density of round and split firewood are explored, because of great importance to commercial trading with firewood. Firewood was made in specialized company using mechanised technology. The tools and machines which have been used were chainsaws, band saws and hydraulic log splitters. Each firewood piece was measured and marked with a purpose of measuring mass, dimensions and moisture in green and dryish condition. Air drying was conducted on well-ventilated and sheltered company area from 20 March 2015 to 12 October 2015. The average value of firewood moisture before drying was 66.02%. In dryish condition, average value of firewood moisture was between 15.74% and 32.72%. Considering green condition, loss in mass was between 25.89 and 29.47%. Given the green condition, reducing the volume amounted to an average between 9.54 and 13.6%. Considering green condition, density was reduced between 14.73 and 19.24 %.

Key words: European beech (*Fagus sylvatica* L.), firewood, mass, volume, moisture, wood density, air drying

PARTICLEBOARDS AND LIQUEFIED WOOD

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ABSTRACT

Particleboards are the most used wood-based composites. The main components needed for their production are the lignocellulosic based constituents and adhesive to bond those constituents together. Usually synthetic resin is applied for bonding purposes. Nowadays we often discuss about bio based materials, materials which are composed mainly from natural based materials. Since one of the main components (resin) is synthetic nature we are going to present the advantages and disadvantages of using of liquefied wood for particleboard production. Main focus of paper will be to present the mechanical and physical properties as well as sorption behaviour and formaldehyde emission when liquefied wood is used for particleboard production

Key words: particleboard, liquefied wood, mechanical properties, sorption, formaldehyde emission