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ABSTRACT BOOK

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PREFACE

This abstract book contains selected papers of the ORENKO 2018 – International Forest Products Congress held on September 26-29, 2018 in Trabzon, Turkey. The congress, organized by the Forest Industry Engineering Department at Karadeniz Technical University, has received about 200 abstracts from all over the world including United States, Canada, Australia, Slovenia, Slovakia, Serbia, Romania, Poland, South Korea, Italy, Iraq, Iran, Czech Republic, China, Chile, Bulgaria, Sweden, Bangladesh and Turkey. After an initial review of the submitted abstracts, about 180 abstracts were accepted for both oral and poster presentation.

The purpose of this congress is to provide an up-to-date discussion in the field of forest products in general. ORENKO 2018 is focused on the theme "Outlining the Forefront Research in The Field of Wood Science and Engineering". The topics that covered in the congress include wood science, technology and engineering, wood and wood-based products, wood anatomy, wood raw materials, wood composites, wood-plastic composites, engineered wood products, wood drying, biomaterials, wood constructions, physico-mechanical properties of wood and wood-based materials, nanotechnology applications in wood science, nondestructive evaluation of wood, sustainable utilization of forest products, wood preservation, wood modification, wood biomass, wood-inhabiting insects and fungi, marine borers, recycle/reuse/disposal of wood and wood based materials, non-wood forest products, wood chemistry, adhesives and bioresins, formaldehyde and VOC emission from wood based panels, pulp and paper, advanced cellulosic products, fiber resources from non-woody plants, furniture design and manufacturing, wood coatings, wood finishing, archaeological wooden structures, industry 4.0 in forest products industry, forest products economics, forest products marketing, production management and operational research, artificial intelligence in forest product industry, forest products ergonomics, environmental and ecological issues in forest products and occupational health and safety in forest products industry.

Reviewing papers of ORENKO 2018 was a challenging process that relies of the goodwill of those people involved in the field. More than 30 researchers from related fields were invited to review papers for the presentation. We would like thank all the reviewers for their time and effort in reviewing the papers.

Finally, we would like to thank to all person of the organizing committee who have dedicated their constant support and countless time to organize this congress. The ORENKO 2018 is a credit to a large group of people, and everyone should be proud of outcome.

ORENKO 2018 Congress Secretariat

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KEYNOTE ADRESSES

PROTECTION OF WOOD: A GLOBAL PERSPECTIVE ON THE FUTURE

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The current state of wood protection is briefly reviewed, and then the issues that are affecting preservative treatments are summarized. The strategies for addressing these issues are discussed in relation to the role of wood as a renewable building material. The potential for addressing biological attack, ultraviolet light degradation and dimensional stability in a single product are discussed in relation to the need to produce a longer lasting material that retains the environmental attributes of wood.

Keywords: wood deterioration, wood protection, preservatives, barriers, wood modification

LIGNOCELLULOSIC-FILLED POLYMER FEEDSTOCKS FOR LARGE SCALE ADDITIVE MANUFACTURING OF LOW COST COMPOSITES

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Application of large scale 3D printers using extrusion-based processing has demonstrated the potential for the creation of larger, faster and lower cost 3D printed parts by large scale additive manufacturing. The University of Maine Advanced Structures and Composites Center in collaboration with Oak Ridge National Labs is investigating the development and application of low cost lignocellulosic-filled thermoplastic pellets for 3D printing large composite components, initially for use in marine tooling applications. This paper will discuss the results of experiments compounding novel materials with wood flour and cellulose nanofibrils using several thermoplastic polymer resins including poly lactic acid (PLA), styrene maleic anhydride (SMA) copolymer and polypropylene (PP). Each lignocellulosic polymer blend was evaluated to determine the material properties of the materials via mechanical and thermal testing. Promising formulations were selected for 3D printing trials on a high feed rate extruder. Finishing options for the lignocellulosic-filled thermoplastic resins were performed using surface treatments and evaluating coating adhesion of the composite samples. The optimum lignocellulosic-filled thermoplastic formulations were used to print tooling molds for trials by local boat builders.

Keywords: Lignocellulosic, polymer, feedstocks, large scale additive manufacturing, 3D printing

DISPERSION-TYPE WOOD PROTECTANTS AND THEIR EFFECTS

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More and more dispersion-type chemicals are used as wood protectants considering the water-insoluble fact of some effective ingredients and the expected low leaching of them from treated wood. In order to understand the different types of wood protectants, first a classification of dispersion types would be given. Then accordingly, some dispersion-type chemicals used as wood preservatives, water repellents, and anti-weathering protectants would be introduced. The emphasis would be put on an organic biocide microemulsion (4,5-dichloro-2-octyl-2H-isothiazol-3-one, DCOIT) used as wood preservative or moldicide, wax emulsion used as water repellent, and titania (TiO2) sol used as anti-weathering protectant. Some compound systems and the combinations of them and their effects on treated wood would also be introduced.

DCOIT microemulsion demonstrated good permeability and high leaching resistance. After the leaching test according to AWPA, DCOIT retention in treated samples were around 80%. It showed high effectiveness against mold fungi even at very low retention level (eg. Soaked in 0.05% DCOIT for 10 min), and to a lesser extent, effectiveness against both brown and white rot fungi. The reason was considered that DCOIT would rapidly depleted in the early stages of incubation by *G. trabeum*. By combining antioxidants in DCOIT microemulsion system, the resistance of DCOIT treated wood against G. trabeum could be enhanced.

Paraffin wax emulsion with an average particle size of 200nm and a good stability was prepared. The permeability of this emulsion depended greatly on wood species, with good permeability in southern pine (*Pinus spp*.) while poor in Scots pine (*Pinus sylvestris*). Wood treated with a combination of paraffin wax emulsion and thermal modification exhibited satisfying water repellency and dimensional stability. To achieve better results, mixed wax emulsions including paraffin wax, beeswax, carnauba wax with different melting temperatures and linseed oil were prepared to construct double layer hydrophobic system in wood internal and external surface under appropriate drying-treatment. When the ratios of beeswax (or paraffin wax) to carnauba wax were 5:5 or 7:3 and the drying temperature was 70oC, the hydrophobic system could be formed.

Titania (TiO_2) sol is a very good anti-weathering protectant for wood surface, but it is not resistant to water. Therefore, it can be combined with wax emulsion or silanes to achieve an overall good performance. These systems were used on thermal modified wood to show the results.

One of the advantages of these dispersion-type systems is the possibility to make multifunctional water-based wood protection system according to the requirements in application. For example, the DCOIT can be combined with wax emulsion to improve both biocidal and water repellent properties of wood, or the dyes can be combined to make colorful wood products.

The penetration of dispersion-type wood protectants remains a problem. It is suggested in future studies, more attention should be paid in this area.

NON-DESTRUCTIVE EVALUATION OF WOOD AND WOOD-BASED MATERIALS: STATE-OF-THE-ART AND FUTURE PERSPECTIVES

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Wood is a very versatile biological material derived from the living plants (trees) that has been used by humans from millennia. The natural origin of wood makes its microstructure extremely complex, with properties varying within species, provenance, forest or even inside a single tree. Mechanically, wood is an orthotropic (or axisymmetric) material with strength significantly varying along and across fiber direction. From the chemical perspective, wood is considered as a complex composite of cellulose, hemicellulose and lignin. The relative content, configuration and special distribution of these polymers affects the wood-derived material properties and therefore these application fields and service life performance.

Comprehensive knowledge regarding wood properties is indispensable to use this resource in optimal and efficient way. The non-destructive evaluation techniques (NDT) are therefore of the greatest interest for wood products manufacturers and users. Different application fields for NDT can be identified in the field of wood technology, including assessment of timber structures, prevention of damage, quality grading and sorting of raw resources, quality assurance, products testing and cultural heritage among the others. Various techniques are used for NDT of wood, with visual/optical/laser-based, ultrasonic, vibration, thermography, drilling resistance, microwaves, x/gamma-rays, electrical resistance or conductivity assessments most commonly utilized. Some other methods, even if not evidently non-destructive by itself can still be used for the routine scanning of wood products, for example Acoustic Emission in prevention of drying cracks or cutting power monitoring for assessment of the fracture toughness.

The keynote will present a review over the state-of-the-art techniques routinely implemented in a daily life of wood engineers: However, a special emphasize will be given to innovative solutions becoming available thanks to the progress of the technological advance in the fields of information technology and sensor development.

Keywords: Non-destructive evaluation, wood based materials

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ORAL PRESENTATIONS

INVESTIGATION SOME PROPERTIES OF THE WOOD TREATED WITH NOVEL POLYSTYRENE-SOYBEAN OIL COPOLYMER CONTAINING SILVER NANOPARTICLES

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In this study, the antifungal effect of wood treated with silver nanoparticles against brown-rot (*Coniophora puteana*) fungi was investigated. In addition, leaching resistance of treated wood was determined. Scots pine (*Pinus sylvestris* L.) sapwood samples were impregnated with Polystyrene-g-soybean oil copolymer-Ag (AgPSbox) nanocomposites and Polystyrene under vacuum process in a small-scale impregnation container.

After impregnation, antifungal effect, leachability, moisture content, weight percent gain, leached formulation (LF) and protection efficiency were analyzed. Structural analysis of the impregnated specimens was characterized by FTIR techniques. The highest value of weight percent gain (WPG) was obtained by AgPSbox (0.78%), while the highest resistance was achieved by PS with a concentration of 0.45 g / l in decay test. However, this effect of treatment seemed to be almost negligible after the leaching test. The FTIR spectra of the specimens impregnated with nanocomposites showed the characteristic signals regarding impregnated components.

Keywords: Antifungal, Decay test, FTIR, Polystyrene-g-soybean oil, Silver nanoparticle

CHANGES IN CONTACT ANGLE OF HEAT TREATED WOOD DUE TO NATURAL WEATHERING OF 2 YEARS

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Heat treatment is one of the environmental friendly wood protection methods since heated wood does not contain any harmful chemicals. Wood polymers are modified by the exposure to high temperature ranges between 160 and 230°C. The main advantages of heat treatment of wood are increased hydrophobicity, improved dimensional stability, lowered equilibrium moisture content, and increased decay and weathering resistance.

In this study, it is aimed to investigate the effect of natural weathering on the wettability of heat treated iroko, ash, Scots pine and spruce wood samples. For this purpose, softwoods were subjected to the heat treatment at 212°C for 90 min while hardwoods were heated at 190°C for 90 min under steam atmosphere, and then all samples including controls were exposed to natural weathering agents in Trabzon for 2 years. Contact angle was measured with the sessile drop technique using water both for weathered and un-weathered samples. The change in volume of the drop (%) was also calculated.

Contact angle measurements after heat treatment showed an increase in wood hydrophobicity. However, weathering increased wettability of the samples probably due to combination of structural and chemical changes of the surfaces. Surface cracks formed during weathering. Cracks were greater in control samples compared to heat treated samples and in softwoods compared to hardwoods. Advancing contact angles of a water drop were in all cases higher for heat treated wood than for control wood after weathering. Change in drop volume of heat treated samples was also found to be less than that of controls showing heat treated wood was less wetted than controls.

Keywords: Contact angle, heat treatment, weathering, wettability

WETTABILITY OF SCOTS PINE COATED WITH ZNO AND CEO_2 STABILIZED ACRYLIC COATING AFTER ACCELERATED WEATHERING

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In this study, influence of nanoparticle stabilized acrylic coating on the contact angle changes of Scots pine wood after accelerated weathering was studied. For this purpose, two metal oxides, nano zinc (ZnO) and cerium oxide (CeO2), and a water based transparent acrylic coating were used. Commercially available nano wood coating was used as a reference chemical. Both nanoparticles were added to the coating as 5% concentration level based on the solid content of the resin in the coating. The mixtures of 200g/m2 were applied to the surface of the samples with a brush for three times. The same procedure was also applied for the reference chemical. Then, samples were exposed to accelerated weathering for 1512h in Atlas UV Test machine according to Procedure 1 in ASTM G154 standard. Contact angle was measured with the sessile drop technique using water both for weathered and un-weathered samples. The change in volume of the drop (%) was also calculated.

Results showed that coatings increased surface hydrophobicity of wood. However, weathering decreased contact angle of the samples in comparison to initial contact angle of samples before weathering. Crack formations were observed on the surface of reference samples after 48h of the weathering, and the cracks continued to propagate during the test. In ZnO and CeO2 treatments, no visible cracks were observed on the surfaces during the weathering period. Advancing contact angles of a water drop were in all cases higher for wood samples coated with nanoparticle stabilized acrylic coating than for coating alone after weathering. Change in drop volume of coated samples was also found to be less than that of controls. The measurements clearly indicated that wood surfaces with ZnO and CeO2 stabilized acrylic coating formed a hydrophobic barrier on the wood to provide surface protection.

Keywords: Contact angle, nanoparticle, weathering, wettability

DURABILITY OF WATER-BORNE ACRYLIC RESIN WITH COMMERCIAL UV ABSORBER AND TREE BARK EXTRACT COATING SYSTEMS IN OUTDOOR CONDITIONS

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One of the main methods used to protect wooden materials against UV rays is to cut the UV rays and contact with the wood surface of the rain water by applying surface treatments. Within the scope of this project; environmentally friendly new wood preservative surface materials have been developed that protect the wood surface against outdoor conditions. Durability performance of different types water borne acrylic resin with bark extract coatings on wood surface exposed to outdoor conditions was investigated.

The scots pine and oriental beech surfaces were coated with 3 different water-borne acrylic resin coatings. Two different tree (fir and black pine) bark extracts and commercial UV absorber (Tinuvin DW 400) were used in acrylic resin coating formulations. The durability of the coatings (test group) containing these bark extracts were compared with coating (control group) with commercial UV absorber (Tinuvin DW 400). The wood samples coated with test and control coatings were exposed to accelerated weathering testing in laboratory conditions. The surface colour and roughness change values on the wood samples coated with test coatings exposed to the accelerated weathering test (QUV, 2016 h) were compared with the control samples. Microscopic images and dry film thicknesses of the control and test samples prepared before the outdoor test were determined.

The results showed that the protective effect of acrylic coating system containing fir bark extracts in QUV test conditions during 2016 h was better than coating containing commercial UV absorbers. However, the increase of antioxidant effect on the fir bark extract has a positive effect on the beech wood to increase the durability in outdoor conditions, while it has a low preservative effect on the pine wood.

Keywords: Accelerated weathering test, Acrylic resin, Color change, Tree bark extract, Surface roughness, Wood coating

COMPARISON OF DURABILITY OF DIFFERENT WATER-BORNE ACRYLIC RESIN WITH UV ABSORBER WOOD COATING SYSTEMS IN NATURAL WEATHERING

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Wood has been used in the construction industry for thousands of years and remains an important material, often protected by surface treatments. In this study, pine and beech sapwood samples coated with 12 different water-borne acrylic resin coating systems were exposed to natural weathering in Trabzon, Turkey. The natural weathering test continued for 18 months. 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 12 different coating systems in natural weathering in terms of the colour change, surface roughness, and macroscopic evaluation.

These test methods were used to evaluate the appearance and physical properties of the coatings after natural weathering test. The results lead to the selection of the best coatings formulation for the wood durability in natural outdoor conditions. The appearance and physical values after 18 months of weathering test showed that boric acid increases durability 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 durability against outdoor conditions.

Keywords: Colour change, Surface roughness, Natural weathering test, Surface roughness, Water borne acrylic varnish, Wood surface

DETERMINING SYMMETRIC-ASYMMETRIC FURNITURE PREFERENCES AND FORM AND COLOUR PREFERENCES FOR CHILDREN'S ROOM OF THE GIFTED CHILDREN

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In this study, it was aimed to determine the preferences of gifted children for symmetric-asymmetric furniture and children room's shape and colour preferences. For this purpose, a questionnaire consisting of 20 pairs of symmetric-asymmetric furniture samples and 18 different children's room designs with triangular, square and circular forms and main and intermediate colours were applied to gifted children and their preferences were determined. When the results were evaluated, the rate of symmetric furniture preference was determined to be 65%. It was also determined that the gifted children firstly pay attention to functionality in their symmetric furniture preference and make their choices accordingly and give particular importance to visual quality in asymmetric and functional designs. The most preferred model is square, followed by circle and triangle. When it comes to the colour preferences, cold colours have been determined to be the most preferred colours; blue, purple and green colours have been selected respectively. According to these results, it can be suggested that square model, cold colours and symmetric designs should be preferred for furniture designs for the gifted children.

Key words: Furniture, Interior architecture, Gifted children

THE EFFECT OF SUB-ZERO APPLICATION ON PARALLEL FIBER PRESSURE RESISTANCE OF THERMOWOOD-TREATED SORBUS TORMINALIS

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This study aimed to analyze the possible changes in the pressure resistance values parallel to the fibers(CS) by subjecting heat-treated wood to sub-zero temperatures. Within the scope of the study, test specimens were first prepared by applying thermowood heat treatment at 190 and 212 °C for 1 h to samples of wild service tree wood (Sorbus torminalis). Both the heat-treated samples along with untreated control samples were then kept at -80 °C for 6. 18 and 54 h to obtain the test specimens. When compared to the control samples. Test results showed a difference in the parallel fiber pressure resistance of the heat-treated test specimens held at -80 °C and the values were seen as very positive, especially with the 6-h and 18-h applications. The CS resistance values of the control samples and the heat treated samples as N/mm2 at 190 and 212 °C for 1 h were respectively 56.12. 69.28 and 62.12 for initial; 51,38. 73.25 and 80.55 for 6 h; 50,31. 72.82 and 75.66 for 18 h; 55.85. 60.19 and 62.14 for 54 h.

Keywords: Heat treatment, Cryogenic treatment. Sorbus torminalis. Compression strength

DIMENSIONAL STABILITY OF WOOD BONDED WITH THE BIO-BASED PHENOL-FORMALDEHYDE (PF) RESIN

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Phenol-formaldehyde (PF) resins have a widely used as adhesive in wood-based product industry. In this study, bio-oil obtained from pyrolysis of wood waste was chemically synthesized with phenol and formaldehyde up to 20 % wt. phenol replacement levels under alkali condition. Afterward, the dimensional stability of wood bonded with modified phenol-formaldehyde (PF) resin was investigated.

Synthesized phenol-formaldehyde resin (lab. PF) was used as reference resin in order to compare the dimensional stability of wood bonded with modified PF resin. As a result of this work, bio-oil can be directly used as chemical feedstock for production of bio-based PF resin.

Keywords: Bio-based adhesives, Bio-oil, Dimensional stability, Phenol-formaldehyde resin

DEPICTIONS ON WOOD: ACCEPTATION AND INTERNALIZATION OF WOOD, WHICH IS AN INTERCULTURAL INTERACTION TOOL, AS "A VALUABLE OBJECT" (THE DISCOVERY OF WOOD IS NOT OVER YET)

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As it is accepted and internalized as a valuable material within intercultural interaction, wood, which is most well-known material for its naturality and versatility in the world since ancient times, and which provides solutions for a wide range of different applications, has been depicted in this article in the following 3 original depictions with distinctive compositions constructed with styles and structures as different as possible with a mentality foresight upon the basis of "The Discovery of Wood is not Over Yet".

The implications forming a basis for these depictions were internalized with professional/technical knowledge and in these depictions that were made with a woodlover approach; certain theoretical explanations to strengthen wood awareness and general depictions to introduce wood (considered as an exquisite natural material in intercultural interaction) were made.

Keywords: Wood, Intercultural Interaction, Natural Material, Creativity, Unending Solutions

MECHANICAL PROPERTIES OF WOVEN CARBON AND GLASS FIBER FABRIC REINFORCED WOOD PLASTIC COMPOSITES

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High mechanical properties are desirable for wood plastic composites (WPC) to compete other conventional composites such as plywood, fibreboard, particleboard etc. Carbon and glass fibers are recognised to have high mechanical properties. In this study, polyvinyl chloride (PVC) based flat-pressed wood plastic composites were reinforced with woven carbon and glass fiber fabric.

The effect of reinforcement with 2 different woven fabrics (carbon and glass fiber) on the mechanical properties of wood plastic composites was investigated. Flexural and tensile strength and modulus elasticity of wood plastic composites were determined to evaluate the effect of reinforcement. Results showed that reinforcement significantly increased mechanical properties of laminated? wood plastic composites. Thus and so flexural strength was improved up to 162 % when modulus of elasticity was increased up to 40% compared to control samples. The highest increase for flexural strength was obtained from woven carbon fiber fabric, while it was woven glass fiber fabric for flexural modulus. Moreover, similar results were obtained for tensile strength and modulus of elasticity which were also enhanced significantly.

Keywords: Carbon Fiber, Glass Fiber, Mechanical Properties, Reinforcement, Wood Plastic Composites

THE PERFORMANCE OF WATER-BORNE ACRYLIC COATING SYSTEMS ON FLAT-PRESSED WOOD PLASTIC COMPOSITES

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The colour change of surface in the outdoor conditions is one of the prominent obstacles for wood plastic composites. In this study, 2 different water-borne acrylic resin with UV absorber coating systems were implemented on polyvinyl chloride based flat-pressed wood plastic composites.

The effect of water-borne acrylic coating systems application on the performance of polyvinyl chloride based flat-pressed wood plastic composites in outdoor conditions is evaluated in this study. The uncoated (control) and coated (test) wood plastic composites were exposed to artificial weathering test during the 200 hours (ASTM G 53-96). The changes in the colour and surface roughness on the uncoated and coated wood plastic composites were determined after the weathering test. Visual examination of wood plastic composites exposed to accelerated weathering was carried out by light microscopy (LM) to determine the weathering effect.

The result shows that water-based coating systems enhanced the surface quality of wood plastic composites. The colour changes of surface decreased as a result of UV absorb ability of coating systems. LM images show that colour changes increased significantly in consequence of severe weathering conditions. Moreover, surface roughness of wood plastic composites also improved compared to control samples.

Keywords: Weathering Resistant, Wood Plastic Composites, Acrylic Resin, Colour Changes, Surface Roughness

DIMENSIONAL STABILITY OF WOOD BONDED WITH THE PHENOL-FORMALDEHYDE/WASTE TYRE PYROLYTIC OIL BLEND ADHESIVE

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Phenol formaldehyde adhesive, whose price depends heavily on petroleum cost is widely used in the wood industry. A large amount of tyre waste is created every year all over the world. Many studies have been carried out on the re-use of tyre waste in the industrial area. In this study, the dimensional stability of commercial phenol-formaldehyde (Com. PF) adhesive containing different amounts of waste tyre pyrolytic oil was investigated. The com. PF adhesive was gradually substituted by increasing amount of waste tyre pyrolytic oil up to 30 %wt. Afterward, the effects of blend ratio on dimensional stability of bonded-wood were determined. The commercial phenol-formaldehyde resin was evaluated as reference resin in order to compare the dimensional stability of wood bonded with modified PF resin. The test results showed that the swelling values of the samples bonded with the PF adhesives containing up to 15 %wt pyrolytic oil were about the same as that of com. PF adhesive.

Keywords: Waste tyre, Tyre pyrolytic oil, Phenol–formaldehyde, Dimensional stability, Wood

ANTIOXIDANT, ANTIMICROBIAL AND ANTI-QUORUM SENSING ACTIVITIES OF *USNEA FILIPENDULA* AND *VISCUM ALBUM*

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Many plants contain a variety of bioactive components. Therefore, it is important to know the bioactive properties of plant materials in order to be a reference for later researchers. In this study, it was investigated the antioxidant, antimicrobial and anti-quorum sensing activities of Usnea filipendula and Viscum album's methanol extracts. To determine the antioxidant properties of the extracts; total phenolic, flavonoid and condensed tannin contents and ferric reducing antioxidant power analyses were performed. The antibacterial potential of plant extracts was tested by agar well diffusion method against Staphylococcus aureus ATCC 25923, Escherichia coli ATCC 25922, Enterococcus faecalis ATCC 29212, Pseudomonas aeruginosa ATCC 27853, Salmonella Typhimurium ATCC 14028, Klebsiella pneumoniae ATCC 13883, Proteus mirabilis ATCC 7002, Listeria monocytogenes ATCC 43251, Candida parapsilosis ATCC 22019 and Candida albicans ATCC 10231 microorganisms. Anti-quorum sensing activity was investigated on Chromobacterium violaceum ATCC 12472 bacteria. The highest total phenolic and ferric reducing antioxidant power was determined in U. filipendula extract. This extract inhibited the growth of S. aureus, K. pneumonia and L. monocytogenes microorganisms. The highest flavonoid and condensed tannin was observed in V. album extract. This extract was also able to prevent the growth of K. pneumonia and L. monocytogenes. None of the extracts showed anti-quorum sensing activity.

Keywords: Antioxidant, antimicrobial anti-quorum sensing, *Usnea filipendula*, *Viscum album*

APPLICATION OF DES (DEEP EUTECTIC SOLVENT) TO WOOD EXTRACTIVES

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Deep eutectic solvents (DES), known as environmentally friendly, recyclable, nonpoisonous, low volatility, non-flammability and harmless are first found by Abbott et al. in 2003. In the last decade, scientists are working with DES in different areas. Mainly, they focus on isolation of cellulose and lignin. Regard to extractives, to the best of our knowledge DES was not studied before. In this study, it was aimed to determine the extractive composition of Scotch pine with deep eutectic solvents.

Pinus sylvestris L. was used as wood material. As deep eutectic solvent (DES) Choline chloride (Merck 5.00117), ethylene glycol (Merck 1.00949) and urea (Merck 1.08487) were used with molar ratio of choline chloride; ethylene glycol (1:2 m/m), and choline chloride: urea (1:2 m/m). Sequential soxhelet extraction was performed first with n-hexane and then acetone-water with 5 g wood sample for 6 hours. With DES two extractions were performed in an ultrasonic (UB) and hot-water bath (HWB) at 60°C for 30 min. 0.05 g wood samples were used for these extractions. Identification and quantification were done with Shimadzu GCMS-QP2010 GC-MS and Shimadzu GC 2010 FID-GC.

Similar results were obtained with DES and organic solvents. Fatty acids, resin acids and stilbenes are the main chemical groups. Oleic acid (1.4-9%), linoleic acid (1.6-8%) and levopimaric acid (0.6-17.7%) are dominant compounds, found in all extracts. Also, monomethyl pinosylvin (51.5%) was found in acetone:water mixture. DES can be an alternative to organic solvents in wood extraction.

Keywords: Deep Eutectic Solvents (DES), Extractives, Scots pine

THE REHABILITATION POSSIBLE OF CHAIR FRAMES MADE FROM SYCAMORE (PLATANUS ORIENTALIS), PINE (PINUS ELDARICA) AND POPLAR (POPULUS NIGRA) USING GLASS FIBER-REINFORCED POLYMERS

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Two elements of furniture frames are usually separate at glue line. The stress of front to back loading are concentrated in this part of furniture frame. Failure location for chair under front to back load occurred at the joint between the back post and side rail, and it less located at the joint between the front post and side rail. The aim of this research was to rehabilitate a chair that broken by force from front to back. To achieve this goal, the separated joints can be reinforced with Glass fiber-reinforced polymers. In this study, six different types of chairs were used. For each treatment, the test was repeated three times. Chairs are custom type that made from species wood of sycamore (Platanus orientalis), pine (Pinus eldarica) and poplar (Populus nigra). Front to back load tests were conducted by mechanical universal testing machine in accordance with DIN EN 1729-2 standard. After the loading test, destroyed chairs were reformed with Glass fiber-reinforced polymers, and then again, front to back load applied. Front to back loads of control samples are compared to resulted loads of reformed chairs. The results of the experiment showed that differences between the control samples and reformed chairs were not significant. The first type chairs were broken at the load about 1010 N, but the reformed type chairs at about 841 N. The chairs strength of made from species wood of sycamore (Platanus orientalis), pine (Pinus eldarica) and poplar (Populus nigra) against applied loads are 1172, 911 and 693 N, respectively. Wooden chairs made of sycamore have a super performance when compared to other samples.

Keywords: Wooden chairs, the maximum front to back load, Chair rehabilitation

DETERMINATION OF BONDING STRENGTH AND COMBUSTION CHARACTERISTICS OF LAMINATED WOOD MATERIAL REINFORCED WITH CARBON FIBER (CFRP)

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In this study, it is aimed to determine bonding strength and combustion characteristics of structural laminated wood material reinforced with carbon fiber (CFRP). Laminated sheets were obtained using moisture curing polyurethane and two component epoxy adhesives prepared from Oriental beech (Fagus orientalis L.) wood samples. In this study, while bonding strength test was made according to BS EN 204 and BS EN 205 standards, combustion test was applied according to ASTM E-69 standard.

As a result of bonding tests, the highest bonding strength value (22.77 N/mm^2) was obtained in laminated sheets bonded with epoxy adhesive and reinforced with carbon fiber (CFRP). In combustion test, while the highest weight loss (31.38%) was found in experimental samples bonded with polyurethane adhesive, the highest temperature value (551.23 °C) was obtained in laminated sheets bonded with epoxy adhesive and reinforced with carbon fiber.

Keywords: Laminated wood material, bonding strength, combustion characteristics, carbon fiber (CFRP), adhesives.

INVESTIGATIONS ON WOOD DESTROYING MARINE BORERS IN THE TURKISH COASTAL WATERS

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Wood is used in the marine environment for several purposes such as groynes, wharves, jetties, dolphins, and navigational posts. It is also important material in the boat construction in many countries due to the wide availability, ease of fabrication, repair and maintenance, strength and elasticity properties. In the marine environment, wood is susceptible to attack and deterioration by marine wood-borers. Temperature and salinity of the seawater influence the distribution of wood-boring organisms. Most studies on wood durability in the marine environment involved in using of tropical timbers as well as wood preservatives or modified wood in different test sites in the world. Although Turkey is surrounded on three sides by the sea, less attention has been given to the marine borers and protection of wood in the marine conditions. The existence of Teredo navalis (shipworm) in the deep waters of Marmara was reported by early investigations. T. navalis was also found to be dominant species in the Western part of the Black Sea, heavily destroyed the Scots pine samples in one year. Investigations revealed that CCA and creosote shoved resistance to marine borers while the performance of copper azole was promising in the Black Sea. From the tropical wood species, wenge, douka, azobe and paduk showed great resistance to marine borers in the Turkish coastlines. Test sites in Trabzon, Ereğli and İskenderun exhibited the highest boring activity in comparison to the other test locations. *Bankia carinata, Nototeredo norvagica, Teredo navalis, Lyrodus pedicellatus* and *Limnoria tripunctata* were found in the wood samples in the Southern coasts of the Turkey. *Teredothyra dominicensis* was identified as an invasive species in the coast of Kaş in Antalya. DNA barcoding study proved that there was no difference in the barcodes of *N. norvagica* collected from the Atlantic and the Mediterranean Sea.

Keywords: Marine wood-borers, Teredinids, Limnoriids, Turkish costal waters

EFFECTS OF PULP STORAGE CONDITIONS ON DEINKED PULP OPTICAL PROPERTIES

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In this study, it is aimed to investigate the effect of storage conditions of deinked pulp on paper optical properties. For this purpose, printed office paper was re-pulped and deinked based on INDEGE Method 11. Printed paper samples were placed into warming cabinets for accelerated ageing at 60 ±3 °C for 72 hours. This accelerated ageing conditions correspond to 3-6 months of natural ageing. After ageing process paper samples were cut into 2x2 cm pieces and 100 g oven-dry paper were weighed for re-pulping processes. This process was followed by re-pulping the printed office papers using sodium hydroxide (NaOH), Hydrogen peroxide (H_2O_2) and sodium silicate (Na_2SiO_3). The re-pulped waste paper was deinked using Degussa flotation device. Deinked pulp samples with 30-35% consistency were stored at different temperatures (+23°C, +4°C and -18°C) and optical properties of pulp were measured at 1st, 2nd, 5th, 10th, 15th and 25th days. The best stored condition for the deinked pulp found to be -18 °C with 30-35% consistency placed in a closed PE bag.

Keywords: Brightness, flotation deinking, deinked pulp storage, optical properties, waste paper.

EXAMINATION OF WORKING CAPITAL DETERMINANTS OF COMPANIES OPERATING IN FOREST PRODUCTS, FURNITURE, PAPER-PAPER PRODUCTS AND PRINTING AND PUBLISHING SECTORS

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Working capital is of great importance to companies for the following reasons. These: (1) to start production, (2) to continue their activities, (3) to not fall into a difficult situation financially, (4) to meet their obligations on time.

In this study, it was aimed to determine the factors affecting the working capitals of companies operating in the forest products, furniture, paper-paper products and printing and publishing sectors traded on Istanbul Stock Exchange (BIST). 12 different ratios and values of 18 companies with the help of the 2016 data were used for analysis. As a result of using multiple regression and correlation methods, factors affecting the working capital have been determined.

Keywords: Working Capital, BIST, Forest Products-Furniture-Paper- Paper Products-Printing and Publishing Sectors

TREATMENT OF WASTE WATER FROM FLOTATION DEINKING PROCESS WITH ACTIVETED CHARCOAL

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In this research, the waste water containing dissolved and suspended solids, obtained from the printed office paper deinking process using flotation method was treated with activeted charcoal obtained from lignocellulosic biomass in order to investigate the effect of activeted charcoal treatment on the optical and chemical properties of the waste water. The office papers were printed at liquid based office printer and subjected to accelerated ageing in accordance with the International Association of the Deinking Industry (INDEGE 11) method. This process was followed by re-pulping the printed office papers using sodium hydroxide (NaOH), Hydrogen peroxide (H_2O_2) and sodium silicate (Na_2SiO_3). The re-pulped waste paper was deinked using Degussa flotation device. The obtained (10 L) waste water were treated with the activeted charcol for the purpose of waste water clarification. Finally, the untreated and activeted charcoal treated waste water optical and chemical properties were investigated.

As a result, the untreated waste water and the treated waste water optical and chemical properties were determined and compared to investigate the clarification effectiveness of activeted charcoal.

Keywords: Activeted charcoal, dissolved solid, flotation deinking, suspended solids, waste water treatment

A STUDY ON THE PLANNING AND TARGETING APPLICATIONS IN FOREST PRODUCTS INDUSTRY ENTERPRISES (CASE OF ISTANBUL PROVINCE)

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Planning and targeting is the first step in the management function in enterprise. The success of management activities in every enterprise goes through effective planning and targeting. Top executives in an enterprise can have more time for planning and targeting than other functions. The junior administrative officer can have more time for other management functions. Priorities should be defined when determining processes in an enterprise. The first step in planning and targeting is to determine where you want to be reached. Also, the procurement and selection of all kinds of sources that will achieve these targets are included in planning and targeting.

In this study, it was tried to determine how much the managers in the management stages of different forest industry industries operating in İstanbul had an important role in achieving the success of the enterprise in terms of planning and targeting function. In the study, a scale consisting of 31 statements was set up for the planning and targeting to the employees in the enterprises. The number of surveys evaluated was 271. The results obtained from managers and other employees in different forest products sectors have been tested in SPSS statistical program with some other factors and the results are presented in detail.

Keywords: Planning, Targeting, Forest Products Industry

EVALUATION OF MANAGERS IN FOREST PRODUCTS INDUSTRY ENTERPRISES ACCORDING TO THREE FEATURES AND MANAGERIAL SKILLS APPROACHES

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Today, social and economic developments are very fast and this is closely related to all businesses. Regarding of this rapid change and development, businesses need to give more importance to the concepts of management and administratorship. In terms of the growth and development of the businesses, how and to what extent the people who work in the management part of the enterprises have the managerial characteristics and how subordinates perceive their managers are very important.

How the properties that should be found in upper management of the forest products industry enterprises operating in Istanbul province were perceived by the employees at the subordinate level were tried to be revealed with three features and managerial skills approach. Face-to-face survey method was used in the study. The survey is composed of three parts. The numbers of persons surveyed were 271. The questions prepared according to the Likert scale were analysed in the SPSS statistical program and the results were given in detail.

Keywords: Manager, Managerial skills, Forest Industry Engineering

THE CHANGES IN THE THICKNESS SWELLING OF THE PARTICLEBOARD RELATED TO THE BOARD DENSITY AND ADHESIVE TYPE

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In this study, changes in the physical property (thickness swelling for 2 h. and 24 h. immersion in the water) of particleboard were investigated related to the panel density and adhesive type. Particleboard samples produced with phenol formaldehyde adhesive showed better thickness swelling than those of the panels blended with urea formaldehyde adhesive. The thickness swelling values of the panels at 0.750 g/cm^3 density blended with urea formaldehyde were found lower than those of the panels at 0.650 g/cm^3 for 2 h. immersion. However, the panels at 0.750 gr/cm^3 density blended with urea formaldehyde showed higher thickness swelling values than those of the panels at 0.650 g/cm^3 density for 24 h. immersion. On the other hand, the panels blended with phenol formaldehyde adhesive at 0.750 g/cm^3 density had lower thickness swelling values than those of the panels at 0.650 g/cm^3 density for both 2h. and 24 h. immersion.

Keywords: Particleboard, thickness swelling, density, urea formaldehyde, phenol formaldehyde

ESTIMATION OF WOOD BIOMASS FOR ANATOLIAN PINE STANDS (A CASE STUDY IN AKÇAY REGION)

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Wood is an indispensable raw material in human life because of its superior properties. Rapidly developing industry and technology together with the growing population, it causes an increase in the demand for wood raw material. As a result, the need for natural resources and energy is increasing day by day. In addition to destroying forest areas for people's needs, global warming and various environmental damage cause the need for protection of forest areas, as a result restrictions on the production of wood raw materials. These restriction are an obstacle to the forest products industry, which supplies raw materials from forest areas. Therefore, it is necessary to consciously use the obtained wood raw materials and rationally evaluate the used raw materials.

In this study, Anatolian Black Pine is selected which having the widest distribution area after oak and brutian pine and one of the most economically important species in Turkey. What's demand for raw materials of Anatolian Black Pine forest products industry has been put forward and tried to determine the wood biomass. For this purposes Akçay Planning unit was selected for study area.

Keywords: Wood biomass, Wood raw materials, Anatolian black pine

THE EFFECTS OF NANO-TIO_2 AND NANO-BORON ON THE THERMAL PROPERTIES OF WOOD PLASTIC COMPOSITES

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Wood polymer composites are preferred due to their different properties in many fields. The ability to modify properties during production is one of the most important properties of wood polymer composites. Like all materials, wood polymer composites have also negative aspects. These properties can be improved with different support materials during production. In this study, wood plastic composites which are composed of cellulose fiber (CF) and polypropylene (PP) were supported with nano sized boron (NB) and titanium dioxide (TiO_2) during production. Thermal properties of produced wood plastic composites (TGA, DTA, DTG) have determined.

It was determined that T10% and T50% values of composites obtained after addition of cellulose fibers at 10% and 20% of pure polypropylene were lower than those of pure polypropylene, whereas T90% and residue amounts were increased after cellulose addition. After the addition of Boron and Titanium, thermal properties were generally found to be lower than that of pure polypropylene. When the DTA curves were taken, it was determined that the Tm values varied between 155.6 and 167.5 ° C and the Td values were between 446.5 °C and 449.4 °C.

Keywords: Thermal characterization, Nano-boron, Nano -TiO_2, Wood Polymer Composites (WPC)

REMEDIATION OF Cu-TREATED WOOD BY RAW BORON MINERALS IN COMPARISON WITH COMMERCIAL BORON COMPOUND, BORAX

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Copper based wood preservatives have been widely used all over the world for a long time especially for exterior applications because of their superior performance against fungal decay and weathering. Due to extensive use of copper-treated wood, in recent years the removal and disposing of large quantity of treated wood pose lot of environmental problems due to presence of toxic elements in the waste. As a result, considerable attention has focused from last one decade on developing new methods for effective and economical remediation of preservative-treated waste wood. Due to many social and economic factors, copper prices have soared in the past decade. While many products that use Cu are 100% recyclable, copper used as the primary active in today's wood preservatives cannot be recycled. Rather than disposal of Cu in landfills along with the wood, copper recovery and reuse would be an economical way to keep the costs of preservative-treatment down while benefiting the environment by diverting Cu from becoming permanently entombed in landfills. Boron compounds have been put to various productive uses like soap and detergents and as actives for removing metals due to their oxidizing properties. In the study, two boron minerals, namely colemanite and ulexite, have been tested due to relatively less toxicity and they can be used without a pesticide applicator license, economically cheaper than other organic and inorganic acids, which are used for metal extraction from treated wood. Along with the minerals, borax (sodium tetraborate) solutions for remediation of copper-treated wood in varying durations were also tested for comparisons. Wood strips treated Tanalith-E (2.4%) solution were subjected to remediation processes by those boron-containing aqueous mediums (concentrations of 1%, 2.5% and 5% based on %BAE) in room temperature. ICP analyses were done to determine Cu removal rates from treated wood. According to ICP test results, colemanite and ulexite minerals are not as effective as borax in the remediation of copper from Tanalith-E treated wood. In all remediation scenarios, borax removed max. 71%; ulexite and colemanite removed max. 50% and distilled water removed max. 45% of Cu from Tanalith-E treated wood

Keywords: Cu, remediation, treated wood, boron minerals

GAMMA IRRADIATION OF WOOD INCORPORATED WITH ORTHOPHTALITIC UNSATURATED POLYESTER RESIN WITH STYRENE: PHYSICAL AND BIOLOGICAL PROPERTIES

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The irradiation of wood incorporated with liquid monomers, using high-energy radiation such as gamma (γ) rays from a 60Co source is one of the new developments in wood protection, consolidation and restoration areas. The various properties of wood can be thus modified by polymerizing several impregnated monomers with γ-radiation. In the study, improvements in physical properties and biological performance against decay and mold fungi of wood by radiation-induced in situ copolymerization of three types of low viscosity-unsaturated polyester resin with styrene were studied. Radiation polymerization of orthophtalitic unsaturated polyester resins with styrene in a viscous system was performed at ambient temperature by using γ-rays. Water absorption and dimensional stability of the modified wood specimens were determined after modifications. Chemically-modified and γ-irradiated-wood specimens were then subjected to laboratory decay and mold resistance tests. Results after 24-immersion of modified wood specimens in water showed that more than 70% of water repellent effectiveness was obtained in the wood specimens after modifications with the three formulations of tested chemical mixtures; however, the highest anti-swell efficiency values (nearly 66%) were seen in the specimens treated with the only one type of treating mixtures (48% styrene + 52% UP resin T3). Mold resistance tests showed that the treating mixtures tested were not completely inhibited mold growth on the specimens' surfaces; however, some improvements in regard with decreasing mold scores were seen in comparison with control wood specimens. Decay resistance tests revealed that after modifications, the specimens showed increased resistance against the fungi tested.

Keywords: Irradiation, polymerization, unsaturated polyester, styrene, wood, decay, termite, modification

PREPARATION AND CHARACTERIZATION OF ACTIVATED CARBON FROM DIFFERENT WOOD TYPES GROWING IN IRAQ

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Lignocellulose materials are considered as suitable raw materials to production low cost adsorbents. In this work, activated carbon was prepared from wood branches for several types of tree (*Calistemon viminalis, Thuja orentalism, Cupressus sempervirens, Pinus brutia* and *Bauhinia variegata*) which are usually left in the forest land after being separated from timbers or through pruning process. Chemical carbonization at 500˚C for 1.30 hr. was used to prepare carbon, KOH solution for 24 hr. was used to activated the carbons. The results indicated that characteristics (Soild yield, burn off, density, moisture content, ash content, pore volume, porosity percent, Iodine number and removal percent of methyl blue) for all activated carbon were compared with commercial activated carbon. The result showed that activated carbon for all wood types using KOH solution has good adsorption properties (removal blue dyes % and iodine number mg/g). This low cost activated carbons can be used for waste water treatment.

Keywords: Activated carbon, wood type, chemical activation, adsorbents.

COMBINED NON-DESTRUCTIVE TEST METHODS FOR PREDICTING FLEXURAL PROPERTIES OF TURKISH BLACK PINE (*Pinus nigra var. pallasiana* Arnold.) STRUCTURAL LUMBERS

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Aim of this paper is evaluating stress wave and screw withdrawal resistance as non-destructive test (NDT) methods to predict density and flexural properties such as static elasticity of modulus (MOEs) and static modulus of rupture (MOR) of Turkish Black Pine structural lumbers (Pinus nigra var. pallasiana Arnold) for using the methods in-situ estimation in wooden buildings. In this study, commercially preferred fifty-three structural lumbers were used. NDT methods were performed with using related devices from Fakopp co. and MOEs and MOR of the lumbers were determined in structural size in accordance with EN 408. In order to analyse the obtained data, the relationships between the following parameters were examined; (1) screw withdrawal force vs. density, MOEs and MOR, (2) stress wave measurements vs. density, MOEs and MOR, (3) combined values of screw withdrawal force and stress wave velocity vs. MOEs and MOR.

Results showed that the best compliance for withdrawal force were found with density (R=0,7414), while correlations with MOR and MOEs were found lower (R=0,6256 and R=0,5288, respectively). The best compliance for stress wave velocity were found with MOEs (R=0,6804), while correlations with MOR and density were found lower (R=0,3148 and R=0,4158, respectively). On the other hand, combination of NDT methods gave higher correlations with destructive values (MOR (R=0,679) and MOEs (R=0,772)). In the light of the results, it is suggested that NDT methods as acoustic based, hardness devices etc. can be combined with together for better correlations.

Keywords: Non-destructive test methods, Stress wave, Screw withdrawal resistance, Turkish black pine, Structural lumber.

ASSESSMENT OF THE PROCESSING ROUGHNESS OF BLACK ALDER SURFACES

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The objective of the study was to compare the surface quality of the processed samples made of black alder (Alnus glutinosa L.) wood when using two milling cutters endowed with different cutting plates. Defect free samples provided by a local company were used. They were processed by longitudinal milling under laboratory conditions when applying various cutting schedules. The surface quality of the resulted samples was expressed by the most relevant processing roughness parameters. The roughness of the specimens was measured with the help of a specific profilometer device of FRT type with white light.

The results of this study showed that the two milling cutters generated smooth surfaces with no or low fuzzy grain and such quality of the processed surfaces can be obtained when using low feed speeds and light cutting depths. Findings of this work could help to use more efficiently the wood of black alder in the furniture sector.

Keywords: black alder, cutting schedule, milling, roughness

MOISTURE CONTENT CHANGES AND SWELLING OF PLYWOOD PANELS COMPOSED OF THERMALLY TREATED AND NO TREATED POPLAR ROTARY CUTTED VENEERS IN LONG TERM OUTDOOR EXPOSITION

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Pre-cut specimens of thirteen different types of five layers, 15mm thick plywoods, have been exposed outdoor during one year period of time, protected from direct sun and rain exposure. Plywoods have been composed of no treated veneers and veneers treated at temperatures of 190 °C, 200 °C, 210 °C, 215 °C, during the one hour in protective steam environment, under computer controlled laboratory process, and hot-pressed with MUF adhesive, in industrial circumstances.

The moisture content changes (MC) and swelling have been measured every day in first week, and every first day of remaining 52 weeks. Relative air humidity and air temperature have been recorded simultaneously. The amplitude of air relative humidity changes, MC and swelling changes have been recorded. During the first week of exposure changing patterns were different compared to changing patterns during the rest of one year period of time. The highest amplitude showed the control group composed of only no treated veneers and the smallest amplitude showed the group composed of veneers treated at highest temperature of 215 °C. Amplitudes of all other groups were between them. Both the moisture content changes (MC) and swelling changes, with some irregular delay, followed the changes of air relative humidity, showing the efficiency of thermal pre-treatment and plywood composition, regarding resistance to micro climatic changes.

Keywords: Plywood, Thermally treated veneer, MUF adhesive, MC, Swelling, Outdoor exposition

ALKALINE SULFITE ANTHRAQUINONE (AS-AQ) AND MONOETHANOLAMINE (MEA) PROCESSES; A PROGRESS IN NON-WOODY PLANTS PULPING

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Non-woody plant pulping is gaining more and more importance, particularly in countries with deficient wood resources. For non-woody plant pulping mostly soda and soda/AQ pulping have been employed. The alkaline sulfite anthraquinone (AS-AQ) and monoethanolamine (MEA) processes may be realistic alternatives to soda pulping. In particular the higher yields and delignification selectivity especially in the case of monoethanilamine process and superior unbleached brightness of AS-AQ pulps along with significantly higher pulp strengths of AS-AQ pulps are main benefits of these processes compared to soda pulping. These advantages could be open an optimistic window in non-woody plants pulping technology. Furthermore, according to the efforts which were done in order to implementation of gasification technology in kraft mills in contexts of realization of biorefinery concepts, the main drawback for using of the AS-AQ process in industry scale namely chemical recovery has been overcome. Monoethanolamine process with simple recovery of monoethanolamine as an organic solvent by distillation is a good solution for a lack of chemical recovery in non-woody plant based pulp mills due to high silica content of these raw materials. In this paper, the different aspects of AS-AQ and MEA processes and their pulps properties as an alternative for soda pulping will be discussed.

Keywords: Non-woody plants, pulping, Soda process, Alkaline-Sulfite Anthraquinone, Monoethanolamine

THE POTENTIAL OF DIFFERENT PULPING PROCESSES IN PRODUCTION OF PULP-PLASTIC COMPOSITES (PPC) FROM BAGASSE AND RICE STRAW

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Natural fibres are renewable, biodegradable, low-cost, low-density raw materials with high stiffness and strength compared to the other conventional products such as glass, aramid and carbon. There are a large variety of natural fibers such as rice straw, rice husk, wheat straw, corn stalks, palm, bagasse, hemp, flax and other agricultural residues. Natural fibers contain various organic materials (mainly celluloses as well as hemicelluloses and lignin) and there are several chemical treatments such as bleaching, esterification, silane treatment, use of compatibilizer, acetylation, alkali treatment and treatment with other chemicals in order to enhance the fiber matrix adhesion, which improve the physical and mechanical properties of composites.

This study investigates different pulping processes as a novel chemical treatment on bagasse and rice straw fibers and consequently, properties of biocomposites. By pulping processes, the treated natural fibers as a biofiller could be used to produce the new classes of bio composites defined as pulp- plastic composites (PPCs). Different pulping processes which are categorized in mechanical, semi-chemical and chemical methods led to natural fibers with different anatomical and chemical properties such as surface modification and delignification in comparison with untreated fibers. Furthermore, the comparison of natural fibers treated by chemical and mechanical pulping processes and effects of these treatments on physical and mechanical properties of natural fibers are worth considering.

Therefore in this paper, High-density polyethylene (HDPE), bagasse and rice straw fibers treated by four pulping processes (AS-AQ (alkaline sulfite anthraquinone), SODA-AQ (soda anthraquinone), MEA (monoethanolamine) and chemical mechanical pulping (CMP)) and maleic anhydride polyethylene as coupling agent were used to produce pulp plastic composites (PPCs) by injection molding. The physical and mechanical properties of corresponding composites were evaluated according to ASTM standards. The results showed that compared to untreated bagasse and rice straw/HDPE composite, the addition of bagasse and rice straw pulp fibers increased significantly the mechanical properties such as tensile strength and modulus, flexural strength and modulus, and hardness. The chemical pulps-reinforced composites showed better mechanical strengths than that of CMP-reinforced composites, but in some properties, CMP pulp composites have comparable results to the chemical pulp-reinforced composites. Natural fibers (untreated and treated) increased water absorption and thickness swelling of composites compared to pure HDPE. The comparison of PPCs from bagasse and rice straw untreated and treated fibers will be also presented and discussed.

Keywords: Biocomposite, pulp, Natural fibre, Bagasse, Rice straw

DEVELOPMENT OF A NEW WOOD PRESERVATIVE

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Structural wood is an ideal medium for a wide variety of applications, however when wood is used in weathering or moisture situations it needs to be protected. Decay and insect attack will weaken the structural properties of the wood. Wood destroying fungi consumes moist wood and will assuredly lead to structural failure. Treating wood to extend its useful life has been done for millennia using a variety of wood treatments. In recent times traditional wood preservatives like Creosote, Pentachlorophenol (PCP) and Chromated Copper Arsenate (CCA) have been used successfully, however environmental and health concerns have raised serious and valid concerns regarding their use. The withdrawal of CCA for domestic applications (decks, playground, etc.) and Creosote, except for use on rail ties in North America, has stimulated many research projects to find alternative wood preservatives that perform better, are less toxic and minimize health and safety concerns. The wide use of copper is still very popular but cooper in its current practice is still toxic for marine organisms. Additionally, these copper based products are more costly compared to traditional wood preservative.

Boric acid wood preservative formulations are excellent alternatives as they are much less toxic and very effective for the control of decay fungi. However, borate has been restricted to interior applications because boric acid has the propensity to leach quickly when exposed to ground contact and outdoor weathering conditions.

Genics and IREQ have been working hard in collaboration to developed a new boric acid based wood preservative that is more completely fixed inside the wood while still allowing for controlled dispersion. We have achieved this by formulating boric acid with a polymer. This formulation inhibits the leaching of the borate while still allowing for fungal control. In the laboratory, leaching as well as soil block tests have proved that this new wood preservative is as effective as CCA and other copper based wood preservatives. We are currently conducting ageing tests, in real outside conditions. These are ongoing at our research facility in Hilo Hawaii. Hilo is known as a high degradation index (Schaffer) ideally suited for the testing of new wood preservative formulas. We are very encouraged. Results to date have shown that the new wood preservative is behaving as effective as CCA after 1 year in test.

Keywords: wood preservative, boric acid, polymer

THE IMPACT OF WOOD VENEER SPECIES ON ITS ADHESION STRENGTH ON SURFACE OF MEDIUM DENSITY FIBREBOARD

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This paper presents results of analysis of the adhesion strength of veneers of selected hardwood species: beech (*Fagus sylvatica*), oak (*Querqus robur*) and walnut (*Juglans nigra*) glued on the surface of medium density fibreboard (MDF). In addition, the impact of MDF preparation by surface sanding before veneering on the adhesion strength of veneer applied on MDF was evaluated. The statistical analysis (two-way ANOVA) revealed that the veneer species had significant impact on the veneer`s adhesion strength on the surface of the MDF. On the other hand, the sanding of the surface of MDF prior to veneering had no effect on the adhesion strength of none of the selected veneer species. The highest adhesion strength was obtained for beech veneered samples (2.40 MPa), followed by walnut veneered samples (2.32 MPa), while the lowest value was observed for oak veneered samples (2.21 MPa). However, the difference in the veneer adhesion strength on the surface of the MDF was statistically significant only for beech veneered samples compared to oak veneered samples.

Keywords: Wood veneer species, MDF, Adhesion strength, Sanding

DETERMINATION OF THE SIGNIFICANCE OF THE PAPER AND PAPER PRODUCTS SECTOR IN TURKISH ECONOMY WITH INPUT-OUTPUT ANALYSIS

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Integration and interaction among sectors are crucial for a national economy. The determination of sector or sectors which highly impact on economy is necessary in terms of planning economic growth and development policies. Input-output analysis is the method used predominantly for determining the sector and sectors which will dominate national economy and the relations between the sectors. The objective of the present study is to identify the relationships of paper and paper products industry, which is one of the sectors among the 64 industries in Turkish economy, with manufacturing, value added, exports, imports and other industries, and the study also aims to reveal the effects of this industry on manufacturing, revenues and employment in the national economy. In other words, the determination of the paper and paper products sector importance in the national economy is aimed. In addition to this research, the place of paper and paper products industry in the national economy and its change will be revealed by using input-output tables published by Turkish Statistical Institute (TSI) in 2008 and 2016. Moreover, the data was obtained from current Inter-Industry Transactions Matrix, Input-Output Coefficients Matrix and Technological Coefficients Inverse Matrix published by TSI in 2008 and 2016 and prepared for 2002 and 2012.

Keywords: Sector Economy, Paper and Paper Products Sector, Input-Output Analysis

CHEMICAL COMPOSITION OF WOOD AND BARK OF TAXUS BACCATA L.

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In addition to industrial and fuel wood production from forests, non-wood forest products are also produced. This is getting more and more important day by day. Our country has rich resources in terms of non-wood forest products. These resources, which are so valuable, will be benefited enought ocontribute to the economy of the country. It is known that some extracts obtained from Taxus baccata L. (Turkish Yew) which is naturally distributed in our country especially in the Black Sea Region have antitumor properties for some types of cancer. In this regard, Taxus baccata L. has a great proposition to illuminate the chemical structure of the heartwood, sapwood and bark and to determine the extractive amount. It is thought that the findings obtained will form a basis for the work to be done in this regard.

In this study, the chemical composition of hearth wood, sap wood and bark of Taxus baccata L. taken from the Amasra Series of Arıt, Espiye Series of Ekindere and Pazar Series of Pazar was determined by standard methods. According to the results obtained, average values of chemical compositions are calculated as follow: Holocellulose content; 57.88% in hearth wood, 67.40% in sap wood, 52.19% in bark, lignin content; 27.67% in hearth wood, 30.45% in sap wood, 25.97% in bark, cellulose content; 45.38% in hearth wood, 52.78% in sap wood, 28.50% in bark, α-cellulose content; 36.89% in hearth wood, 43.31% in sap wood. Besides these chemical contents obtained, some solubility characteristics were investigated. According to the results obtained, the solubility characteristics are as follows: Solubility in hot water content; 12.69% in hearth wood, 2.86% in sap wood, 27.41% in bark, solubility in cold water content; 8.34% in hearth wood, 1.83% in sap wood, 23.43% in bark, solubility in 1% NaOH content; 22.21% in hearth wood, 11.02% in sap wood, 49.24% in bark, solubility in alcohol- benzene content; 15.30% in hearth wood, 2.59% in sap wood, 22.38% in bark.

Keywords: Taxus baccata L., Wood Constituents, Bark Constituents, Extractives

ANALYTICAL APPROACH TO SITTING FURNITURE DESIGN AND AN EXPERIMENTAL APPLICATION

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In this study, the internal forces distributed to the frame members were analyzed by loading the working load on a supporting side frame of a bench in accordance with TS EN 1728 standard. Elements and joints of the required dimensions to accommodate the maximum forces distributed to the elements of the carrier frame have been determined. In the dimensions suitable for this analytical calculation, 10 experimental specimens (total 20) were produced from yellow pine (*Pinus silvestris* L.) and eastern beech (*Fagus orientalis* L.) wood. The performance of the chair specimens from both materials was determined by applying diagonal force to the test specimens representing the static load of seat and backrest according to TS EN 1729-2 standard.

As a result, it was determined that the highest performance was achieved on the side of the prototype chair designed and developed from the eastern beech wood, and the yellow pine chair was in the second place. Performance in the eastern beech chair; An average of 2380 N, and a yellow pine chair, 2140 N, respectively. These forces correspond to 4760 N and 4280 N in a full seat and it is determined that the average load of the boat is 800 N and 5.75 and 5.35 times, respectively

Key words: Wooden chair, design, performance, stress analysis, prototype.

DETERMINATION OF THE EFFECT ON THE COLOR HOMOGENEITY OF THE USE OF NATURAL DYE STUFF IN PAPER OBTAINED FROM RECYCLED PAPER BY ACCELERATED WHEATHERING

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In the event of reusing the waste paper, which was exposed various contaminants according to its place of use, the stain on it breaks the colour homogeneity. In this study, it was aimed to obtain the colour homogeneity of waste paper with the dyestuff obtained from the wild cranberry (Cornus australis L.). In the study, waste paper groups were formed as mixtures (MP) in the same proportions from offset printed magazine (OPM), newsprint (NP), copy paper (CP), unbleached paper (UP), corrugated cardboard (CB) and paper. In order to investigate the effect of dyestuff, the waste paper groups were produced under groups including the control paper without any additives (I), paper mixed with dyestuff (II) and paper with dyestuff and alum (III). The same conditions were repeated with the imported bleached paper (BP) with the purpose of controlling the hiding power of the dyestuff. The paper produced was subjected to accelerated weathering test for 5-10-25-50 and 100 hours. Wave intensity of 0.65 W/m2 was chosen as the test condition. At each weathering period, the changes in colour, gloss and opacity values of samples were investigated. According to the results obtained, the highest colour change value was obtained in the sample group I, and the lowest total colour change value was obtained in the sample group III. In Group II, the total colour change was the highest in imported bleached paper. The increase in weathering period did not affect the opacity. During the first 5 hours of weathering, the lowest opacity value was obtained in imported bleached paper. Through weathering method, the maximum decrease in opacity was observed in group II-BP

Keywords: Waste paper, dyestuff, mordant, accelerated weathering

INVESTIGATION OF THE SIGNIFICANCE AND THE LOCATION OF THE FURNITURE SECTOR IN TURKISH ECONOMY

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Input-output analysis is utilized to analytically determine general economic structure of a country and the relationships between each other of all sectors of forming this structure. Furthermore, input-output analysis is used to determine a country or regional economy, or the selected sector that makes up these economies; production, value added, export and import, and revealing the relationship with other sectors and the location of the sector within the country's economy. The objective of the present study is to identify the relationships of the furniture manufacturing sector, which is among the 64 sectors that constitute Turkish economy, with manufacturing, value added, exports, imports and other sectors, to reveal the effects of this sectors on manufacturing, revenues and employment in the national economy, and thus to determine the significance of the furniture manufacturing sector in the national economy. Besides, this work which will reflect the current situation of the furniture manufacturing sector will be compared with situation revealed by the help of Input-Output Table published in 2008 by the Turkish Statistical Institute (TSI) for this sector. The data to be used in the input-output analysis method selected to achieve this aim will be provided the input-output tables, input coefficients matrix and inverse coefficients matrix prepared for the year 2012 and published in 2016 by the TSI.

Keywords: Economy of Turkey, Sector Economy, Furniture Manufacturing Sector, Input-Output Technique

THE IMPACT OF SANDING SYSTEM ON THE SURFACE ROUGHNESS OF MEDIUM DENSITY FIBREBOARD

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This paper examines the impact of the sanding system on automatic sanding machine in real production conditions on the surface roughness of medium density fibreboard (MDF). The surface of samples was egalized by sanding on wide–belt sanding machine using P80 grit sanding belt. Afterwards, the samples were sanded on the 4 aggregate automatic sanding machine at sanding speed of 14 m/s in a two-step process with the following sanding belt grits: P120+P150 and P120+P180, using two conveyor speeds: 8 and 12 m/min. In the first stage of sanding, the samples were sanded by narrow belt aggregate, with sanding direction perpendicular towards the processing direction of sample in sanding machine. The second stage of sanding was conducted on the wide-belt aggregate, with sanding direction parallel towards the processing direction of sample in sanding machine. The surface roughness was measured by the contact-mechanical gauge and expressed by parameters Ra, Rz and Rt. As expected, results confirmed that sanding belt grit in the last stage of sanding had significant effect on the surface roughness of MDF. On the other hand, variation of speed of conveyor did not affect the surface roughness of MDF, for both combinations of sanding belt grits.

Keywords: MDF, Sanding, Surface roughness, Sanding belt grit, Speed of conveyor

CHEMICAL COMPOSITION OF *PINUS BRUTIA* TEN. TURPENTINE

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In this study, volatile composition of *Pinus brutia* Ten. oleoresin collected from Kahramanmaraş was analyzed. Oleoresin tapping was done according to borehole method in 2014 between July -November. Average diameters of trees were between 30-31 cm. In each tree two holes were drilled on the south aspect of stem. Diameter and depth of holes were 35 mm and 10 cm, respectively. Hydro-distillation was applied to obtained turpentine and colophony from oleoresin. Chemical composition of turpentine was elucidated with Shimadzu GCMS-QP2010 GC-MS coupled with TR5-MS column and quantified with Shimadzu GC 2010 FID-GC.

35 compounds were found in the turpentine of *P. brutia* Ten. and 30 were identified. The major compounds were α-pinene and β-pinene. Δ^3-carene and caryophlene were the other important compounds.

Keywords: *Pinus brutia* Ten., Turpentine, Pinene

CAPACITY CALCULATION APPROACH FOR FURNITURE COMPANIES AND APPLICATION OF A PROCESS EFFICIENCY ANALYSIS

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One of the most important decisions affecting the establishment process for a company is production capacity. Basic information such as the size of the enterprise, the establishment area, the qualifications of the machines, the number of the auxiliary facilities, the connections between the worker cells, the flexibility and the automation structure, the supply need, stock, energy and personnel need to be clarified in the process of establishment decision. However, such policies can not be careful enough capacity in the process of organization in fast-growing countries such as Turkey after the new machines are also added as needed to the production line and the line re-balance is composed in a different way. From this point of view, furniture enterprises have a characteristic feature. Flexibility and automation in the furniture factories are two important critical concepts and directly affect production capacity in practice. This study examined the capacity calculation in Turkey approaches and methods applied in the furniture industry, the process on the basis of existing practices, resources and capacity from the level of injury were analyzed. For this purpose, 55 furniture enterprises operating in Istanbul and the existing capacity reports are discussed. The machinery and installation structures, closed areas, number and quality of employees, product structures, installed power and production and consumption capacities of the companies were investigated and it was investigated whether there is a significant relation between these parameters. As a result of the research, it can be seen that there is not enough meaningful relations between the enterprises in terms of field use, installed power and production capacities. In the Turkish furniture companies, process efficiency is 61% for sizing process, % 64 for edge banding process and % 64 for sheathing process.

Keywords: Furniture Companies, Production Capacity, Capacity Calculation, Proses Efficiency

DEVELOPMENT OF FOREIGN TRADE AND PRODUCTION IN FURNITURE HARDWARE SECTOR IN TURKEY

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Nowadays, the birth and spread of modern electro-furniture equipped with technology as a necessity of modern trends and global trends have increased the importance of furniture accessories. In this study, accessories that give functionality and prestige to the furniture and contribute to the quality, aesthetics and beauty at the same time, industrial production and foreign trade as the development of the structural situation in Turkey in this field have been investigated. In this context, the development of the sector present results of the study conducted on furnishing accessories manufacturer in Turkey last 10 years foreign trade (exports-imports) was evaluated in the framework of the data. Material and technological development level of world standards, some product groups have shown that an equivalent structure of Turkey accessory industry; (45.4%) in terms of catching up and implementing the development trends in the world furniture sector and being in a market environment open to unfair competition conditions (35.6%).

As a result, the general problems of the sector study essentially both product groups, identified as undefined as well as industry groups stems from a sector effect in achieving the strategic objectives of Turkey's furniture sector, was also making suggestions for the improvement of international competitiveness of taking accessories industry into consideration.

Keywords: Furniture hardware, Hardware production, Hardware import, Hardware export.

CHEMICAL COMPOSITION AND FIBER MORPHOLOGY OF ALMOND SEEDLING NATURALLY GROWN IN KAHRAMANMARAŞ

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In the recent years there is an increasing attention to find alternative sources to wood processing factories. In this study, the chemical and fiber morphological properties of almond seedling woods were determined. Heartwood, sapwood and bark samples were separately investigated. Also, some derived values (slenderness ratio, flexibility coefficient, rigidity coefficient, mühlsteph ratio and F ratio) were found from the fiber properties (fiber length, fiber diameter, cell wall thickness and lumen diameter).

The results are given in the order of heartwood, softwood and bark; holocellulose 61.63, 63.43 and 54.58%, α-cellulose 36.58, 38.73 and 35.08%, lignin 21.18, 21.07 and 34.94% and at last ash content 0.45, 0.50 and 11.42%. The soluble content of toluene-alcohol-acetone mixture, hot water, cold water and 1% NaOH for heartwood samples were 12.43, 15.31, 9.62 and 27.02% and for sapwood samples 10.92, 11.80, 7.87 and 25.23%. They were 11.19, 20.26, 12.42 and 53.18% for bark specimens.

Fiber length, fiber diameter, lumen diameter and cell wall thickness were found in the order for heartwood 0.92 mm, 14.74 μm, 6.52 μm and 4.87 μm and for sapwood 0.86 mm, 20.42 μm, 7.69 μm and 8.21 μm, respectively.

Keywords: Almond seedling, Chemical composition, Fiber morphology

UTILIZATION OF *TRAPA NATANS*

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In this study, *Trapa natans* nut collected from the costs of Inkumu-Bartin was analyzed according to its lignin content. In the last two years, *T. natans* nut husks were seen in the north-west Anatolia costs. The husks were 3-5 cm wide and sclerosis. Husks were miled in a Wiley-mill. Acid-insoluble lignin content was determined according to TAPPI T222om-02 as 28.31%. TGA and FTIR analysis were done.

FTIR analysis indicated that *Trapa natans* contained cellulose, hemicelluloses and lignin. The peaks at 1506-1510 cm-1 in both samples are characteristic peaks for the lignin components due to C = O and COO- non-symmetric stretching vibrations in the aromatic rings of the lignin structure. 1510 cm^{-s} peak is found in the literature as lignin's fingerprint peak. The peaks at 1230-1270 cm^{-1} band show the vibrations of guayasil ring with CO tension in lignin and hemicelluloses. Around the 900, 1025, 1030 and 1050 cm^{-1} peaks cellulose's O-H, C-H and C-O-C type bonds are seen. When TGA analyzes are examined, approximately 4.5% of the sample is lost from 30 °C to 200 °C. At these intervals, samples generally lose volatile constituents and moisture. From 200 to 271 °C 4.6% of the weight is lost. The decrease in this range may be due to the decomposition of cellulose and hemicelluloses. The DTG curve shows maxima weight-loss occurring at 349 °C. The weight-loss in the range from 271-352 °C is about 50%. Pure lignin sample's TGA and DTG curve results show 10%, 50%, and 70% weight-losses at 233 °C, 489 °C, and 1167 °C respectively. According to these results, dominantly lignin and small quantities of cellulose and hemicelluloses are present in trapa samples. After consumed as food, husks can be utilized in various areas according to its lignin content

Keywords: *Trapa natans*, lignin, water-chestnut.

SOME NATURAL AND EXOTIC PLANT TAXA, WHICH IS USED NON-WOOD FOREST PRODUCTS, IN PARKS OF TRABZON

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Trabzon contains many exotic and natural plant taxa in its green nature. These plant taxa have been used in the parks and gardens in order to ensure for local people benefit from this green nature in daily life. In order to benefit non-wood forest products, priority natural species have been brought to these areas. And also exotic plant taxa have been exploited for aiming direction. 100th Year Park, Trabzon Fatih Park, Trabzon Square Park, Atapark, Ekopark, Olympic Park, Zağnos Valley park were studied and determined the floristic situation of these areas. Generally in these areas have; *Aesculus hippocastanetum, Berberis thunbergii, Betula pendula, Citrus* sp., *Coryllus avellana, Cotoneaster salicifolius, Cotoneaster nummullaria, Crataegus* spp., *Erica arborea, Eriobotrya japonica, Eucalyptus camaldulensis, Eucalyptus globulus, Fraxinus excelsior, Junglas regia, Juniperus communis, Juniperus virginiana, Lauroceracus officinalis, Laurus nobilis, Liriodendron tulipifera, Magnolia grandiflora, Malus floribunda, Morus alba, Nerium oleander, Olea europea, Pinus pinea, Platanus orientalis, Populus tremula, Prunus avium, Prunus cerasifera* "Atropurpurea", *Prunus persica, Pyrus communis, Rosa* spp., *Rosmarinus officinalis, Rhododendron ponticum, Rhus coriaria, Robinia pseudoacacia, Salix babylonica, Taxus baccata, Tilia platyphyllos, Tilia tomentosa* taxa. As a result of the study, it has been recommended that some different natural and exotic plant taxa will be used in these park and gardens.

Keywords: Trabzon, Non-wood, Natural, Exotic, Park.

SOME PLANT TAXA WHICH IS USED ON HANDICRAFTS IN TRABZON REGION

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In Turkish culture, handicrafts are treated as one of the most important cultural elements. Wood materials which is used on handicrafts by local people, not only supply additional income but also used for to meet their own needs in Trabzon. In this study, plants which are used by people dealing with handicrafts in Trabzon region were investigated. Plants that benefit from handicrafts of local people such as woodworking, basket, saddle, door ornament, broom, dyestuffs and so on were identified and usages of these plants have been revealed. As a result of the study, some plants used in handicrafts are *Phyllostachys bissetii, Marsdenia officinalis, Cornus* sp., *Corylus* sp., *Cannabaris sativa, Phragmites australis, Musa cavandishii, Zea mays, Juglans regia, Buxus sempervirens, Erica arborea, Sambucus nigra, Allium cepa*, moss and cones. The plants, which are used making handicrafts, have been listed that their family, botanical and local names, usage parts and usage purpose. As a result of the study has been seen that using plants are mostly exotic species, for that reason suggestions have been made that the natural species will be used more extensively.

Keywords: Trabzon, handicraft, exotic.

ERGONOMIC INVESTIGATION OF COMPUTER LABORATORIES OF ÇAY VOCATIONAL AND TECHNICAL HIGH SCHOOL IN TERMS OF STUDENTS

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In this study, physical disorders caused by ergonomic problems arising by increased computer use were examined. For this purpose, this study was carried out in two different computer laboratories in the same school as the students of Information Technology Technologies in Çay Vocational and Technical Anatolian. With the measurement tools, the physical conditions of the laboratories, relative humidity and temperature, noise, desk and chair, monitor, keyboard etc. dimensions have been determined. A healthy computer usage simulation was shown to the students and a questionnaire applied to the students was tried to determine problems arising from the laboratory environment and equipment. As a result, much more complaints emerged than in the literature, and students were found to be uncomfortable with the physical conditions of the laboratories. According to the results obtained, it has been discussed which improvements should be made.

Keywords: Ergonomics, Information Technology, Computer Laboratory, Classrooms Conditions

IMPACT OF IMPREGNATION AND VARNISHING ON COMBUSTION PROPERTIES OF SPRUCE (*PICEA ORIENTALIS* L.) WOOD

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Wood and wood based materials have been used as construction and building material in woodworking industry for years. The ignition or combustion properties of wood are the most important disadvantages for woodworking industry. Many fire retardants solutions were used for to protect wood materials from fire and its destructive effects in recent years. The objective of this paper is to evaluate the effects of varnishing after impregnation process on combustion temperature of spruce (*Picea orientalis* L.) wood. Firstly test samples were impregnated with Imersol aqua (Ia) Timbercare aqua (Ta) Boric acid (Ba), and Borax (Bx) solutions according to ASTM-D 1413-99 and then surfaces were varnished with water-based (Wb), cellulosic (Cv) and polyurethane (Pu) varnishes according to ASTM-D 3023 standard. Combustion temperature of samples was determined according to ASTM-E 160–50 standard. The results showed that the impregnated spruce wood had a lower value than untreated wood. In addition, cellulosic and water-based varnishes showed an increasing effect, while polyurethane varnish has a little decreasing effect on combustion temperatures.

Keywords: Combustion, Impregnation, Varnish, Wood material

COMBUSTION PROPERTIES OF SOME WOODS TREATED WITH VEGETABLE TANNIN EXTRACTS

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In this study, it was investigated the effect of pine bark powder (*Pinus brutia*), valonea (*the extract of Quercus ithaburensis*) and gallnut (*Quercus infectoria* Olivier) extracts on weight loss during combustion properties of Scotch pine (*Pinus sylvestris* L.), European oak (*Quercus Petraea* L.) and Oriental beech (*Fagus orientalis* L.) woods. For this purpose, the solution has been prepared by dissolving tannin 3%, 5% and 7% in distilled water based on the amount of weight. The test samples prepared from wood species were impregnated with these natural solutions according to ASTM D 1413-76. After impregnation process, combustion test was performed according to the ASTM E 160-50 standard. The results showed that test samples treated with aqueous solutions of tannin extract had a negative effect on combustion properties. Generally, the weight loss of impregnated specimens increased. Moreover, weight losses increased with concentration level and the oak samples gave better results than beech and scotch pine.

Keywords: Impregnation, Tannin, Combustion, Wood

THE EFFECTS OF NANOBORON NITRIDE ON THE PHYSICAL PROPERTIES OF PLA AND PHB NANOCOMPOSITES

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The goal of this study is to investigate the effect of nano boron nitride (hBN) on the physical properties of polylactic acid (PLA) and polyhydroxybutyrate (PHB) nanocomposites. PLA and PHB nanocomposites reinforced with cellulose nanofibrils (CNFs) and nanoclays (NC). hBN added to composites with optimum properties and all composites were used to prepare in twin screw extruder. According to results, the highest water absorption values were found pure PLA (1,57) and 1% hBN-NC (1,31) in PLA composites, 2% NFC (2,33) and 10% hBN-NFC (2,26) in PHB composites. The highest thickness swelling values were found 0,5% NFC (5,74) and 10% hBN-NFC (8,94) in PLA composites, 4% NFC (7,81) and 5% hBN-NFC (16,02) in PHB composites. Both PLA and PHB composites reinforced with hBN increased thickness swelling.

Keywords: Polylactic acid, Polyhydroxybutyrate, Nano boron nitride (hBN), Nanocomposites, Water absorption, Thickness swelling.

DETERMINATION OF THE SIGNIFICANCE OF TIMBER, TREE PRODUCTS AND MUSHROOM PRODUCTS (EXCEPT FURNITURE) SECTOR IN TURKISH ECONOMY WITH INPUT-OUTPUT ANALYSIS

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Developing countries are planning their economies to improve their socio-economic structures and to reduce the disparities in development between countries that have provided economic development. Nowadays, it has developed an input-output method that is used by these countries in economic planning to record commodity and services flows in detail. Moreover, this method, which economically reveals the general economic structure of the country and all sectors' relations with each other, is also utilized in resolving economic problems such as production, revenues and employment. The objective of the present study is to identify the relationships of timber, tree products and mushroom products (except furniture) sector, which is one of the sectors among the 64 industries in Turkish economy, with manufacturing, value added, exports, imports and other sectors, and the study also aims to reveal the effects of this sector on manufacturing, revenues and employment in the national economy. In other words, the determination of the timber, tree products and mushroom products (except furniture) sector importance in the national economy is aimed. In addition to this research, the place of timber, tree products and mushroom products (except furniture) sector in the national economy and its change will be revealed by using input-output tables published by Turkish Statistical Institute (TSI) in 2008 and 2016. Moreover, the data was obtained from current Inter-Industry Transactions Matrix, Input-Output Coefficients Matrix and Technological Coefficients Inverse Matrix published by TSI in 2008 and 2016 and prepared for 2002 and 2012

Keywords: Sector Economy, Tree Products and Mushroom Products (except furniture) Sector, Input-Output Analysis

APPLICATION OF ABC ANALYSIS IN A LARGE-SCALE FURNITURE FACTORY

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Nowadays, inventory management and control play an important role in the success of the organizations in the business environment. It is not clearly possible for a large-scale furniture factory that store thousands of inventory items to economically design an inventory management policy for each inventory item separately. Hence, the managers need to classify these items in order to control each inventory category properly based on its importance rating.

The importance of inventory items should be determined in a large-scale furniture factory. Quantities of inventories must be met according to order cost and need, value classification for thousands of inventories must be done. In this study, ABC analysis will be made to classify inventories in a large-scale furniture factory. In a large-scale furniture factory, inventory will be allocated primarily to raw materials, semi-finished products and accessories. Approximately ten thousand inventories will be allocated according to currencies and units of measure. ABC analysis will be applied when there are no currencies and units of measure differences between the inventories.

In materials management, the ABC analysis is an inventory categorization technique. ABC analysis divides an inventory into three categories- "A items" with very tight control and accurate records, "B items" with less tightly controlled and good records, and "C items" with the simplest controls possible and minimal records. After applying the ABC analysis, A, B and C group inventories will show up. It is aimed to use ABC analysis data in system analysis program for Material Requirement Planning (MRP).

Keywords: ABC Analysis, Inventory Control, Furniture, SAP

THE EFFECT OF VERMICULITE USAGE ON SURFACE PROPERTIES OF MEDIUM DENSITY FIBERBOARD

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In this study, the effects of vermiculite of volcanic minerals usage on the surface properties were investigated in medium density fiberboard (MDF) production. The test boards were produced using the dry method with 12% urea formaldehyde resin. Additions of 10%, 15%, 20% and 30% vermiculite were used based on the full dry fiber weight. Surface roughness, color and gloss values of both surfaces of the obtained boards were determined. Based on the results, the ratio of vermiculite increased, roughness values on the surfaces increased. The roughness values in the bottom surface of the produced boards were determined to be higher than the top surface. With the use of 30% vermiculite, the average minimum surface roughness (Ra) was found to be 8.65 µm on the upper surfaces and 15.44 µm on the lower surfaces. It has been found that total color change and brightness are improved by the increase of vermiculite usage and the color change on the bottom surface is found higher. In short, the use of vermiculite in the production of MDF negatively affects the surface roughness and discoloration of the boards, but it has been found to positively affect the gloss.

Keywords: Color, Gloss, MDF, Surface roughness, Vermiculite.

COMBINED APPLICATION OF OCCUPATIONAL HEALTH AND SAFETY RISK ASSESSMENT METHODS AND RISK MANAGEMENT; A CASE STUDY

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The aim of the Occupational Health and Safety studies is to protect employees from work accidents and occupational diseases and to work in a healthier environment. Perhaps the most important demonstration of human resource; It is given importance to Occupational Health and Safety. Risk assessment is a very important step in protecting employees, business continuity and legal compliance. It helps you understand and resolve the real potential hazards in the workplace. The main problem is that by using these methods alone, the scope of all the risks of a process is not possible. However, the legislation says that all risks should be minimized and workers should be protected as much as possible. That is why there is a need for an integrated risk management method that covers all the hazards. In this context, more than one risk assessment method can be used to better identify possible risks and to take preventive measures. In this study, detailed information has been given about Occupational Health and Safety, work accidents and occupational diseases and the ways to prevent them, risk assessment and risk assessment methods. Risks were evaluated by using L Type Matrix Method, Error Tree Analysis Method and Bowl Analysis Method in the operation phase of Kuruoglu Kerestecilik ve Dış Ticaret A.Ş, timber and panel sections and the measures to minimize these risks were discussed in detail. As a result of the study, it has been determined that, within the scope of the risk assessment process, provision of training, preparation of instructions and taking protective measures for risky operating materials and the implementation of these control measures by the enterprise, the risks determined on a high scale can be reduced to medium or low scale risk level.

Keywords: L type Matrix method, Error Tree Analysis Method, Bowl Analysis Method, Risk Analysis.

EFFECT OF PARTICIPATION OF MASS OF MAIZE STALKS ON SOME PHYSICOMECHANICAL INDICATORS OF MEDIUM-DENSITY FIBREBOARDS (MDF)

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Main advantage of the technology for production of fibreboards (FB) are the reduced requirements to the wood and the possibility for inclusion of other non-woody lignocellulosic raw materials in the composition of boards. This is of main significance in view of the world shortage of wood raw material. Such lignocellulosic raw materials are residues (waste) from the agriculture, e.g. maize stalks.

In this paper, an investigation about the effect of participation of mass of maize stalks on some physicomechanical indicators of MDF is presented.

Under laboratory conditions, test boards with participation of mass of maize stalks to the amount of 0% to 100% were produced. The defibration was performed in a laboratory disk crusher defibrator. The main fraction of maize fibres has a length of 1 to 2 mm. The boards were produced with 10% participation of urea-formaldehyde resin (UFR), at a temperature of hot pressing of 185 °C. The set density of the boards is 850 kg/m^3.

The qualitative yield during defibration of maize stalks was determined. Regression models for the effect of content of mass of maize stalks on some physicomechanical indicators of MDF were derived. The permissible share of mass of maize stalks in the MDF composition and at what share of mass of maize stalks most significant deterioration of these indicators is observed were analyzed. On the basis of the results, a recommendation with respect to the maximum content of mass of maize stalks in the MDF composition was derived.

Key words: MDF, non-woody lignocellulosic raw material, maize stalks.

UTILIZATION OF MASS OF INDUSTRIAL HEMP IN THE PRODUCTION OF MEDIUM-DENSITY FIBREBOARDS (MDF)

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In the near past, industrial hemp (Cannabis sativa L. subsp. sativa) found main application in the production of ropes and fabrics. At the present moment, this crop finds increasingly big application for pharmaceutical purposes and in the cosmetics industry. As a result of which not only hurds, but whole stalks remain as waste from this production. On the other hand, MDF, which on a world scale are the second production of wood-based boards in terms of volume after that of veneer plywood, allow at least partial inclusion of non-woody lignocellulosic raw materials in their composition. That is why, in this paper, an investigation about the possibility for inclusion of mass of hemp stalks in the MDF composition is presented.

Under laboratory conditions, previously washed hemp stalks were defibred. The defibration was performed in a laboratory crusher defibrator for 2 min. Under laboratory conditions, MDF with participation of mass of hemp stalks form 0% to 100% in the MDF composition were produced. The content of mass of hemp stalks was increased by a step of 10%. The boards were produced at a temperature of hot pressing of 185 °C, with 10% participation of urea-formaldehyde resin (UFR) and have a density of 850 kg/m^3.

The effect of the content of mass of hemp stalks on the physicomechanical indicators of MDF was established. Regression equations for this effect on the individual physicomechanical indicators were also derived. It has been established in case of increase of what share in the composition of boards, most significant deterioration of the MDF indicators is observed. On this basis, a recommendation for the maximum justified content of mass of hemp stalks in the MDF composition was derived.

Key words: MDF, non-woody lignocellulosic raw material, stalks of industrial hemp.

SURFACE FINISHING PROBLEMS OF HISTORICAL WOODEN HOUSES LOCATED IN WESTERN BLACK SEA REGION OF TURKEY

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In this study, historic houses from seven different localities (in Amasra, Bartin, Eregli, Goynuk, Kastamonu, Mudurnu, Safranbolu) from the Western Black Sea Region in Turkey was chosen as the study areas. In addition to the natural beauty of these historical wooden houses, they have great importance in terms of tourism and authenticity in the region. Interior wooden parts were examined in terms of finishing treatments (paint, varnish, etc.). In this context, primarily the present situations of interior wood surfaces were examined in place and the problems have been identified. Then, measures to be taken against these problems were presented according to nano-technologic application on wood surface studies carried out and finally solutions needed to be taken urgently are presented for sustainability of these structures on behalf of the future generations. Consequently, nano-technologic finishing materials were found superior in terms of; specular gloss, hardness, surface adhesion, surface resistance to cold liquids properties compared to conventional finishing materials. To summarize, by using nano-technological finishing products in renovation works in wooden internal walls, the lifespan of the wood can be extended. And thus, possible economic losses will be prevented.

Keywords: Finishing, Wood, Historic houses

AN APPLICATION ON THE ASSIGNMENT OF THE MOST PROPER WORKER WITH THE HUNGARIAN ALGORITHM IN THE FURNITURE MANUFACTURING PROCESSES

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In the problems of worker's assignment to machines, inadequacy of worker skills in making of the work and/or changing of operation time of the work from employee to employee are very important problems to consider. In the production activities such as furniture production in which many operations are performed simultaneously and in parallel, assignment of the most proper worker in terms of quality and making time of work has a significant effect on productivity, delivery time and costs.

In this study, in the course of production activities carried out at the Application Workshop of Wood Products Industrial Engineering Department in the Faculty of Technology of Gazi University; operation times of 4 workers (students) in the machines of jointer, spindle moulder, router and horizontal drilling machines were measured in accordance with work measurement techniques. The obtained data were analysed and adapted to solve the 0-1 integer assignment problem. The derived data from analyses were used to solve the problem of "which person will be assigned to which machine by considering the smallest total time" using "Hungarian Method" of Kuhn (1955).

Keywords: Assignment Problem, Hungarian Method, 0-1 Integer Programming, Furniture Production, Employee Selection

THE EFFECT OF SEASONAL CONDITIONS ON THE FLUE GAS (O_2, CO, CO_2, NO_X) VALUES FORMED BY THE COMBUSTION OF WOOD MATERIAL

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This study was carried out to determine the amount of gases (O_2, CO, CO_2, NO_x) that emerged with the combustion of the wood material left in the season (outdoor) conditions. For this purpose, Oriental beech (*Fagus orientalis* Lipsky) wood samples were left in outdoor at the beginning of each season after applying impregnation materials (tanalith-E, wolmanit-CB) and varnishes (synthetic, water based). At the end of the seasons, samples were combusted and flue gas device was used for gas measurements. The combustion process was carried out in 3 stages. At the first stage the combustion with flame phase (CF) was carried out, the flame source was cut to achieve self-combustion (SC) and ember combustion phases (EC).

According to the results of flue gas analysis, summer samples showed the lowest O_2 values in CF phase and highest in EC phase. The winter and year groups that received a lot of rain showed the opposite values. At the beginning of the combustion O_2 values increased by impregnation materials and decreased by varnishes. In all combustion phases showed NO_x amounts the highest in summer samples and the lowest in year samples.

Keywords: Outdoor conditions, Combustion, Wood, Impregnation, Flue gases analysis

OCCUPATIONAL HEALTH AND SAFETY AWARENESS IN TURKISH WOOD, WOOD PRODUCTS AND MUSHROOM PRODUCTION SECTOR

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Occupational health and safety pursues the goal of improving working conditions as well as the projection of workers from treats like occupational accidents and diseases. In developing countries including Turkey, where occupational accident and disease ratios are high, occupational health and safety issue has been becoming more and more significant. The forest products industry, which is one of the sectoral fields where the most occupational accidents occur, is in the position as one of the areas which must be put under excessive emphasis regarding the magnitude of total workplace and employee number along with difficulty level of works carried. The wood, wood products and mushroom production sector, which is in sub-sectors of Turkish forest products industry, constitutes the second biggest manufacturing group after furniture production in terms of total enterprise number. %98 of the enterprises in aforementioned sector are small and medium sized enterprises. In enterprises with low number of employee, the low sensitivity shown to occupational health and safety precautions increases the significance of this sector in terms of occupational health and safety.

In this study, it is aimed to reveal the differences in opinions of personnel in enterprises, which fall into Turkish wood, wood products and mushroom production group, concerning occupational health and safety. Within this framework, a questionnaire application was conducted based on face to face meeting in a total of 68 enterprises. In the questionnaire, the 5-point Likert rating scale was used in determination of agreement level to scale items containing 9 different opinions concerning occupational health and safety issue underlying demographic characteristics of personnel and features of enterprises. The reliability coefficient of the scale utilized in the study was calculated to be 0.787 as Cronbach Alpha method and it is seen to be within the confidence limits.

As the result of the study, it was observed that training level of personnel in wood, wood products and mushroom production sector is low, and they fall within middle age group. On the other side, it was detected that machinery maintenance frequencies are too far, necessary personal protective equipment is not supplied in time and basic occupational health and safety principle implementation has deficiencies. Besides, statistically significant differences ($p<0.05$) were identified between opinions of employees in relation to variances as age, marital status, department worked, total time of employment in the enterprise, machinery maintenance frequency that is applied, workplace change intervals and exposure to occupational accidents. Achieved findings revealed that occupational health and safety awareness is low in Turkish wood, wood products and mushroom production sub-sector and notable inadequacies exist in application, thereby improvement and development on a significant level is needed.

Keywords: Occupational health and safety, Wood products sector, Awareness, Small and medium sized enterprise.

PHEROMONE TYPES USABLE AGAINST WOOD DESTROYING INSECT SPECIES

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Wood destroying insect species are one the most important biotic factors and decrease the economic value of wood as well as tecnological properties. For this reason, the struggle methods have to applied against wood destroying insects. Various methods have been developed and used in fighting with wood destroying insects. One of these is pheromone traps. Pheromones are based on the principle of catching insects by bringing them towards the trap system by affecting the opposite sex. It is possible that different pheromones can be used against each insect as well as the same pheromone against more than one insect. In this study, pheromones used against insect species which have caused considerable damage to wood materials was stated and some instructions about principle these pheremone types were given.

Keywords: Pheromone, Wood, Insect, Fighting methods with insect

THE EVALUATION OF WOOD DESTROYING INSECTS DETECTED IN SOME PROVINCES OF TURKEY ACCORDING TO SHANNON SPECIES DIVERSITY AND MARGALEF SPECIES RICHNESS

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The purpose of the study was to determine insect species diversity and abundance according to Shannon species diversity and Margalef species richness in log depots covering Düzce, Bolu, Zonguldak, Bartın, Karabük, Kastamonu and Sinop provinces in Western Black Sea region of Turkey. For this purpose, two indexes were calculated based on log depots, provinces and sub regions. The highest species diversity was calculated in Düzce Yığılca Aksu log depot while the lowest species diversity was calculated in Zonguldak Alaplı Mollabey log depot based on the log depots. For provinces, the highest species diversity and richness was calculated in Düzce while the lowest was calculated in Zonguldak provinces. When evaluated according to regional directorates, the highest species diversity and richness were found in Bolu Forest Regional Directorate and the lowest was found in Zonguldak Forest Regional Directorate. It was found that the temperature, relative humidity, altitude and wood species in log depots effected on species diversity and richness differences in the working area.

Keywords: Shannon species diversity, Margales species richness, Insect, Log depots

D15 – TYPE FLOORING STRUCTURES DESIGNED FOR GYMNASIUMS AND TESTED FOR THE BALL REPELLING REQUIREMENT

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In this paper the results of the experiments carried out on three wooden flooring structures are presented. The structures are made from beech wood and they are designed for the indoor basketball courts. These structures are characterized by simple design, ease of manufacture and low price. The proposed flooring structures have to have good elastic properties in order to ensure a proper bounce height of the ball and the high efficiency of the athletes when playing the basketball game.

The basic and reference structure is composed of flooring board strips of 15 mm thick and arranged as the English parquet model. The flooring board supports on half-lap jointed joists and noggins that form a wooden grid frame with 16 square openings on a tested surface of 1000 mm x 1000 mm. The flooring board strips had the dimensions of 500 mm x 50 mm x 15 mm and 250 mm x 50 mm x 15 mm respectively. Joists and noggins had the dimensions of 1040 mm x 40 mm x 20 mm, spaced 250 mm between the crosscut sections midpoints. The two improved variants proposed in the research had additional wooden shock pads positioned differently: for the first variant they were positioned at equal distances between the half-lap joints, whilst for the second variant they were positioned under the half-lap joints. The shock pads with dimensions of 60 mm x 40 mm x 10 mm were made of beech wood, as the whole flooring structure was made.

The tests were carried out on a floor test stand S-TPS-3, designed and executed for this purpose at the Transylvania University of Brasov according to SR EN 12235:2014. During the test, the basketball ball dropped on the tested floors from the height of 1.80 m set to the stand, and the bounce ball height was afterward measured and compared to the height measured on a standard concrete floor. The purpose of the research is to assess whether floor structures designed and built for sports courts, following the tests carried out, meet the requirements of indoor sports flooring courts.

Keywords: wooden floorings, sport floorings, rebound, ball, testing stand

INDUSTRY 4.0 AWARENESS IN FURNITURE ENTERPRISES: CASE STUDY OF ORDU AND GIRESUN

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The Industry 4.0 approach has added a new and different window to the viewpoints of the revolutions that took place during the industrialization process throughout human history. In the nineteenth century, the power and importance of water and steam was understood and this power was made part of the production. In the 20th Century, electricity and mechanical energy production technologies were fed and this has provided the production to enter in all areas. After this process, digital technologies were developed quickly. The constant and rapid change of technology has been brought the necessity of the industry to take a new step. This situation is influential to make changes of production of the enterprises. That is it is the Industry 4.0 approach which will be totally effect of the world and humanity and as a new vision for the industry.
This approach will cause enterprises to make a breakthrough for change in production, and to move towards new and ever-evolving technologies such as digital planning, artificial intelligence, and robotics in production facilities to increase production and productivity. Industry 4.0 is to introduce new concepts such as the internet of objects (Internet of things – IOT), virtual three dimensions, artificial intelligence, robots, continuous innovation in to face of enterprises. This is forced to enterprises to set up new teams who know the software well, follows the new technologies, plans and programs them, open to change and development, entrepreneurial spirit. Turkish furniture industry which has a suitable structure of development is confronted us as one of the important sector. Nevertheless, the fact that the sector is consisted of small and micro scale enterprises and the structural and economic problems caused by being small to emerge as a big obstacle to the use of digital technologies.
Within this study, it was tried to show the awareness of the furniture industry about the Industry 4.0 approach, the present possibilities, future plans and where they saw themselves in these developments. As a target group of the study, furniture enterprises of Ordu and Giresun were selected. Data were collected through questionnaire from the 45 enterprises in these provinces. The obtained data were analysed in computer environment. The possible effects of the Industry 4.0 on the furniture industry were highlighted, what should be done in this transition and transformation process, and suggestions were developed and discussed.

Keywords: Industry 4.0, Furniture Industry, SME, Industry 4.0 Awareness.

HOUSING SUGGESTION FOR LARGE FAMILIES

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This research includes housing suggestion and furniture arrangement for a family of 4 (four) living with grandparents (grandmother and grandfather). There is a separate bed, living room and bathroom for grandparents in the project which has been developed considering the importance of the privacy necessity of grandparents in common life and providing more comfortable living conditions. Therefore, a child will not have to stay in other child's room, children's room will not be separated and sofas that are available every day in the living room will not be opened and closed for the grandparents. Grandparents will be able to spend time with other members of the family in daily life easily and will be able to use the spaces reserved for them in the evening or when they need to be alone. In addition, there is a living room, kitchen, two children's rooms, parents' bedroom, bathroom and a water closet in the housing. It is possible to go to the spaces belonging to grandparents with a door opening from the kitchen. Space measures have been kept at the minimum limits taking the costs in the housing design into consideration.

Key words: Furniture, interior space, housing

RADIAL STICK SAWING OPTIMIZATION

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Stability in wood is related to moisture content and annual ring direction. Many manufacturers choose radial material for less shrinkage and swelling ratios and uniform shape change avoiding deformations especially for layered and joined materials. Sawmill operators usually prefer quarter sawing diagram to obtain radial boards from logs for this purpose. However, quarter and another diagrams give solutions for only boards that have larger dimensions than sticks, which are commonly used layered materials.

In this study, radial stick sawing optimization from logs was aimed. For this purpose, commercially preferred logs with 200mm, 300mm, 400mm and 500mm diameter, and cylindrical shape, were drawn in CAD program. Commonly used sawing diagrams (live, quarter, around) were tried empirically basing on cross sections. However, studies showed that when tangential boards were sawn to obtain radial sticks, all sticks could not be radial due to annual ring direction, especially at the end of boards. Therefore, some diagrams were modified to obtain maximum radial stick yield.

Results showed that the radial stick yield can reach 57,8% and the yield increment reached max. 28,9% (12,97% in average) when the all diagrams for all logs were considered. Especially around sawing method gave maximum radial stick yield. It is originated from the diagram, which normally gives radial sticks from tangential boards. Furthermore, modified sawing diagrams gave better yields from commercially preferred diagrams. However, sawing process is becoming extended and complicated with them.
Otherwise, it is suggested that log sawing optimization programs should calculate lower dimensions than boards with considering secondary sawing process and annual rings can be drawn in program or scanned for evaluating board is radial or tangential.

Keywords: Log Sawing, Sawing Optimization, Around Sawing, Radial Stick

COMPARISON OF MECHANICAL AND THERMAL PROPERTIES OF WASTE AND NEAT POLYPROPYLENE

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Polypropylene (PP) have used in many areas for different purposes. In addition to neat polypropylene (NPP), waste polypropylene (WPP) has also found its place of use for different purposes. Climate change and international agreements have forced many countries to reorganize waste management, especially plastic waste. Due to its petroleum-derived nature, the use of polypropylene and the recycling process are becoming more important. In this study, waste and neat of polypropylene which is high potential in the production of wood plastic composites was examined. The bending resistance and tensile strength properties of NPP were found the higher than WPP 54.2% and 20.8%, respectively. On the other hand, impact resistance of WPP is 46.5% higher than NPP. As a result of XRD (X Ray Diffraction) tests, NPP has been found to have a higher degree of crystallinity. According to TGA (Thermo-Gravimetric Analysis) curves T10% values of neat and WPP are the same (433.5 °C). Amounts of weigh loss of neat and WPP are 99% and 86%, respectively. The DTA (Differential Thermal Analysis) results showed that the Tm and Td values of neat and WPP were 166.6-462.9 and 159.1-459.4, respectively.

Keywords: Mechanical properties, Thermal characterization, Waste polypropylene, Neat polypropylene

CONSTRUCTION OF FRAMEWORK FOR DETERMINATION OF WOOD BIOMASS IN TURKEY FORESTS

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The rapid increase in the population of the world and, in parallel with this, the pressures on the use of natural resources with industrialization are increasing. Therefore, the need for forest resources increases and the use of these resources in a planned manner gains importance over time. The only natural raw material that can be recycled from these sources is the wood raw material, the forest industry at the top of the demand. In parallel with the developments in other industries in the world in recent years, the forest products industry has also shown a rapid change and development, which has led to a considerable increase in the use of wood materials. Along with this increase, forest assets are also rapidly consumed. Because of this, the raw materials of the wood should be used consciously and have a lot of knowledge about the characteristics of the wood. At the same time, the physical properties of the wood must be known so that it can be evaluated appropriately for its purpose and purpose. Therefore, the anatomical structure, physical and mechanical properties and chemical composition of the wood raw materials enable the use of wood materials in various fields. Physical properties of wood; wood-water relations, weight-volume relations, and in this context the determination of wood biomass is of great importance. Many studies have been carried out to determine wood biomass in the world. As a result of these studies, direct methods applied by the development of the allometric equations belonging to each country in line with the guidelines of Land Use, Land Use Change and Forestry (LULUCF), Agriculture, Forestry and Other Land Use (AFOLU) and Global Forest Resources Assessments (FRA) are used. In this study, through the methods being used until today, has created conceptual framework for the calculation of wood biomass in Turkey's forests.

Keywords: Wood Biomass, Guides, Volume Weight, Regression Analysis

WEATHERING OF HEATED AND VARNISHED SCOTS PINE AND ORIENTAL BEECH WOODS

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This study was aimed to determine surface roughness and gloss changes of heated and varnished Scots pine (*Pinus sylvestris* L.) and Oriental beech (*Fagus orientalis* L.) woods after 3 months of weathering for in Mugla Region. Heat treatment of Oriental beech and Scots pine woods were carried out by hot air in an oven for 1, 2, and 3 h at 205, 215, and 225°C. After heat treatment, Scots pine and Oriental beech wood specimens were varnished using a polyurethane varnish (PV) and cellulosic varnish (CV).

According to the test results, the weathering process caused an increase in the surface roughness of the test specimens. In general, heated and varnished Oriental beech and Scots pine woods gave better surface roughness and gloss properties than only varnished Oriental beech and Scots pine after weathering. Generally, higher duration and temperature for Scots pine and Oriental beech resulted in better surface characteristics of Oriental beech and Scots pine woods after weathering. Our results showed that while heat treated and PV coated both wood specimens gave better results in terms of surface roughness, heat treated and CV coated both wood specimens gave better results in terms of gloss values after weathering.

Keywords: Heat treatment, Scots pine (*Pinus sylvestris* L.), Oriental beech (*Fagus orientalis* Lipsky), weathering, surface roughness, gloss.

THE REACTION TO FIRE OF SOME CHEMICALS TREATED PINE WOOD PRODUCT SURFACE

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Wooden materials have been extensively used for furniture, outdoor and indoor cladding, buildings, terrace, fence, garden furniture and interior decoration and to decorate the roofline of houses. However, wood which is used outdoors or in areas exposed to moisture needs to be protected against wood-destroying organisms and to be shielded from water, marine pests, fungi, fire and weather conditions. Untreated wood materials have no resistance to the spread of fire and many buildings which constructed from wood based materials needs to fire resistance. It is possible that the wooden material ensures very durable and resistant against physical effects by surface applications such as wood preservative paint and acrylic resin-based varnish. The application of fire retardant chemicals can also provide to satisfy regulatory requirements for wood products.

In this study, titanium dioxide and antimony trioxide were applied on pine (Pinus sylvestris L.) solid wood material to determine durability of reaction to fire using by oxygen index test technique (ASTM D 2863-6) and real fire test. These chemicals were added to the wood preservative paint which is a commercial product as concentrations of 2%, 5% and 10% for titanium dioxide and 2% and 5% for antimony trioxide. The effects on colour change of their surfaces, brightness and surface roughness measurements, water absorption and thickness swelling of this wood material were also carried out. The results obtained were analysed statistically and compared with the related standards. Addition of these chemicals to used wood preservative paint had a positive impact on the fire properties of the pine wooden surface.

Keywords: Titanium dioxide, Ammonium trioxide, Fire retardant, Wood preservative paint

FORMALDEHYDE EMISSIONS AND EFFECTS ON HEALTH DURING ARRIVAL OF FURNITURE TO ULTIMATE CONSUMER

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People spend most of their time in closed areas such as home, office, school. For this reason, indoor environment pollution has great importance for human health. In this environment, the formaldehyde gas in the indoor furniture produced by the synthetic resin made from the panels is gradually released into the living spaces. The indoor concentration of formaldehyde gas in ppm is higher than the international standard, that is, the comfort limit value accepted by the western countries, which causes considerable damage to human health, especially to children.

In this study; formaldehyde emission values of five different companies' wood-based panel products determined by three different methods in Turkey and in 50 furniture manufacturing facilities, 50 furniture stores, 50 new apartments; formaldehyde gas analyzes have been performed. As a result; on average, furniture manufacturing 0.45 ppm, in furniture store 0.37 ppm, in new apartments 0.11 ppm formaldehyde gas release has been measured.

Keywords: Formaldehyde, Furniture, Particleboard, MDF, Human health

USE OF PERSONAL PROTECTIVE EQUIPMENT IN MICRO-SCALE WOOD WORKING ENTERPRISES

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About two million employees lose their lives from work-related diseases or accidents every year. Further, 317 million employees suffer from work-related diseases and 337 million work-related accidents per year are estimated. The incidence rate of these work-related diseases or accidents varies according to sectors. The wood manufacturing sector is one of the risky sub-sectors within the manufacturing sector in terms of work-related hazards. Furthermore, the vast majority of enterprises, operating in the manufacturing sector, are of micro-scale. Such enterprises have to cope with many business constrains and their ability to control risks is lower. Therefore, the use of personal protective equipment (PPE) remains the ultimate tool for micro-scale enterprises to protect their employees from occupational diseases and accidents. In this study, the types of PPE used, their usage rates, the motivations for not using them and other issues related to PPE in the micro-scale furniture and sawmill sub-sectors were investigated. The study was conducted in 120 micro-scale enterprises in Trabzon, Turkey. A structured face-to-face questionnaire survey was used to gather information from the owner/employees of the enterprises. It has been revealed that the use of PPE in the enterprises producing furniture was higher than in the sawmill and the most prevalent reason for PPE usage was to protect the employees from wood dust. About half of the owner/employees did not indicate any reason for not using the PPE. However, the remaining stated that they did not use personal protective equipments (PPEs) because these often made it difficult to work.

Keywords: PPE, Wood, Occupational safety

TRANSITION METAL OXIDE CLUSTERS AS CATALYSTS FOR BLEACHING OF CELLULOSIC PULPS AND NATURAL FIBERS

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Soluble transition metal oxide catalysts (polyoxometalates, POMs) have received special attention due to their importance in a variety of industrial, pharmaceutical and biological applications. They were originally proposed as activating agents for oxygen delignification of wood pulp. They can react selectively with phenolic lignin structures in cellulose fiber and that can be regenerated with oxygen gas.

We were able to develop new green catalysts based on a special class of POMs for selective oxidation of lignin from cellulosic pulps and natural fibers in one or two stages. The experimental results in lab, and pilot scale are very promising, the brightness is higher than 80 %.

Keywords: polyoxometalates, bleaching, cellulose pulps, natural fibers.

EFFECT OF GLUTARALDEHYDE, WASTE TEA WOOD FLOURS (WTF) AND POLYCAPROLACTONE (PCL) ON THE SOME PROPERTIES OF THERMOPLASTIC STARCH (TPS) BASED BIOCOMPOSITES

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In recent years, efforts to produce biocomposites that can degrade in the environment have increased rapidly. In this study, thermoplastic starch (TPS) based biocomposites were produced using waste tea wood flours (WTWF) as a lignocellulosic filler, glutaraldehyde (GA) as a the cross-linker and polycaprolactone (PCL) as an additional synthetic biodegradable polimeric matrix. The effects of lignocellulosic fiber (0 and 10%), glutaraldehyde (0- 5- 10%) and PCL (0 and 30%) were studied. GA and WTWF were added to the matrix based on wheat starch weight. PCL was added to the matrix based on thermoplastic starch weight. Density, tensile strength, tensile modulus, elongation at break, flexural strength, flexural modulus and impact strength of the manufactured samples were determined in accordance with ASTM D 792, ASTM D638, ASTM D790 and ASTM D256, respectively. Results showed that WTWF, GA and PCL had significant effect on the mechanical properties of the produced biocomposites. GA improved properties of biocomposites having no filler in it. Addition of PCL improved the tensile strength, flexural strength, elongation at break and impact strength while reducing density, tensile and flexural modulus values. On the other hand, mechanical properties of the composites were decreased with the rise of the GA amount in samples both WTF and PCL. Density values of the produced composites were decreased with the rise of the PCL and WTF amount. With the rise of the GA and WTF amount, impact strength of the composites was decreased.

Keywords: Thermoplastic starch, glutaraldehyde, biocomposite, polycaprolactone (PCL), mechanical and physicalproperties

INVESTIGATION EFFECT OF LIQUID GLASS ON LEACHING PERFORMANCE OF WOOD MATERIALS STAINED BY LICORICE (*Glycyrrhiza glabra* L.), EXTRACTS

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The aim of this study is to develop durable and eco-friendly natural colorants by mixing liquid glass for the surface of wooden products and determine their desorption performance by leaching method. For this purpose, natural colorant was extracted from Licorice (Glycyrrhiza glabra L.), by ultrasonic-assisted method and mordanted with ferrous sulfate ($Fe_2(SO_4)_3.7H_2O$), aluminum sulfate ($KAl_2(SO_4)_3.18H_2O$), and vinegar (CH_3COOH). Wooden blocks were prepared from chestnut (*Castanea sativa* Mill.), mahogany (*Khaya ivorensis*) and Scots pine (*Pinus sylvestris* L.). Immersion and ultrasonic assisted methods were utilized for application of the dyestuff on the wood blocks. Leaching test application conditions included temperature (22 °C), pH (3, 7, and 11) and agitating speed (120 rpm).

The results showed that the leaching performance of some tested samples increased by percentage 96, 49 due to liquid glassed samples when compared with without liquid glassed (control) samples.

Keywords: Natural dye, Licorice (*Glycyrrhiza glabra* L.), Liquid glass, Leaching

EVALUATING SOME SURFACE PROPERTIES OF THERMALLY COMPRESSED PAULOWNIA WOOD MATERIALS

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The aim of this study is evaluating effect of thermal compression process on the some surface properties of Paulownia solid wood materials. The samples were exposed to thermal compression during 45 min. under different pressure (20 bar and 22.5 bar) and temperature (150°C and 170°C) levels. Totally four groups of thermally compressed samples were compared each other and with unmodified (control) group to evaluate the results. Roughness properties were determined with measuring arithmetical average roughness (Ra), maximum height (Ry), ten-spot average roughness (Rz), and root-mean-square deviation (Rq) according to JIS B 0601 standard. All roughness measurements were obtained at both parallel and perpendicular to grain. Wettability was determined with measuring contact angle (CA) changes according to time of the dripped droplet to the surface.

The obtained results indicated that wettability significantly changed according to control group. When the thermal compression process conditions were examined in detail, wettability results were similar in the change of pressure while, contact angle values were significantly increased with change of temperature. The another results indicated that surface roughness results changed significantly with thermal compression, only surface of 150°C - 20 bar condition group were similar with control group for all values at both direction. Otherwise, the samples exposed to 170°C - 20 bar condition were the lowest value especially perpendicular to grain direction. When results of the parallel to grain direction were investigated, the samples were only the lowest values in two measurements, while 150°C – 22,5 bar condition were the group had the lowest values in another measurements.

The results of this research revealed that thermal compression method could be used to change surface properties this fast-growing specie. Since the temperatures of the materials exposed to was close at thermal modification method, the study can be extended with trying these temperatures (such as 180°C, 212°C) used.

Keywords: Thermal compression, Paulownia, Wettability, Contact Angle, Surface Roughness

THE EFFECT OF MODIFICATION WITH EPOXY AND POLYESTER RESINS ON SOME MECHANICAL PROPERTIES OF PINE AND CHESTNUT WOODS

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In this study, the effects of epoxy and polyester resin applications on some mechanical strength properties of scots pine (Pinus sylvestris L.) and chestnut (castanea sativa) wood samples were investigated. Firstly, in the circular sawing machine, a different numbers of channels (2+1 and 3+2) were opened on the surfaces of wood samples. Then, these channels were filled with casting type epoxy and polyester resins. The density, modulus of repture (MOR), modulus of elasticity (MOE), and compression strength parallel to the grain (CS) tests were performed on the samples. According to the results of the study, the density values of pine and chestnut samples increased by 25% and 42%, respectively, depending on the number of channels after resin application. In addition, compared with epoxy resin applied samples, the density increase was higher in the polyester resin applied samples. After application of resins, a slight increase was observed in the MOR and MOE values of chestnut samples. However, CS values tend to decrease in these samples. In pine samples with resin applied, the strength properties (MOR, MOE and CS) decreased depending on the increase in the number of channels. Furthermore, the effect of the resin type on all strength properties of the samples was statistically insignificant.

Keywords: Epoxy resin, Polyester resin**,** Wood material, Mechanical properties

HISTORICAL VALUE AND CONSERVATION PROBLEMS OF TRADITIONAL WOODEN ARCHITECTURE IN TURKEY

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Wood is one of the oldest construction materials in Turkey, due to the presence of large forested areas. Wood can be used in different ways during the contraction of the walls. For example, only wood is used for building, or wood pieces, stones or bricks is used as infill material of framed structures. Even though many traditional wooden buildings have left their place in concrete, it is still possible to see the good examples of traditional wooden architecture today. However, due to conservation problems in rural areas, local people tend to give up living in wooden buildings. In addition, construction dates of traditional wooden buildings, which are important for identifying definitive architectural period, and for nomination and registration as cultural heritage, are generally unknown.

Here, we present a review of researches dating of historical buildings using dendrochronological methods; and multidisciplinary studies which reveal the historical value of wooden structures and develop conservation approaches. We believe that multidisciplinary studies combining dendrochronology, wood conservation and architectural features, will lead the quality refurbishment of wooden buildings and encourage building owners to protect their buildings and sustainable use of traditional wooden structures.

Keywords: Dendrochronology, Wood Conservation, Traditional Wooden Architecture

DETERMINATION OF POMEGRANATE (*PUNICA GRANATUM* L.) DYE AND LIQUID GLASS PAINTING (SIO_2) MIXTURE ON ANTIMICROBIAL ACTIVITY AND WOOD SURFACES PROTECT AGAINST THE DEVELOPMENT OF ROT FUNGI

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The aim of this study was to determine the antifungal and antimicrobial properties of pomegranate (*Punica granatum* L.) extract mixed with liquid glass when used as an environmentally friendly wood preservative. The extract was dissolved from pomegranate (*Punica granatum* L.) by using and ultrasound assisted method and applied to Scots pine (*Pinus sylvestris* L.), mahogany (*Swietenia sp*.) and chestnut (*Castanea sativa* Mill.) wood blocks with the immersion (classic) methods. Ferrous sulfate ($Fe_2(SO_4)_3.7H_2O$), aluminum sulfate ($KAl_2(SO_4)_312H_2O$) and vinegar were used for mordants, results were compared with synthetic dye. Treated blocks were exposed to *Postia placenta* and *Trametes versicolor* attacks for 16 weeks, according the standard TS 5563-EN 113, 1996 method. Antimicrobial activity of the extracts was determined with the agar dilution method by using the disk diffusion method for bacteria. Results showed that the mordant mixes were considerably more resistant to fungal decay compared to their untreated and synthetic counter parts. Results showed that the mordant mixes were considerably more resistant to fungal decay compared to their untreated and synthetic counterparts. It has been observed that liquid glass has shown better protection on the chestnut and mahogany compared to pine trees. Natural dye we obtained has shown better protection more then, synthetic dye against brown rot (*Postia placenta*) and white rot (*Tramates versicolor*). As a result, it was found that pomegranate (*Punica granatum* L.) extracts, pomegranate (*Punica granatum* L.) + liquid glass and mordant mixes could be used as wood preservatives. Dyes extract used in the experiments was determined to prevent the antimicrobial activity.

Keywords: Pomegranate, *Punica granatum* L., antimicrobial activity, white rot, brown rot.

EVALUATION OF THE RISKS IN WOOD HARVESTING ACTIVITIES BY THE PRELIMINARY HAZARD ANALYSIS (PHA)

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The first step of the wood harvesting process is the harvesting that include cutting-felling, pruning, peeling, and bucking. These activities involve a variety of hazards, because of in the work environment, done and machines used. Forestry operations are among the most difficult and risky. Taking the necessary precautions is crucial to ensure occupational health and safety in forest operations before the operations is done that identification and classification of hazards posed by these activities. In this study, it is aimed to determine the hazards that the trees cutting-felling, pruning and bucking activities carry in terms of occupational health and safety and evaluate them according to the preliminary hazard analysis (PHA) method. Preliminary hazard analysis method has been chosen as the risk analysis methods because of the necessity of documentation is less in the study, the ability to be done by an expert, the medium level of experience and the application of each sector. The hazards of these activities have are revealed by the literature survey and the field studies in the wood harvesting area in the Black Sea, Central Anatolia and Mediterranean regions of the Turkey. Twenty-nine hazardous situations were identified in the study, of which 12 were high risk, 9 were serious and 8 were intermediate risk. It is not possible that the working environment and all hazards in the forests that are living ecosystems and work material is heavy are completely removed. Intervening according to the importance classes of the hazards to minimize and the level of the risk to decrease should be taken precautions that determined in the study.

Keywords: Risk analysis, PHA method, Wood harvesting, Forestry activities

USE OF SILICONE BASED CHEMICALS IN THE MEDIUM DENSITY FIBERBOARD PRODUCTION

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In this study, the use of silicone based chemicals were investigated as water repellent agent for the production of medium density fiberboard (MDF). Two different chemicals (Dow Corning 87 and Xiameter) were applied to fibers by spraying together with melamine ürea formaldehyde resin (MUF) in different proportions (0.5%, 1.0% and 3.0%). Addition to the water uptake and swelling properties, the change in the tensile strength, bending strength and elasticity modulus of MDFs were investigated.

The results showed that fiberboards produced with these chemicals had lower water absorption and swelling in thickness compared with MDFs having only MUF resin. In addition to closing the hydroxyl groups of the fibers, the water repellent hydrophobic structure protects the fiber-fiber bonds against water. It was founded that fibreboard produced with these chemicals had better tensile strength, bending strength and elastic modulus depending on addition level.

Keywords: Medium density fibreboard, Hydrophobicity, Silicon based chemical, Water repellence

THE EFFECT OF THE WATER-BASED COLOR BARRIER ON THE NATURAL WOOD VENEER

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In this study, the effect of water based color barriers on the color change of wooden coverings of various tree species was investigated. For this purpose, wooden coatings of castanea, eucalyptus, and scots pine species which are widely used in the industry have been selected. Then the wood veneers were divided into two groups and two separate top surface prescriptions were applied to each group. In the first group, only varnish was applied. On the second group, a water-based color bar and varnish application was carried out, and a total of 6 variation test samples were prepared, with and without water color barriers applied to each tree type. Test samples were tested on both UVA and UVB lamps in the QUV aging device. it has been determined that water-based color barriers do not show a significant color change in the applied parts, and that the color barriers are sulphated in those that are not subjected to color barriers. These results can be regarded as an industrially significant result of preventing sagging which may occur over time on varnished surfaces.

Keywords: Water based color barrier, wooden coating, QUV, eucalyptus

EFFECT OF CEMENT AND ACCELERATOR TYPES ON THE PHYSICO-MECHANICAL PROPERTIES OF CEMENT-BONDED PARTICLEBOARDS

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In this study, it is aimed to determine the effect of the use of different types cement and accelerator on the physico-mechanical properties of cement-bonded particleboards. Within this scope, two types of cements (calcium aluminate cement and Super white CEM I 52.5 R cement) and accelerators (aluminum sulfate and calcium chloride) were used in the production of boards. Therefore, CBPBs with 1200 kg/m^3 target density and 1/2.75 wood-cement ratio were produced. Based on cement weight 1.5% accelerators were used. A total of four experimental panels, two repetitions for each board group, were manufactured. The test results obtained were evaluated according to EN 634-2 (2009). According to result, density values of the boards were changed with using depending on cement and accelerator types. The use of super white cement and calcium chloride positively affected the both mechanical properties and dimensional stability of the boards. The use of calcium aluminate cement and aluminum sulfate resulted in lower strength properties.

Keywords: Cement-bonded particleboard, cement types, accelerator, physico-mechanical properties

DETERMINATION OF IMPORTANCE LEVEL OF WOOD HARVESTING ACTIVITIES AND OCCUPATIONAL SAFETY EQUIPMENT BY SMART METHOD

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Today, wood harvesting activities are shown as the "dangerous works" both in the International Labour Organization (ILO) and in various laws and regulations in Turkey. Wood harvesting process is comprised of three stages that are cutting-felling, extraction, and transport. The cutting is formed of sub-stages that are falling down, branching, bucking, and peeling. These activities have a lot of important risks due to steep slope, hard terrain, open air conditions, heavy work materials, insufficient mechanization and uneducated workers in terms of the occupational health and safety. It is not possible to completely remove the risks or replace them with less dangerous ones because the main risk sources for the logging operations are nature-based. For this reason, it is generally recommended using of suitable personal protective equipment. In this study, it was aimed to determine the importance level of the personal protective equipment used during the tree cutting activities in terms of occupational health and safety. In this context, the sub-stages of the cutting activity and used personal protective equipment were clearly stated, and it was taken total 24 expert's ideas including 10 practitioners from the forestry sector and 14 academics. Furthermore, the Simple Multi Attribute Rating Technique (SMART) has been used to determine the importance level of the sub-stages of the cutting activity and the personal protective equipment. As a result, the most important and the least important sub-stages were determined as the falling down (47%) and the peeling (16%), respectively. As for the personal protective equipment, participants rated for the most important equipment as head guard (24%) and the least important colored workwear (6%).

Keywords: Wood harvesting, Personal protective equipment's, Expert opinion, SMART

SUPPLY CHAIN OF RESIDUAL WOODY BIOMASS AFTER LOGGING OPERATIONS

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Residual woody biomass, which means the available woody portions of logging residues left on stand after logging operations, is crucial feedstock for various stakeholders such as forest industry and bioenergy sectors. It is essential to design cost-effective supply chain for residual biomass recovery. The objective of the study is to clarify supply chain possibilities for recovering of residual woody biomass through traditional wood harvesting system in Turkish forestry. Hence, this study considers the determining the source of available biomass potential and defining the residual biomass recovery options to supply market demands. The example of a case in Mediterranean Region of Turkey in pine forest was interpreted to constitute a supply chain and to minimize operational unit costs for more quality residual. Residual biomass was especially produced from branches and tree tops, the diameters of which were between 1.5 cm at the small end and 4 cm at top end with length of 1 m. It has the qualification to be utilized in both fuel and energy wood, and also chip wood because of rich in fiber content. Using of manual cut-to-length harvesting systems, between 4 % and 15 % of the total aboveground tree biomass was left on stand as logging residues, 50 % of which could be recovered as residual biomass with higher quality more than slash residues. Motor-manual harvesting and also manual extraction techniques were stated as preliminary solution for feasible biomass recovery. The loading and hauling of residual biomass in original condition regardless of chipping was the suitable in shorter transportation distances lower than 50 km. However, chipping in terminal or plant could be a possible best option for chip board industry or maybe bioenergy sector. The operational variables (yield, tree characteristics, etc.) and quality-based factors (biomass type, moisture content, energetic value, etc.) were significantly and relatively effective on productivity and realization cost of residual biomass recovery.

Keywords: Residual woody biomass, biomass recovery, supply chain, logging operations

THE EFFECT OF DEGRADATION TIME ON THE MECHANICAL PROPERTIES OF POLYCAPROLACTONE (PCL) BASED BIODEGRADABLE COMPOSITES THROUGH 18 MONTHS OF LABORATORY SOIL TEST

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In recent years, efforts to produce biocomposites that can degrade in the environment have increased rapidly. In this study, thermoplastic starch (TPS) based biocomposites were produced using waste tea wood flours (WTF) as a lignocellulosic filler, glutaraldehyde (GA) as a the cross-linker and polycaprolactone (PCL) as an additional synthetic biodegradable polimeric matrix. The effects of lignocellulosic fiber (0 and 10%), glutaraldehyde (0, 5 and 10%) and PCL (0 and 30%) were studied. Each of them were added to the matrix based on thermoplastic starch weight. Density, tensile strength, tensile modulus, elongation at break, flexural strength, flexural modulus and impact strength of the manufactured samples were determined in accordance withASTM D 792, ASTM D638, ASTM D790 and ASTM D256, respectively. Results showed that WTF, GA and PCL all had significant effect on the mechanical properties of the produced biocomposites. GA improved properties of biocomposites having no filler in it. Addition of PCL improved the tensile strength, flexural strength, elongation at break and impact strength while reducing tensile and flexural modulus values. On the other hand, mechanical properties of the composites were decreased with the rise of the GA amount in samples both WTF and PCL. Density values of the produced composites were decreased with the rise of the PCL and WTF amount. With the rise of the GA and WTF amount, impact strength of the composites were decreased.

Keywords: Thermoplastic starch, glutaraldehyde, biocomposite, polycaprolactone (PCL), mechanical and physical properties

GEL PERMEATIVE CHROMATOGRAPHY (GPC) ANALYSIS POLYCAPROLACTONE (PCL) BASED BIODEGRADABLE COMPOSITES THROUGH LABORATORY SOIL TEST

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Biodegradability is an important asset for a polymer for their acceptance by the society due to the increased environmental awareness people over the years. In this study, Polycaprolactone (PCL) based biocomposites were produced using PCL, polyvinyl alcohol (PVA)/Starch mixture and polyethylene (PE) as a polymeric matrix and Turkish Red Pine Pruning waste flours (RPWF)a lignocellulosic filler. Biocomposites were manufactured through combination of extruder and injection molding processes. Forest soil was collected from arid regions of Konya and transferred to Laboratory.During 18 Months of soil test, degradation of PCL was monitored using Gel Permeative Chromatography (GPC). Results showed major factor on GPC results were RPWF and degradation time. Especially at higher level of lignocellulosic filler use, there is a linear relation between filler and degradation time.

Keywords: Gel Permeative chromatograph (GPC), polycaprolactone (PCL), polyvinyl alcohol (PVA), biodegradable, mechanical and physical properties,

EFFECTS OF HEAT-TREATMENT AND VARNISH APPLICATION ON THE COLOUR CHANGE OF PINE AND ASH LAMINATED VENEER LUMBERS

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Heat treatment temperatures and varnish effects on colour properties of pine (*Pinus sylvestris* L.) and ash (*Fraxinus americana*) laminated veneer lumbers (LVL) were evaluated. In the first instance the wood lumbers were exposed to heat treatment with the temperatures of 190 and 212 ºC for 1.5 and 2 h, respectively. After heat treatment process, LVLs were manufactured from heat treated pine and ash veneers with polyurethane (PU) and melamine urea –formaldehyde (MUF) adhesives and one surface of them varnished with yacht varnish. A spectrophotometer was employed to determine colour change of heat-treated and varnished specimens. The samples had significant discoloration as a result of heat exposure and varnish application. Colour difference of the specimens increased as a result of all treatment temperatures. Varnish application caused a significant colour change for both tree species.

KEYWORDS: Colour, Heat-treatment, Varnish, ThermoWood.

INFLUENCE OF WOODEN OUTDOOR FURNITURE FINISHED SURFACES WATER ABSORPTION ON AND THE PROPERTIES OF COATING FILMS

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The aim of this study is to investigate the effects of repeating water absorption of wooden outdoor furniture finished surfaces n wood coatings and finished surfaces. During the testing the influence of five cycles of water absorption on the quality finished surfaces and tensile strength of coating films will be measured. In this contribution there is researched the correlation among the changing the quality of physical-mechanical and appearance properties of tested wood based samples finished surfaces and the changing the tensile strength of coating films prepared from the same coating materials.

The testing method was coming from the standard EN 927 – 5. The reached results can improve the predictive the durability of coating materials after influence of the water.

Keywords: Water absorption, coating films tensile strength, adhesion.

OPTIMIZATION OF VENEER DRYING TEMPERATURE FOR THE BEST MECHANICAL PROPERTIES OF PLYWOOD VIA ARTIFICIAL NEURAL NETWORK

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The drying of veneer is an essential part of the veneer-producing process to aid the gluing during the manufacture of the plywood and laminated veneer lumber. Determining the optimum veneer drying temperature without decreasing of mechanical properties is also very important from industrial viewpoint. Due to the high drying costs, increased temperatures are being used commonly in plywood industry to reduce the overall drying time and increase capacity. However, high drying temperatures can alter some physical, mechanical and chemical characteristics of wood and cause some drying-related defects. In this study, it was aimed to predict the optimum drying temperature for alder and scots pine veneers via artificial neural network modelling for optimum mechanical properties. Therefore, mechanical strength values of plywood panels manufactured from alder and scots pine veneers were dried at temperatures of 110, 130, 150, 170, 190 and 210°C. Shear strength, bending strength and modulus of elasticity of the plywood panels were experimentally determined according to EN 314-1 and EN 310 standards. Then, the mechanical strength values based on veneer drying temperatures are subjected to prediction by artificial neural network modelling. As a results of this study, the optimum drying temperature values were obtained as 165, 162 and 161˚C in Scots pine plywood and 190, 195 and 196˚C in alder plywood, for best shear strength, bending strength and modulus of elasticity values, respectively.

Keywords: Veneer Dying Temperature, Alder, Scots Pine, Artificial Neural Network, Mechanical Properties

MODELING THE EFFECTS OF PROCESS PARAMETERS ON THE SURFACE ROUGHNESS OF WOOD USING ARTIFICIAL NEURAL NETWORKS

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In the present study, an artificial neural network (ANN) model was developed for modeling the effects of wood species, number of knives, feed rate and cutting depth on the surface roughness of wood processed with a planer. The required data for training and testing of the model were obtained from the experimental results of Demirci (2013). The ANN model having the best prediction performance was determined by means of statistical and graphical comparisons. When the experimental data were compared with the results obtained by ANN, it was shown that ANN is quite successful in predicting the surface roughness values of wood. Consequently, satisfactory results can be obtained by the ANN instead of conducting time-consuming and costly experimental activities.

Keywords: Artificial neural networks, Surface roughness, Planing, Modeling

COLOUR IN THERMALLY MODIFIED WOOD OF PINE, ASH AND SPRUCE

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The effect of high temperature on colour of pine (*Pinus sylvestris* L.), ash (*Fraxinus americana*) and spruce (*Picea abies*) wood species were investigated in this study. For this purpose, wood species were treated with heat by using ThermoWood method at temperatures 190 and 212 °C for 1.5-2 hours, respectively. The results show that increasing heat treatment temperature caused dark colour on the samples compared with untreated ones. Heat treatment changes physical properties of wood species. So, it becomes available for outdoor application. Among these physical properties colour is important for industry especially decorative purposes.

Keywords: Colour, Heat-treatment, Thermowood, Physical properties.

THE EFFECT OF HEAT TREATMENT ON SURFACE ROUGHNESS AND EQUILIBRIUM MOISTURE CONTENT OF SOME WOOD SPECIES

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In this study, changes in surface roughness and equilibrium moisture content values of heat treated pine (*Pinus sylvestris* L.), ash (*Fraxinus americana*) and spruce (*Picea abies*) wood species were investigated. The specimens were treated with heat by using ThermoWood method at temperatures 190 and 212 °C for two periods of time: 1.5-2 hours, respectively. Roughness measurements were performed with using test device TIME TR-200 based on the ISO 4287. Three main roughness parameters; mean arithmetic deviation of profile (R_a), mean peak-to-valley height (R_z), and root mean square roughness (R_q) obtained from the surface of wood, were used to evaluate the effect of heat treatment on the surface characteristics of the specimens. The results showed that heat treatment caused decrease on equilibrium moisture content of wood species compared to untreated wood samples and it decreased with increasing heat treatment temperature. It was seen that heat treatment temperature significantly effected surface roughness for each wood species. This study is useful for industry, such as window frames, where working stability and surface smoothness are important factors.

Keywords: Wood, Heat treatment, Surface roughness, Equilibrium moisture content

COSTING PRACTICES WITH INDUSTRY 4.0 APPROACH

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The costing practices in industrial enterprises are not yet achieved at the desired levels. It is known that some certain factors incur the expenses of all processes that are effective in the emergence of a product and that these expenses have effects on the parts that form the product in different rates. In other words, the statements of cost and profit planned by the manager does not coincide with the figures occurred at the end of the period. Businesses generally defines the difference between the planned and actual statements as an invisible expense. In fact, this creates an unavoidable situation for businesses which is expressed as the forced acceptance of these uncertainties. One of the biggest financial error that arises as a result of this is that the cost of a product does not reflect its real value and accordingly the profitability ratios cannot be estimated correctly.

The prevention of the financial losses resulting from the inability to calculate unforeseen expenses goes through the accurate reflection of all the factors that affect the cost of a product. The key factor underlying this is the requirement of quickly gathering and processing the clear data from all the variables in the production areas and external factors under a single source (big data). In order this to happen, a smart costing system must be established. The "Industry 4.0" concept, which has been widely spoken recently and is referred to as the 4th Industrial Revolution, has put the smart factories on the agenda. In this way, Industry 4.0 and smart factories will allow businesses to eliminate all the disadvantages mentioned above.

Within the framework of this academic research, the radical changes that Industry 4.0 approach will bring about in product costing are explained by sectoral examples.

Keywords: Industry 4.0, Smart Costing, Smart Factories, Forest Products Industry

INNOVATIVE APPROACHES IN WOOD INDUSTRY

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For businesses to act in accordance with the developing technology will enable them to differentiate from their competitors with innovative approaches in a competitive environment. In addition to competitive elements such as cost, aesthetics, functionality, etc., all the innovative approaches of a business from design to final product are also an important mechanism in getting the edge over the competition.

Innovative thinking has different and important effects on the development of business models. Traditional revenue models involve unforeseen risks. For example, wrong and weak preferences that may occur in the parameters such as selection of job type and job site, determination of target group, pricing policy etc. can cause the related business model to fail. It is, however, possible to prevent financial losses by exhibiting the innovative approaches that minimize these risks.

In order businesses to survive, it has become essential to maximize their profitability because of the high-ranking competition as a result of the global economy. In this context, the businesses that operate efficiently are able to achieve the desired profit margins. Otherwise it has become nearly impossible for them to survive.

In the wood industry, the final products are produced by passing the raw material obtained from forest resources through various processes. Within all this complex structure, the businesses often suffer financial losses or cannot take huge leaps because of traditional habits. Apart from this, the handling of production processes and marketing the products with a new perspective form an important basis for the economic breakthroughs.

Within the framework of this academic research, the effects of the innovative methods and the transformations that these methods would bring in to the wood industry besides its traditional structure are examined.

Keywords: Innovative approach, Wood industry, Sectoral competition

EMPLOYING A MULTI-CRITERIA DECISION MAKING METHOD TO EVALUATE ENGINEERED WOOD PRODUCTS AND TIMBER

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In the present study, a decision-making model was devised to evaluate parallel strand lumber (PSL), laminated strand lumber (LSL), laminated veneer lumber (LVL), glued laminated timber (GLT) and timber. Assessment criteria were identified based on the literature review. The fuzzy analytic hierarchy process (AHP), one of the multi-criteria decision making (MCDM) methods, was employed to obtain the weights of the criteria and to determine the ranking of the alternatives. The results showed that LVL is the best alternative. Consequently, the evaluation model and results can assist building designers in making decisions during the selection of wood products.

Keywords: Multi-criteria decision making, Fuzzy analytic hierarchy process, Engineered wood products, Timber

MOLD RESISTANCE OF NANO AND MICRONIZED PARTICLES-TREATED WOOD AFTER ARTIFICIAL WEATHERING PROCESS

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When used in outdoor applications, unprotected wood develops color differences, cracks, and rough surface due to a number of deteriorating factors and eventually surface and performance of wood change in a short time. Various applications can be used to overcome such problems. In this study, we compared nano-scale (zinc oxide, copper oxide), micro-scale (MCQ - micronized copper quat) and common wood preservatives CCA (copper chrome arsenic) and ACQ (alkaline copper quat) in treated wood in terms of their effectiveness against mold fungi before and after artificial weathering process. Wood specimens were treated with the prepared solutions of nano copper oxide, nano zinc oxide, micronized copper quat, CCA and ACQ by vacuum methods. Accelerated weathering tests were performed in Xenon arc radiation cabinet with cycles of water spraying. Test parameters were arranged according to outdoor conditions. The test consisted of cycles of 102 min of radiation followed by 18 min of water spray in the same radiation conditions. The total duration of the test was 288 h for 3 specimens per each treatment group. Artificially weathered and treated wood specimens were evaluated for resistance to mold fungi according to the ASTM D4445 by employing three mold fungi. Following incubation with the fungi, the specimens were visually rated on a scale of 0–5. The mold scoring results collected before and after artificial weathering process showed that CCA and MCQ-treated specimens had the best performance properties; however, nano zinc oxide-treated wood specimens had the weakest performance against mold fungi.

Keywords: Artificial weathering, Mold growth, Micronized copper, Nano copper, Nano zinc

CERTIFICATED OF MEDICINAL AND AROMATICAL PLANT

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Demand for medical and aromatic plants in the world markets is increasing day by day. Turkey's foreign sales of medicinal and aromatic plants is one of the world's leading countries, while many medicinal plant exportation, foreign purchases also perform many plant. The fact that our country has different climatic and ecological conditions has a great economic potential in terms of the medicinal and aromatic plants cultivated and cultivated in nature in terms of the Flora's variety of plant species and diversity. In some species it may be economical to collect from nature, but it is difficult to obtain quality and standard crops from plants collected from nature. The cultivation of these plants, which are essential for reasons such as not being always at the desired level in the plants collected from the nature, post-collecting processing, storage and transportation conditions can not be met adequately.

Medicinal and aromatic plants are of high priority for conservation action, as their wild-crafting will certainly continue to play a significant role in future trade. Accordingly, it is necessary to ensure the sustainability of their wild-collection through developing and implementing adequate general and species-specific management programmes which should cover trade monitoring and guidelines for sustainable collection, maybe supported by an adequate certification. This requires co-ordinated conservation work at regional, national or even global level involving conservationists, scientists, governmental authorities, producers, traders and the processing industry.

In this study, the evaluation of medical and aromatic plants by different certification bodies will be examined. In addition, different certification bodies in the world will be compared and the practices in the country will be compiled

Keywords: Medicinal and Aromatical Plants, Certificated, Non-Wood Forest Products

THE EFFECT OF SOME TECHNOLOGICAL PROPERTIES OF PLYWOOD PANELS ON SEISMIC RESISTANT PERFORMANCE OF WOODEN SHEAR WALL

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Wooden buildings with many advantages such as being lightness, durability, earthquake resistant, healthy, insulating, and aesthetic are suitable for all kinds places especially in earthquake zones. The aim of this study is to investigate the effect of some technological properties of the plywood panels manufactured from some wood species grown in Turkey on seismic resistant performance of shear walls. Two different wood species (scots pine, spruce) and two different number of layers (5 and 7) were used in this study. Phenol formaldehyde resin was used as adhesive for plywood panels manufacturing. Bending strength and modulus of elasticity and density of plywood panels manufactured in an industrial plant were determined according to TS EN 310 and TS EN 323, respectively. Plywood panels were tested on full scale shear wall to determine the actual structural performance, maximum load and maximum displacement under the monotonic load according to ASTM E72. As a result of the study, the bending strength and modulus of elasticity values increased with number of layers for scots pine while the values decreased with number of layers for spruce. It was determined that maximum load values were increased for shear wall of each group with increasing bending strength and modulus of elasticity values of the plywood panels, while maximum displacement values of them were decreased.

Keywords: Shear Wall, Plywood, Scots Pine, Spruce, Seismic Resistant Performance

ANALYSIS OF SOCIO-ECONOMIC SITUATION FOR WOOD PRODUCTION WORKERS IN SUPPLY CHAIN

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Forestry works have an important place in the Eastern Black Sea Region because of the wealth of forested areas, the multiplicity of forest villages, the intense forestry activities and the lack of different income sources of forest villagers. Therefore, forestry activities are one of the main industries for forest villagers to prevent unemployment and to reduce income imbalance between different regions. Forestry activities differ from other sectors because of job difficulty, difficult working conditions, limited time, temporary work, low income and work that should be done by forest villagers as required by forest law. The analysis of the socio-economic structure of a community is important both in giving photographs of the current period and in presenting the transformations of working class dynamics over time. In this study, the socioeconomic status of temporary wood harvesting workers was examined in the Eastern Black Sea region. Within the scope of the study, a questionnaire including questions about personal characteristics, family structures, economic incomes and job satisfaction was applied to the workers. As a result, it was determined that 36 percent of all male workers were between 31 and 40 ages, secondary school graduate (42.27%) and moderately experienced (45.43%). In addition, forest workers had no income sources except for timber harvesting (75.2%), and most of the workers were the livelihoods of their families (81.4%) working for 6-8 hours. Most of them are satisfied with timber harvesting (78.4%), and the main reasons for not being satisfied were determined as low income, lack of social security and difficult working conditions (57.1%).

Keywords: Wood harvesting, Wood production workers, Socio-economic situation

EFFECT OF DRYING TYPES AND POLYSTYRENE DENSITY ON THERMAL CONDUCTIVITY OF POLYSTYRENE COMPOSITE PARTICLEBOARD

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Thermal conductivity of wood material is superior to other building materials because of its porous structure. Thermal conductivity is a very important parameter in determining heat transfer rate and is required for development of drying models in industrial operations such as adhesive cure rate. Thermal conductivity is used to estimate the ability of insulation of material. Thermal conductivity of wood material has varied according to wood species, direction of wood fiber, resin type, and addictive members used in manufacture of wood composite panels.

The aim of the study is to produce a new wood composite material with insulating properties by using insulating material called as polystyrene instead of formaldehyde based adhesives as bonding material. Five different wood species (beech, poplar, alder, pine, spruce), six different polystyrene species with different density values were used in this study and three layers particleboard in 18 mm thickness was produced. Urea formaldehyde resin (UF) was used in conventional panels manufacturing as adhesive. Technical drying was applied half of the test groups, while the other group was conditioned until reach to 12% equilibrium moisture content at room temperature as natural before manufacturing process to determine the effect of drying. The thermal conductivity of new composite panels were determined according to ASTM C 518 & ISO 8301.

According to the results from the study, thermal conductivity values obtained from natural drying were found to be higher than technical drying. The type of binder that gives the lowest thermal conductivity values among tree species in natural drying is generally S5. The lowest values in technical drying were obtained from panels bonded with XPS.

Keywords: Thermal Conductivity, Polystyrene Composite Particleboard, Drying Types

BRAND MANAGEMENT STRATEGIES FOR FURNITURE ENTERPRISES: CASE STUDY OF ORDU AND GIRESUN

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In today's dynamic business world, enterprises which are innovative, open-minded, knowledge-creating can be kept their assets as powerful players on the market they are in. In this challenging competitive environment, enterprises need to have a realistic and sustainable vision. Sustainability is an important focus for enterprises. Being recognizable and easy accessibility are the goals of each enterprise. One of the necessities to achieve this is to have a brand that is effectively managed on the market. Creating effective brand value in the domestic and foreign markets requires the existence of strategic studies. In the competitive environment where change and transformation are very fast, brand concept is one of the most critical concepts for enterprises one of the most critical concepts for businesses to tell themselves and reach their customers.

One of the most important branches of the Turkish forest products industry is the furniture industry. Turkish furniture industry is a heterogeneous structure which is consisted numerous enterprises that is micro and macro structure. Because of these heterogeneous structures and the multiplicity of structural and economic problems they have, enterprises need the change and improvement Customers are at the forefront of effective determining factor when most of the businesses are taking a decision.

This study is aimed to determine brand management strategies of furniture enterprises. Accordingly, current brand studies, brand assets, future plans related to brands, how their brands are seen in comparison with other brands in the sector, and their views on how their brands are transforming have been tried to be determined. In this context, data were collected with survey method from 45 furniture enterprises reached from Ordu and Giresun provinces which are located in Blacksea Region of Turkey. The obtained data were analyzed in computer environment, evaluations were made and suggestions were developed.

Keywords: Brand management, Turkish furniture industry, Furniture enterprises, SMEs.

PREDICTION OF BENDING PROPERTIES OF ORIENTAL BEECH WOOD EXPOSED TO TEMPERATURE

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In this study bending properties of Oriental beech (*Fagus orientalis* L.) wood which exposed to temperature predicted using ultrasonic measurements. Samples exposed to 120, 150, 180 and 210°C temperature for 2, 5 and 8 hours by oven that operated in atmospheric environment. Static bending samples, 20x20x400mm, acclimatized at 65%RH and 20±1°C. Clear cubic samples, 20x20x20mm, prepared from the end of bending samples to conduct ultrasonic measurements. Epoch 650 ultrasonic flaw detector and contact type transducers that propagate longitudinal waves at 2.25Mhz frequency used to measure time of flight values. And then sound velocities calculated with time of flight values. At first non-destructive and then 3 points bending tests performed. Relations between E_{dyn} values that predicted by ultrasonic method and Modulus of Elasticity in bending (MOE) figured out by coefficient of determination. Coefficient of determination values varied from 0.74 to 0.82 and these results showed that bending properties of beech wood that exposed to temperature can be reasonable predicted using ultrasonic measurements.

Keywords: Bending properties, Oriental beech, Ultrasound, Ultrasonic

FINITE ELEMENT MODELLING IN WOOD AND WOOD BASED MATERIALS

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Finite element analysis (FEA) has now become an essential and often indispensable part of engineering analysis and design. Finite element computer programs are commonly utilized in most fields of engineering for the analysis of structures, solid and fluid substances. In order to cope with the physical problems in engineering analysis and design, the finite element method (FEM) is employed. The main assumption of FEA is that sophisticated domains is discretized and presented by an assembly of simpler finite sized elements. To idealize physical issues to mathematical models, specific assumptions leading to differential equations with the mathematical models are necessary.

Modern engineering offers that a model may be used to predict beyond the test data. Thus, finite element model represents the definition of the progressive defect mode (i.e., crack, fracture, ductility, and brittle) of wood, as well as finger-joint timber beams and glue-laminated timber. Finite element model predicts properly nonlinear behavior of wood and mechanical connections and adhesive behavior under loading. The benefits of mathematical simulations are their efficacies that are associated with time, cost and decreased variability of outputs. However, FEA and several other quantitative analyzing methods are not anticipated to replace experimental observations. Rather, they are known to be powerful tools that have been allied with empirical monitoring and material characterization. In order to verify the numerical models using experimental study, material properties must be well known and entered into the program as engineering data.

There are numerous publications about finite element analysis of wood in the literature. Examining past studies this reviews study has been written. This review study provides information about the finite element models of wood and fasteners, damage distribution criteria of wooden materials and failure numerical model, material behavior.

Keywords: Finite element method, wood, connections, numerical analysis, failure mode

SHEAR MODULI DETERMINATION OF NATURALLY AGED BLACK PINE WOOD

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In this study shear moduli of naturally aged black pine wood predicted using ultrasonic measurements. Black pine timbers stored in a yard without any protection and exposed to rain, temperature, sunlight and etc. for approx. ten years. Clear 26 surface polyhedral test samples prepared from these timbers. All the samples acclimatized at constant temperature of 20±1°C and 65% relative humidity. And then ultrasonic measurements performed to predict shear moduli. Direct wave propagation method using two transducers chosen to conduct measurements. Olympus shear wave coupling medium used to ensure contact between transducers and sample surface and minimize the noise. Velocity of wave propagation calculated using time of flight values. And shear modulus of LR, LT and RT planes of wood calculated with density and velocity values. Results compared with the literature. It's seen that there were differences between results and literature data. But it's thought that making an inference can be validated when both aged and non-aged samples belong to same log.

Keywords: Shear moduli, Black pine, Ultrasound, Ultrasonic Testing, Non-Destructive Testing

RISK ANALYSIS APPLICATION IN FURNITURE PRODUCTION SYSTEMS: FINE KINNEY METHOD

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Industrial developments, technologically, have opened the way for people to change of their working conditions in production systems. While current developments increase the diversity of work, the work of the employees is easier in terms of physical work load, but they are concentrated in the mental angle, and things that need attention are increasing. All these developments require that business systems be evaluated within the framework of a system approach and that the workplace be designed and operated in accordance with the principles of occupational health and safety as a whole.

As well as being in many industrial manufacturing, furniture manufacturing enterprises also experience significant work-related accidents, deaths and loss of labor. When 98% of work accidents are thought to be preventable, it can be considered that such work accidents are caused by not taking adequate measures of occupational health and safety. In recent years, the legal regulations that are being pursued due to the increasing importance of occupational health and safety have forced businesses to conduct risk assessments.

In this study, it was aimed to determine the level of preventability of work accidents by applying the corrective and preventive actions to determine, evaluate and prevent the risks arising from the hazards the workers are exposed in furniture manufacturing sector. For this purpose, risks in a furniture manufacturing workshop operating in Istanbul province were evaluated using the Fine-Kinney method. Although the Fine Kinney method poses problems in quantifying possible relative values in assessing risks, It has some advantages in terms of accessibility, ease of use and workers' understanding. It is also a convenient and simple method for small and medium-sized businesses.

A table of risk values was created by using the probability, frequency and intensity values of the Fine-Kinney method in furniture manufacturing facility. As a result of the risk assessment, in the furniture manufacturing facility, to be 20 is very high, 29 is high, 27 is important and 1 is a possible risk; a total of 77 risks were identified. According to this, it is seen that 26.0% of the risk distribution is very high, 37.7% is high, 35.1% is important and 1.3% is in the possible risk category.

The risk groups are as follows:

- Very high risks; no precautions have been taken in response to emergency situations, deficiencies in electric and heating systems and air compressors, and the absence of environmental measurements to be made.
- High risks; ergonomic risk factors, lack of health examinations of employees, deficiencies in work equipment and misuse of equipment.
- Important risks; hygiene inadequacy, psychological risk factors, deficiencies in electrical and heating systems, deficiencies in work equipment and misuse of work equipment.
- Possible risks; unauthorized access to third parties' business environment.

After the risk assessment, the order of priority of the actions was determined according to the risk scores for all the identified risks, application report prepared. In the assessment of the risk made by the assumption that the COSs are applied in line with this report; it was found 63 collapsible risks and 14 possible risk levels.

There is agreement between findings in this study and literature findings.

Keywords: Furniture, Risk analysis, Fine Kinney method

USAGE POSSIBILITIES OF FLAXSEED (*LINUM USITATISSIMUM*) AS GROWTH MEDIUM FOR *CONIOPHORA PUTEANA FUNGI*

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Flax (*Linum usitatissimum*) is blue-flowered and one-year-old culture plant. Its species name, "*usitatissimum*", means "most useful" in Latin. In this study, ground and unground flaxseeds forms were used as agar medium instead of commercially available malt extract agar culture media to growth of *Coniophora puteana* fungi species. Malt dextrose and potato dextrose agars were used as control samples. *Coniophora puteana* mushroom micelles were put on the cooling mediums and kept in the air conditioner cabinet. The rate of growth of the micelles was observed and measured 7 and 10 days later using the DigiMizer program. Afterwards, samples of *Pinus sylvestris* L. were placed on the petri dishes and weight losses were measured after 3 weeks. The weight losses obtained from the samples on flaxseed showed similar findings compared to the synthetic agar mediums in which the *Coniophera puteana* ideally growth.

Keywords: Flaxseed, *Coniophora puteana*, Growth medium

THE STRENGTH PROPERTIES OF FURNITURE CORNER JOINTS ASSEMBLED WITH FASTENERS APPLICABLE WITHOUT PRE-DRILLING PROCESS

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In this study, the moment capacity and stiffness of furniture corner joints were examined. L type corner joints were prepared from 18mm thick melamine faced particleboard and assembled with 5 different fasteners (plastic, metal butterfly fasteners, plastic, metal angle bracket and 4.5x50mm screw) which are applicable without pre-drilling process. Diagonal tension and compression tests were applied to specimens. According to test results, the highest moment capacity was obtained in steel butterfly fasteners for diagonal tension tests and in 4.5x50mm screw for diagonal compression tests. Furthermore 4.5x50mm screw joints showed the best stiffness value in both diagonal tension and compression tests.

Keywords: Furniture, Corner joint, Moment capacity, Stiffness

EFFECT OF ACID RATIO USED ON THE RESIN YIELD IN THE PRODUCTION OF PINE RESIN (OLEORESIN) FROM (*PINUS MARITIMA* L.) AND RED PINE (*PINUS BRUTIA* TEN.)

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In this study, the effect of percentage of acid used in the production of pine resin (oleoresin) from *Pinus maritima* L. and *Pinus brutia* Ten. on the resin yield was investigated. Acid ratios for *P. maritima* L. were selected at 10%, 15% and 20% (Cmc3, site class I). Two separate fields were selected for altitude of 30 meters in Kefken (Cmc3, site class I) and 250 meters in Derince (Cmc3, site class II). In each region, 45 trees were selected in different acid groups in different diameters from 15 different trees were selected and a total of 90 trees were selected in two areas. A total of 7 wounds were opened in every 18 days. For acid concentrations 10%, 15% and 20%, Tree yields in Kefken were 2532gr / tree, 2635gr / tree and 2713gr / tree, and tree yields in Derince were 1367gr / tree, 1723gr / tree and 2147gr / tree, respectively.
The altitudes of 10 meters (Mavikent, Czd1, site class III) and 150meters (Şehitlik, Czcd3, site class II), were selected as two fields for the *Pinus brutia* acid ratios of 10%, 20%, 30%, 40% and 50%. For each concentration, 15 trees were selected in different diameters, and it was totally worked on 150 trees in two regions. Sulphuric acid with a concentration of 50% was used in the paste. Every 15 days, a total of 8 wounds have been opened. The yields for acid concentrations of 10%, 20%, 30%, 40% and 50 % were obtained as 753, 786, 881, 975 and 1035gr / tree for Mavikent field and 632, 643, 735, 750 and 766gr / tree for Şehitlik field, respectively.

According to the above results, as the acid concentration increased, the resin yield increased. The highest yields for P. maritima and P. brutia were 20% and for 50%, respectively.

Keywords: Oleoresin, *Pinus brutia, Pinus maritima*

THE EFFECTS OF PRIMER TRANSPORT TECHNIQUES ON RAW WOOD MATERIALS IN TURKEY

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Generally, there are two stages in the transportation of raw wood material from the forest. The first one is the primer transport that is the process of moving trees or logs from the cutting site to a landing or road side where they will be processed into logs or consolidated into larger loads for transport to a processing facility or other final destination. The second one is to transport the products from the stacked or main storage areas to trading storage and factories.

Primer transportation systems are commonly recognized as ground skidding systems, forwarders, cable systems, aerial systems, draught animals and other extraction systems (manual, pit-sawing, chute, winch truck, water). Primer wood transport, are heavy and quite costly in the mountainous terrain conditions. Because of difficulties in the primer transportations, instead of the human and animal forced transport systems, the machine usage has become more and more important during the primer transportation of raw wood material at the steep terrain. The primer transport methods with machines may cause technic, economic and environmental problems. One of these problems is the technical and physical defects on the wood raw materials.

In this study, the mechanized primer transportation systems (tractors and cable yarders) in Turkish forestry were introduced and each of them evaluated for the environmental and physical defects on raw wood materials. In addition to this, their work productivity of machine extraction systems and some research results obtained from some literature were given. At the end of this paper some assessments and recommendations were done.

Keywords: Primer wood transport, tractors, cable yarders

EFFECTS OF PRESSING TIME ON SOME TECHNOLOGICAL PROPERTIES OF LAMINATED VENEER LUMBER (LVL) PRODUCED USING NYLON WASTE AS ADHESIVE

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It is desired the wood composite materials which have broaden using areas in human residence have no negative effects on human health and environment. But because of formaldehyde content of most of resins used in wood based composite production, wood composite materials have been seen a threat on human health and environment. Therefore, numerous studies have been made to develop an effective method to decrease formaldehyde emission from the wood based panels and various methods have been tried.

The aim of the study was to investigate those effects of pressing time on some technological properties of nylon composite LVL. Poplar (Populus deltoides) veneers were used to produce nylon composite LVL. Three different pressing time (8, 10, 12 minutes) and pressing temperature 140 °C were chosen as press parameters in the manufacturing of nylon composite LVL. Bonding strength, bending strength, modulus of elasticity, density and equilibrium moisture content of nylon composite LVL panels were determined according to TS EN 314-1, TS EN 310, TS EN 323 and TS EN 322, respectively. The experimental results showed that technological properties of panels generally increased with decreasing pressing time.

Keywords: Nylon Composite LVL, Pressing Time, Technological Properties

COMPARISON OF TECHNOLOGICAL PROPERTIES OF PARTICLEBORADS PRODUCED FROM BRANCH AND STEM WOOD OF SEQUOIA

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Sequoia trees are the world's largest and longest living trees. The sequoia tree is commonly found in the United States of America. The tree is among the species that can be grown in Turkey, especially in the Black Sea Region. It is known that there are differences in technological features between the trunk and branch wood in the trees. In this study, the technological properties of particleboards produced from stem and branch woods of Sequoia species were compared.

Some mechanical properties such as bonding strength, bending strength, modulus of elasticity of the particleboard panels were determined according to EN 319, EN 310, respectively. Physical properties such as density and equilibrium moisture content were determined according to EN 323, EN 322, respectively. Also, thermal conductivity of particleboard panels was determined according to ASTM C 518 & ISO 8301.

As a result of the study, the technological properties of particleboards produced from branch wood were found to be higher than stem wood. In addition to, some technological properties of particleboards produced from stem and branch woods of the Sequoia, which has not been studied as much as its technological properties, have been investigated and partially tried to fill the literature space of Sequoia.

Keywords: Particleboard, Branch Wood, Stem Wood, Technological Properties, Sequoia

SOME PROPERTIES OF FIBERBOARD MANUFACTURED WITH WASTES OF KRAFT PULP MILL

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In this study, it was aimed to investigate the usability of some wastes such as wood chip screening rejects and kraft pulp screening rejects as fibrous materials in the manufacture of medium density fiberboard (MDF). Chip screening rejects were refined with a laboratory type refiner; however, pulp screening rejects were not refined.

These materials were added to commercial fibers with the rates of 10%, 30%. Fiberboards were manufactured using urea formaldehyde (UF) adhesive. Some properties of these fiberboards such as water absorption (WA), thickness swelling (TS), surface roughness parameters, color change, modulus of rupture (MOR) and modulus of elasticity (MOE) values were determined. As a result of these, it was found that all values showed different trend depending on rates and types of Kraft mill wastes. Generally, the use of these materials had positive effects on the panel properties.

Keywords: Fiberboard, Pulp fiber, Kraft process, Screening rejects, wood chips

INVESTIGATION OF THERMAL CONDUCTIVITY OF WOOD SANDWICH PANELS WITH ALUMINIUM AND POLYPROPYLENE CORE

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Sandwich panels are obtained by placing thick but rather light core material between two thin and rigid lower and upper surface layers. Sandwich panels, especially due to their light weight, high "strength / weight" ratio and durability compared to conventional materials have many use areas such as aviation and space industry, maritime, automotive and building industry It is one of the biggest advantages that sandwich materials can be obtained from different materials and geometric structures by choosing the lower and upper surface layers and the core for various applications. The aim of this study is to investigate the thermal conductivity values of the sandwich panels, which are manufactured with different types of surface and core materials in sandwich panels. An aluminium and polypropylene as a core materials and alder, birch and scots pine wood veneers were used as wood species for surface panels for manufacturing of sandwich panels. A polyurethane modified epoxy-adhesive were used for binding of core layer to both surface layers. Thermal conductivity of sandwich panels was determined according to ASTM C 518 & ISO 8301. As a result of the study, the highest thermal conductivity values were obtained from aluminium core sandwich panels. The highest values were obtained from alder for the aluminium core panels and scots pine for the polypropylene core panels as wood species.

Keywords: Sandwich Panel, Aluminium, Polypropylene, Core, Thermal Conductivity

SOME PHYSICAL AND MECHANICAL PROPERTIES OF THE HOT PRESSED EASTERN BEECH (*FAGUS ORIENTALIS* LIPSKY) WOOD

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The aim of this study is to determine some physical and mechanical properties of the staypack material obtained from the hot pressed eastern beech (*Fagus orientalis* Lipsky) wood that arranged with tangent to annual rings and 45 degrees angle to annual rings. For this purpose, test samples were prepared from the eastern beech wood, which was used in an old furniture. Half of the prepared samples were pressed in the hot press at 150 ° C and 100 bar pressure for 45 minutes. Air dry moisture, air dry and oven dry densities, the compression set ratio, the compression set recovery ratio, the bending strength and the modulus of elasticity, the compression strength values of the prepared samples were determined.

As a result, the compression strength, modulus of elasticity and tensile strength values of pressed with tangent to annual rings of samples were found to be higher than control samples and pressed with 45 degrees angle to annual rings of samples.

Keywords: Staypack, beech wood, physical properties, mechanical properties.

THE EFFECT OF OCCUPATIONAL SAFETY ON THE MOTIVATION OF EMPLOYEES IN THE ORGANIZATIONAL CULTURE: CASE STUDY FOR FURNITURE ENTERPRISES

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Organizational culture; is defined as a basic theoretical thoughts which are developed for harmonize internal and external environment and eliminate integration problems of a group who comes together for a spesific purpose. The responsibility of people who take part in the organization, their attitude and behaviours forms with reliability for the quality of human resources. Security culture which is consisted of organizational culture may have a different meaning for each person. This also indicates the relationship between the security culture and the organizational culture. The matter of occupational health and safety is closely related to the organizational culture that exist in foundations. For this reason; all the subjects of occupational safety culture belong to the organizational culture at the same time.

Occupational acidents and professional diseases, though many measuremnts taken and got strict constantly, are increasing day by day. Every accidents or disease which is experienced effects considerably employee's motivation. How the measurements which are taken in order to decrease the health and security risks in workplace effect is a significant issue that should be taken into consideration.

The aim of this study is to investigate the effect of work safety on the motivation of employees in the furniture enterprises within the scope of SMEs in Giresun and Ordu. In this context, 60 furniture operations were reached and data was collected via a questionnaire. The data was analyzed in computer environment via SPSS and AMOS programs. In the analysis, road models were established between the dimensions of the motivation scale and the dimensions of the work safety scale. According to the results of analysis, It was seemed that internal and external motivation dimensions have significant effects on x, y, and subdimensions of work safety. The obtained results have been interpreted together with literature and the subject has been opened to debate.

Keywords: Organizational Culture, Occupational Safety, Motivation, SMEs, Furniture Enterprises

OVERVIEW OF FURNITURE ADVERTISING IN TURKEY

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Turkish furniture industry reflects its development with various parameters such as product structure including design, function and marketing strategies. The importance of the design parameter has increased in recent years which lead to innovative furniture manufacturing. Most of the enterprises have improved Research and Development departments working on the design and manufacturing techniques of the products. Consumer demands also play an important role on the innovation of the furniture design and production. As final consumer is the target for manufacturers, marketing issues also appear on stage. Information regarding consumer buying patterns is critically important in estimation of future demand levels. Manufacturers keep sales volume information each year to be able to foresee the trend in the furniture market and buying potentials of their customers. Key information such as current market trends and demand helps to identify the potential of the profit from the furniture market. Manufacturers use this information to identify needs, preferences and buying habits of their customers. Manufacturers work on strategies to call the attention of the consumers in every way. Promotion is the way to communicate with the customers for manufacturers. Commercials help the manufacturers introduce their products. Companies are in need to emphasize and distinguish their product from competitors. Product innovation, fashion and individuality are very important notions for growth in the market. The connection between Design-Research and Development enhances the product improvement. Therefore, manufacturers aim to show their products to the consumers in the best way. In this study, advertising strategies of furniture manufacturers in Turkey are investigated by using selected TV, press and social media commercials.

Keywords: Furniture commercials, Turkish furniture industry, Furniture commercials, Turkish furniture manufacturers

PROTECTING OF TRADITIONAL KNOWLEDGE AND BIODIVERSITY: AN ASSESTMENT IN TERMS OF INTELLECTUAL PROPERTY RIGHTS AND NON-TIMBER FOREST PRODUCTS

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Providing non-forest forest products (NWFP) from forests is one of the important functions of forest resources. Recently, besides the ecological and economical aspect of utilization of non-wood forest products, the cultural aspect also stands out. The picking and use of the NWFP for food, medicine and other aims is as old as human history. Changing and developing tradition of utilization has become a part of the cultures of societies over the time. In this period, the communities benefiting from the NWFP have created a "Traditional Knowledge" which reaches to the present day. The components of this production are cultural elements such as knowledge, practice, belief, attitude, observation, experiences.

Today, there is an increasing social demand for culture related to NWFP, which has not been preferred in the past and not seen up to date. Despite the fact that there are sectors where intensive commercial activities are carried out in this area, NWFP and related cultures has been used until now without any permission from their owners. It was not examined who belongs to ecological traditional knowledge produced by the people interacting with the NWFP.

Today, the understanding of that conservation of traditional knowledge cause the preservation of biodiversity has in fact led to a further clarification of the value added. At this point, “Intellectual Property Rights” (IPR) are emerging as a legal tool to preserve traditional knowledge and therefore biological diversity. In this paper, we argued how we can benefit from IPR as a legal tool to transfer traditional knowledge and biodiversity to future generations. Today, in Turkey, there is only “Geographical Indication Protection” (GIP) as an IPR relating to NWFP. For instance, Bergama Kozak pine nuts, Safranbolu saffron, Aydın chestnut and Pervari honey were registered as a designation of origin; and Bozdağ candied chestnut and Hatay laurel soap were registered as a geographic indication. In addition, there are some examples which continue the registration process such as caper plant, Bolu saffron milkcap, Doğanyurt chestnut honey, Düzce chestnut honey, Ernez pine honey, Anzer honey Gökçeada thyme honey and Marmaris pine honey. At this point, the conservation of traditional knowledge, not including plants and related products is lacking. Therefore, new legislative arrangements are needed that can protect both traditional knowledge and biodiversity. This will lead to obtain gains such as protection of nature, prevention of biopiracy and economic benefit.

Keywords: Biodiversity conservation, Traditional ecological knowledge, Intellectual property rights

PRODUCTION BATCH SIZE 1 AS THE PRECURSOR FOR THE INDUSTRY 4.0 INITIATIVE

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In Europe, there has been promoted the trend of individually furnished interiors by furniture, which carries features of craftsmanship and is manufactured in an industrial manner.

The current level of network communications and the strong development of CNC woodworking machines make this type of production possible. The furniture company equipped with CNC technology has analyzed the working time consumption in production and identified weaknesses places. A solution has been designed to speed up the response to the customer's wishes.

Keywords: furniture production, CNC woodworking machines, customer, individually furnished interiors, Batch size 1

EFFECT OF HEAT TREATMENT ON THE SURFACE CHARACTERISTICS OF BAMBOO (*PHYLLOSTACHYS BAMBUSOIDES*)

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This study aimed to investigate the changes in the surface roughness, surface colour and surface gloss of heat-treated bamboo (*Phyllostachys bambusoides*). Bamboo culms were obtained from Trabzon, Turkey. Bamboo samples used for this study were cut from middle section of bamboo culms, and node sections of the culms were removed. Bamboo samples, which were conditioned at 20°C and 65% relative humidity, were heated at 140°C, 170°C and 200°C with heating time of 2 and 4 hours. The results of heat treatment samples were compared with the control samples. The results showed that the surface colour of the heat-treated bamboo samples changed from light to dark and total colour change values (ΔE^*) increased depend on heating time and temperature. The gloss values decreased after 140°C and 4 hours of heat treatment. The mean surface roughness parameters (R_a and R_z) generally increased with higher temperature and longer heating time.

Keywords: bamboo, heat treatment, surface roughness, colour, gloss

THE EFFECTS OF COUPLING AGENT ON SCREW DRIVING TORQUES IN WOOD POLYMER NANOCOMPOSITES

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The aim of this study was to investigate the effects of coupling agent on screw driving torques in wood polymer nanocomposite. The nanocomposite material prepared from black pine wood flour (pinus nigra j.f. arnold subsp. Nigra var. Caramenica (loudon) rehder). As factors, coupling agent type (with and without coupling agent) and pilot-hole diameter (0, 1, 1.5, 2, and 2.5 mm) were selected. The results indicated that the mean SET and STT values in wood polymer nanocomposite was higher when the coupling agent of MAPP was used for all pilot hole diameters and without pilot hole diameter. The mean SET values were significantly higher when the pilot hole diameter was increased from 0 to 2.0 mm.

Keywords: Pilot hole diameter, screw, seating torque, stripping torque, MAPP

SOME ANTHROPOMETRIC MEASUREMENTS ABOUT PRESCHOOL STUDENTS (DİYARBAKIR CITY EXAMPLE)

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In order to increase the compatibility between users and products, it is very important to make product designs that match the body size of the users. For this reason, anthropometric measurements are one of the essential tools for user-centred design applications.

The main purpose of the study is obtaining reference measure for product designs for preschool age group children in addition to contribute to the anthropometric measurement database of our country. For this purpose, anthropometric measurements were taken from the students aged 36-72 months in the kindergartens in Diyarbakır city centre. Measurements were made in accordance with normal anatomic position and anthropometry rules, with 46% female (266) and 54% male (312), totalling 578 students.

Correlations between the anthropometric measurements obtained in both sexes were analysed statistically and descriptive statistical results were evaluated. It can be said that the results of the study will be useful in ergonomic designs for physical areas and furniture in kindergartens and children's rooms, especially in Diyarbakır province.

Keywords: Anthropometry, Ergonomics, Pre-school students.

THE ROLE OF GS CERTIFICATION MARK ON FURNITURE INDUSTRY

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According to a new global innovative research, development and investments of furniture industry, World trade of furniture amounted to current US$ 94 billion in 2009 and grew in the following years to US$ 135 billion in 2014, then contracted in 2015 (mostly as a consequence of the depreciation of currencies of some major economies in relation to the US$) with no change in 2016. (A Report by Centre for Industrial Studies (CSIL, Milano)). And the industry is still growing. Furniture manufacturers, distributors and retailers who traditionally source goods and materials from across the globe are coming under increasing pressure to identify and comply with a raft of market specific regulations and strengthened safety requirements.

Although it is manufacturers responsibility to manage safety and quality assessments as well as to identify and meet regulatory and industry standards in target markets, customers look for assurance. Today's advertising world, it is quite difficult to understand product quality. Even if the products provide adequate strength, products' components can affect end user's health. That's why they want to choose certified products.

By getting GS test mark, customers can assume that their safety and health are not at risk during the intended and foreseeable use and during the foreseeable misuse of GS certified products. Therefore, the GS test mark offers the consumer an important decision aid and increases the trust and confidence in your products. The GS certificate has a high recognition value with consumers on the international markets and offers customers a clear and conclusive decision-making aid. With a GS certificate, manufacturer minimizes the probability of liability risks and gain a competitive edge.

Keywords: Furniture Industry, GS Mark, Quality Assesment

CRITICAL BUCKLING LOAD OF THE SIDE WALLS OF CABINET FURNITURE

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Loss of furniture stability may constitute a rapidly occurring, direct hazard to the user's life or health. Studies conducted to date have concerned the effect of the type of material and method of back wall attachment on its stability. In contrast, practically no analogous data are available on the stability of side walls. In the case of loading with a vertical force applied on a furniture item supported at three corners all the elements are subjected to torsional strain. However, the static pattern changes when the structure is supported at four corners. Then loading of a piece of furniture with a vertical force results in slight displacements in the direction of the acting force, whereas buckling and considerable deflections are perpendicular to the direction of that load. This has a significant effect on side wall stability. For this reason, it was decided in this study to determine the effect of side wall structure on stability (buckling) and postbuckling behaviour of side walls in cabinet furniture. The analyses consisted in numerical calculations using the Finite Element method. Three types of side wall structures were used: particleboard, honeycomb panel and board-on-frame. Values of critical forces, lateral deflections and normal stresses in the direction of the acting load were calculated. Testing results confirmed that the honeycomb panel provides the most advantageous structure for side walls.

Keywords: Furniture, side wall**,** honeycomb**,** buckling, postbuckling, numerical analysis

THE EFFECTS OF PRE-OZONE TREATMENT ON RETENTION LEVELS AND THE COMPRESSION STRENGTH OF SPRUCE WOOD TREATED WITH ACQ

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In this study, ozone pre-treatment was applied to spruce wood samples. Spruce wood samples at equilibrium moisture content (EMC) were pre-treated using ozone for 30 and 60 min, respectively. The intensity of ozone was kept constant at 15 g/h for all variations. The ozone pre-treated spruce wood samples were then impregnated with 2.5 % Alkaline copper quat ((Celcure AC500) (ACQ)) and 1% copper chromium arsenic (CCA) solution by applying initial vacuum for 20 min and then free-pressure for 30 min. The retention levels and penetration depths were determined for each variation and control sample. The ozone pre-treatment increased the retention levels and penetration depths. It was found that the retention levels were 5.03 and 5.27 kg/m^3 for the ozone pre-treated (30 and 60 min) spruce for wood samples treated with 2.5% ACQ, while the retention level for control wood samples was 3.84 kg/m^3. The results showed that ozone pre-treatment enhanced the impregnation properties of spruce wood. In addition, the applied ozone pre-treatment increased compression strength parallel to grain values (CS).

Keywords: Spruce; Ozone treatment; Penetration Depths; Retention; Mechanical Properties

A REVIEW OF LOG DEGRADATION RESULTING FROM MANUAL FELLING AND GROUND-ORIENTED HARVESTING IN TURKEY

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Forests in Turkey are generally situated on mountainous and treacherous terrains, making the initial phase of forest operations, a.k.a. primer transport, difficult. Primer transport includes manual felling of the marked trees from the stand, processing them on site, i.e. delimbing, debarking and bucking into merchantable sizes, and skidding the pieces, using human, animal or tractor power from stump to intermediate locations or road site landing zones to be loaded onto log trucks which would transport them to log depots or mills. Since both the level of logger professionalism and mechanization are considered as rather low to none-existent, the damage occurring on the final product, the logs, is worth mentioning. The compartments to be harvested are handed over to village cooperatives comprising of a number of abled individuals equipped with chainsaws and farm tractors. They have the initiative to enter the woods and carry out the given task. No harvesting scheme, micro level transport planning, is supplied and they do the job as they have observed from their elders over the years. Some degree of log degradation and devaluation has been reported through numerous studies. This study would summarize the wrongdoing in timber production. It is readily obvious that there is a drastic need in Turkey to upgrade the logger education and training, and mechanization must one way or another be embraced if forest operations and the resulting log quality are to improve.

Keywords: Logger training, mechanization, log damages

AN OVERVIEW ON FOREST INDUSTRY SECTOR IN TURKEY: CONSTRAINTS, PROBLEMS AND SOLUTIONS

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In this study, the effects on forest industry sector, price determination policies and past and present conditions of wood raw materials supplied from national forest resources to forest industry sector were examined in Turkey. The data which is obtained from literature review, legislation and applications are analysed using data analysis method, and then the subject is evaluated. With the establishment of the Republic of Turkey, it is accepted that the principle of operation and management of national forests is given to General Directorate of Forestry (GDF) which is state institution. Until the privatization of state-owned enterprises, Forest Products Industry Corporation (ORUS) and Turkey Pulp and Paper Factories (SEKA), a large part of the wood raw material produced from national forest resources supplied subsidy to these institutions by the GDF. At the end of the 20th century, forest industry sector in Turkey began to be represented by factories, plant and businesses established by private sector entrepreneurs. The GDF has lagged behind in new forest industry structure composed of private sector entrepreneurs; it reduced the cost of wood raw material production and prevented the real price from being produced in the wood raw material market, since GDF is a monopoly. Due to both the growth of the sector and the high prices of wood raw materials produced by the GDF, companies had to import wood raw materials. The GDF is the monopoly of wood raw materials; it is still on the market to present to estimated price with high costs of the wood raw material for buyers that have to buy. The GDF, which accepts high costs on the formation of wood raw material prices, declared that due to both high labor costs of production of the wood raw material and supporting the development of the forest village. But this high costs is still paid by forest industry firms who still receive wood raw materials from GDF. It is understood that raw material supply and pricing policies implemented by GDF constitute a major obstacle to the development of the sector. Nowadays, Turkey is structurally developed positively; both the sector and rural areas have been affected positively by this development. The change in the size and scope of rural development altered the concept of poor and poor forest villagers. The Law design to ensure the real prices of wood raw materials produced by GDF were accepted the Grand National Assembly of Turkey (TBMM) on April 19, 2018. This draft law introduces changes in 30 and 40 articles of the Forest Law 6831. With the amendment of this legislation, it is believed that GDF will eliminate unnecessary burden on wood raw materials costs and contribute to the development of private sector businesses operating in the forest industry sector. Thus, after privatization of ORUS, OGM will establish positive relationships with the forest industry sector in Turkey.

Keywords: Forest resources, Forestry, Forest products industry, Marketing, Turkey.

FOREST INDUSTRY ENGINEERING EMPLOYMENT IN TURKEY: WHY ARE WE UNEMPLOYED?

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The first Forest Industry Engineering program in Turkey established in the Karadeniz Technical University (KTU), Faculty of Forestry in 1971. The Faculty of Forestry of Istanbul University (IU), which only studies Forestry Engineering, opened the Department of Forestry Industrial Engineering in 1982. In the mid-1980s in Turkey, significant developments took place in the social, political and cultural field. These developments and changes also reflected forestry and the forest industry sector. In this period, Forest Products Industry (ORUS) and Turkey Pulp and Paper Factories (SEKA) were the most important state owned enterprises operating in the forest industry sector. Forest Industry Engineers graduated from Forestry Faculties of IU and KTU were employed in the public ORUS and SEKA. However, after the privatization of these two institutions and their withdrawal from the forest products market, there was an uncertainty in terms of employment in the forest industry sector. Then, seven Forestry Faculties were established within the new universities in 1992, these faculties are based on the departmental model available in Forestry Faculties of IU and KTU. Thus, 7 new Forest Industrial Engineering Department was opened. Some of them have taken part in the activity and they have begun to graduate in a short time. Furthermore, in some faculties opened evening education program as well as normal education program. While "The law numbered 5531, Forest Engineering, Forest Industry Engineering and Woodworking Industrial Engineering" which entered into force in 2006 as a professional law, benefited persons belonging to the Forestry Engineers, the problem of unemployment of Forest Industry Engineers have not remedied. Since factory or plant are needed for employment of forest industry engineer. Forest Industry Engineers do not have professional organizations. Although they can become members of the Chamber of Forest Engineers (OMO), it is debatable that they are protected by this chamber.

Keywords: Forestry, Forest industry, Forest industry engineering, Employment, Turkey

THE EFFECTS OF H_2SO_4 CATALYST AMOUNTS IN PRODUCTION PROCESS ON CELLULOSE ACETATE PROPERTIES

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The aim of this study was to investigate the effects of H2SO4 catalyst usage at different rates in cellulose acetate synthesis on its properties. Cellulose acetate production was carried out at 0.01, 0.025, 0.05 or 0.1 parts H_2SO_4 at 20 °C with traditional acetic acid method. Cellulose acetate samples were investigated FT_IR spectroscopy, x-ray diffraction method and Differential Scanning Calorimeter methods. Free acidity of cellulose acetate was 12.06% for 0.01 part H_2SO_4 catalyst and 10.55% for 0.1 part H_2SO_4 catalyst ratio in process, respectively. Degree of substitution of cellulose acetate was found higher for 0.1 part H_2SO_4 catalyst than for the other catalyst ratios. The glass-transition temperature (Tg) and the decomposition temperature (Td) for 0.01 part H_2SO_4 catalyst in cellulose acetate production were determined 183.5 °C and 329.2 °C, respectively.

Keywords: Cellulose acetate, Catalyst, Biodegradable polymer, Acetic acid

THE OXIDATIVE PRETREATMENTS OF CELLULOSE FOR CELLULOSIC SUPERABSORBENTS

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Cellulosic superabsorbents (SAP) are produced by using cellulose and cellulose derivative blends with different binding methods, generally. But cellulose in SAP leads decrease in water absorption and water bonding ability because of nonreactive character of cellulose based on its chemical structure. The oxidative pretreatments of cellulose were attempted for the resolve of disadvantage of cellulose in SAP, in this study. Hydrogen peroxide and TEMPO (2,2,6,6- tetramethylpiperidine-1-oxyl) were used for oxidative pretreatments of cellulose. Oxidized cellulose and carboxymethylcellulose (CMC) blended and cross-linked by epicholohydrin for cellulosic SAP production. Water absorption capacity of cellulosic SAP were determined in pH:2, 7 and 10. The results show that the oxidative pretreatments of cellulose had affirmative effect of water absorption capacity of cellulosic SAP according to control samples.

Keywords: Cellulose, Carboxymethylcellulose, Superabsorbents, Crosslinking, Epicholohydrin

SURFACE ROUGHNESS OF COMPOSITE PANELS AT DIFFERENT RELATIVE HUMIDITY LEVELS

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This paper describes a study of the quantify surface roughness of experimentally manufactured particleboards and sandwiched panels having fibers on the surface layers. Surface quality of specimens before and after overlaid with thin melamine impregnated papers were determined by employing a profilometer equipment. Roughness measurements and Janka hardness were carried out on the specimens conditioned at 60% and 95% relative humidity levels. Based on the findings in this work, surface roughness of the specimens exposed two relative humidity exposure showed significant difference from each other. Data determined in this study could be beneficial to understand behavior of such panels exposed different humidity levels.

Keywords: Surface roughness, Composites, Hardness, Overlaying

EVALUATION OF CONNECTIONS MADE BY DIFFERENT WOODEN MATERALS AND BRACKET UNDER CYCLIC LOADS

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Non-structural components including office furniture, bookshelf, office equipment dresser... which are used in the building during the earthquake, causes significant human and financial losses. In order to prevent injuries, non-structural components must be fixed by fasteners. The purpose of this study was to investigate the behavior of wooden connections made with different brackets under cyclic loading. For this purpose, connections on members from 3 different types of wooden materials including MDF and particleboard, along with 3 different brackets including four, six, and eight screws were manufactured. The 18 mm panel screws were used to fix the bracket on wooden materials. The manufactured connections were loaded under monotonic and cyclic load according to European standard EN 12512 and parameters such as impairment of strength, hysteresis, ductility, maximum load and displacement, and the stiffness were determined. During cyclic loading, the joints made by eight and six-screws brackets exhibited the highest and the minimum strength, respectively. The highest elastic stiffness was found for the six-screw bracket joint. The hysteresis in all joints was less than %20, which indicates the bracket joints are high resistance to cyclic loads.

Keywords: Cyclic loading, Wood, Particleboard, MDF, Bracket, Ductility, Hysteresis

MUSCULOSKELETAL RISKS IN FURNITURE INDUSTRY AND MODEL APPLICATION

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Musculoskeletal disorders which are affecting especially back, legs, arms, neck, wrist etc, frequently seen in workers working in jobs that require physical strength. The furniture industry is one of the labor – intensive and generally the hand–made working industries. Unsuitable working postures cause musculoskeletal disorders, as well as a reduction in productivity. In order to reduce the wear conditions of the people in the working environment, to benefit from skills of people more effectively, the spread of ergonomic applications has become mandatory. Ergonomic risk assessment methods in the literature were mentioned and work related to musculoskeletal disorders in furniture manufacturing were explained in this study. The implementation phase of the study, a furniture factory which is located in a hazard class and industry-leading was preferred. When selecting methods, OWAS, REBA and QEC methods were selected because of they are combined body assessment methods.

Keywords: Ergonomics, furniture, risk assessment

WASTE WOOD-FROM ORDINARY WASTE TO VALUABLE BIORESOURCE

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This research study is a compilation of literature review that presents a general overview about the generation, handling and utilization of waste wood. The present scarcity in natural resources due to exploitation, besides the environmental problems created by industrialization in mass production methods has transformed the concept of waste into resource. In this aspect, waste wood is also considered as a promising resource, since it is generated in each process stage of the forest industry operations; initiated by harvesting logs from the forest, followed by the primary processing at the sawmills, then continuing with the use of sawn timber in secondary production facilities and even in the end at the disposal stage after use, if certain material quality requirements are met. The resource-based management perspective and the environmental concerns have led the waste wood to be handled with the sequence of reduce, reuse, recycle, recover and landfill from most favoured to least option, respectively. About recycling stage of the waste wood, the influence of mechanical innovations regarding machinery and equipment which have been used in the sorting and size reduction processes is a determinant factor to be highlighted, since contaminant removal is a key issue for many end use applications. In addition to hierarchical handling of waste wood, there has been also implementations towards cascading-use of waste wood in order to prolong its useful life and reduce the amount of residues that are disposed to landfills.

The study points out that handling waste wood is interdependent with solid waste management systems regarding the municipal and construction-demolition waste streams. Furthermore, the legal bindings are important to encourage industry and consumers to separate waste at site for manufacturers as much as it is viable, otherwise penalties should be imposed for unproper applications in order to prevent future occurrences.

Through the investigation of waste wood handling, it is found out that the utilization availability options of waste wood are primarily present in renewable energy sector, conventional wood-based panel industry and the innovative composite materials field. The intensive industrial implementations, scientific research studies, legal regulations and state sanctions are implemented by Germany, Finland, Sweden and United Kingdom in the European continent and United States of America and Canada in the American continent. The inspection about waste material handling in general reveals that this issue is just not related to industrial development, but also dependent on government regulations and social-cultural awareness of societies.

Keywords: waste wood, resource management, waste management, recycle, reuse, cascading-use, bioenergy feedstock

INVESTIGATIONS OF THE AESTHETIC-DECORATIVE FEATURES OF COATINGS IN ANALOQUE PRINTING TECHNOLOGY

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The aim of the study was the determination of the influence of UV + IR radiation on selected coatings properties of UV acrylic lacquer systems. The cognitive aspect was the estimation of the aesthetic-decorative features (appearance, color, gloss) and the adhesion of the tested system to the substrate (adhesion, wettability). Samples for the investigations in printed version with the imitation of 3 wood species ("ash", "birch" and "oak") were prepared in industrial on-line conditions of BORNE FURNITURE Comp. in Gorzów Wlkp. The aging of the samples was carried out, exposing the samples to UV+IR radiation at 1, 2, 4, 8 h respectively. The gloss was determined by the photoelectric method using the PICO GLOSS apparatus at three angles of 20, 60 and 85°. For evaluation color the colorimeter DT-110/145 (CIELab system) was used. Contact angle was determined acc. to the PN-EN 828 standard using a PG-3 pocket goniometer. Free surface energy with dispersion and polar shares for each coating system was calculated. The adherence acc. to the pull-off method (PN-EN 4624) was carried out. It was stated that tested finishing systems showed very good adherence to the substrate. Aging test including UV+IR radiation didn't influence to the aesthetic-decorative features of coatings. Gloss level was stable during aging, while color slightly changed.

Keywords: UV lacquer, printing, coating, gloss, color, adhesion

DETERMINATION OF THE OPTIMUM FEED RATE AND SPINDLE SPEED DEPENDING ON THE SURFACE ROUGHNESS OF SOME WOOD SPECIES PROCESSED WITH CNC MACHINE

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In modern furniture industry, CNC machines are widely used, especially when high quality of product and flexibility of manufacturing process are expected. Even though there are many advanced computer-aided manufacturing systems for furniture producers, it is difficult to set process parameters according to obtain desired material surface properties because wood is a natural polymeric material with a heterogeneous structure. Wood surface properties are affected both material and machining factors, such as wood species, anatomical characteristics, moisture content, grain direction, feed rate, spindle speed, cutting depth, and tool geometry. In this study, it was aimed to determine of the optimum feed rate and spindle speed depending on the surface roughness of some wood species processed with CNC machine. Spruce, chestnut, larch and iroko were used as wood species. Three spindle speed (10000, 14000 and 18000 rpm) and feed rate (5000, 7000 and 9000 mm/min) were determined for CNC processing. The surface roughness (Rz) of wood samples were determined according to DIN 4768 standard.

As a result of the study, the lowest surface roughness values were found in 10000 rpm spindle speed and 5000 mm/min feed rate for spruce and chestnut wood and 18000 rpm spindle speed and 7000 mm/min feed rate for larch and iroko wood. The highest values in the all of wood species were obtain from 10000 rpm spindle speed and 9000 mm/min feed rate.

Keywords: CNC, Spindle Speed, Feed Rate, Surface Roughness

SOME TECHNOLOGICAL PROPERTIES OF ORIENTAL BEECH (*FAGUS ORIENTALIS* LIPSKY.) WOOD GROWN IN AYANCIK/SINOP REGION IN TURKEY

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In this study, it was investigated some physical and mechanical properties of naturally grown Oriental beech (*Fagus orientalis* Lipsk.) in the Ayancık-Sinop in the Middle Black Sea Region of Turkey. The experiments were carried out on the test specimens obtained from randomly selected 5 samples trees taken from the region, according to the relevant TSE, ASTM and ISO standards. As a result, density values of air and oven dry, volume density value, compression strength parallel to the grain, static bending strength and modulus of elasticity, impact bending, tensile strength parallel to grain, tensile strength perpendicular to grain in tangential and radial direction, cleavage strength perpendicular to grain in tangential and radial direction, shear strength parallel to grain in tangential and radial direction, values of Brinell-hardness in transversal, tangential and radial sections were 0.693 gr/cm^3 and 0.666 gr/cm^3, 0.552 gr/cm^3, 619 kp/cm^2, 1182 kp/cm^2, 119256 kp/cm^2, 0.96 kpm/cm^2, 1407 kp/cm^2, 37.66 kp/cm^2 and 33.74 kp/cm^2, 109.68 kp/cm^2 and 72.78 kp/cm^2, 110.70 kp/cm^2 and 106.59 kp/cm^2, 5.42 kp/mm^2, 2.85 kp/mm^2 and 2.60 kp/mm^2 respectively. Somewhat higher values were obtained in this study by comparison with another research in the same region. This difference may be related to growth conditions of trees. In particular, it can be stated as the most important factor that the sample areas are at lower altitude.

Keywords: Beech wood, physical properties, mechanical properties.

DRILLING BITS AND OPERATIONS USED IN DRILLING MACHINES IN FURNITURE INDUSTRY

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Various manual, semi-automatic or fully automatic tools and machines which have different capacities are used for drilling operations in furniture, joinery, wooden and wood building industries. These show significant structural and functional changes based on traditional and advanced technologies. Especially in the last quarter of the 20th century, the use of CNC machines in the processing of wood and wood-based materials provided significant possibilities in production elasticity and capacity. These have high dimensional sensitivity and surface quality processing technology from the simplest to the most complex product geometries. Although CNC machines have advanced technologies, the interactions between cutting tools, machining conditions and materials have an important place in the machining of wood and wood-based materials for a good surface quality. Parameters of machining conditions are presented in a wide range with technical data, equations and graphics associated with surface quality for both traditional and modern machines. However, in practice, the machining conditions are usually based on the feed rate, rotation speed, grain direction, cutting width and material type according to cutter characteristics. In this study, it is focused on drilling bits and machines used in furniture industry. Problems and proposed solutions encountered with drilling operations were indicated.

Keywords: Drilling machines, drilling bits, furniture industry, wooden materials.

EFFECT OF DIFFERENT RATIO PERACETIC ACID BLEACHING ON THE SURFACE ROUGHNESS AND COLOUR CHANGING OF SPRUCE WOOD AND BEECH WOOD

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Final quality of finishing depends on various elements including application method of coating, characteristics of substrate such as porosity, chemical structure, and interaction between coating and the substrate. The purpose of this work is to determine some surface properties of peracetic acid bleached specimens of wood species with cellulosic varnish as a function of peracetic acid ratio. For this purpose, beech which hardwoods species and spruce which softwoods species were used and also cellulosic varnish were used and peracetic acid with there diferent raito (undiluted, 1/3 diluted and 1/6 diluted) was used. The surface roughness values and colour changing of the samples were determined. As a result, it was determined that the use of peracetic acid increased the surface roughness of the samples. The highest surface roughness was found in samples of bleached spruce with peracetic acid diluted 1/3. The highest colour changing was determined of bleached beech wood with peracetic acid diluted 1/3.

Keywords: Spruce, Surface roughness, Colour changing, Bleaching, Peracetic acid (undiluted, 1/3 diluted and 1/6 diluted)

INFLUENCE OF BLEACHING CHEMICALS ON THE SOME VARNISHING PROPERTIES OF COATED FIR WOOD

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This study was performed to determine the effect of bleaching chemicals on surface adhesion strength and surface roughness in Fir wood. This purpose five different bleach chemicals which sodium hydroxide-hydrogen peroxide, oxalic acid, peracetic acid, peracedic acid diluted 1/3, peracedic acid diluted 1/6 and fire wood (Abies normanniana) were used. In this study, effect of heartwood, sapwood ratio and flat, edge grained cross section surface roughness and adhesion strength on fir wood were determined. All specimens were varnished with cellulosic varnish. Surface roughness of coated samples were also measured using a stylus method. Adhesion strength was determined according to related standarts for bleaching and control samples. The results indicated that, all bleaching chemicals were increased the surface roughness. While the lowest adhesion strength was determined for the samples treated with oxalic acid bleaching, the highest adhesion strength was determined for the samples treated with perasetic acid bleaching. Peracedic acid diluted 1/6 bleaching gived the the highest colour changing values.

Keywords: Fir, Bleaching, Surface roughness, Colour Changing, Adhesion strength

THE LOW-VELOCITY IMPACT BEHAVIOUR OF WOOD SKINNED SANDWICH COMPOSITES WITH DIFFERENT CORE CONFIGURATIONS

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In this paper an experimental investigation on the low-velocity impact response of wood skinned hybrid sandwich composites was presented. Firstly, the impact damage analyses were made on different thermo-wood materials; ashwood, ıroko and pinewood at low speeds with different energy levels. And so the ashwood one was observed as the most suitable skin for sandwich design. Several alternative design configurations were developed by using rubber-cork and E-glass composite layers between the foam core and wood skin in order to improve the impact performance of conventional sandwich composites. Low-velocity impact (LVI) tests were performed using a drop weight test machine at different impact energies and destructive cross-sectioning was performed to examine the interior damage growth and penetration depth of the specimens. The impact performances of the specimens were evaluated in terms of energy absorption capacity, maximum contact force and penetration depth. The multi-core design concept significantly improved the energy absorption capacity with a reduced extent of impact induced damage. The proportion of recyclable materials in each configuration and the energy absorption levels per unit cost were also presented for the interest of product designers.

Keywords: Wood skin, Sandwich structures, Impact behaviour

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POSTER PRESENTATIONS

MODELLING OF WOOD UTILIZATION IN THE TRANSITION TO A GREEN ECONOMY

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This paper presents the preliminary results of the ongoing research project aimed at the use of wood in the transition to a green economy in Slovakia. The main objective of the project is to propose and develop optimal models of wood use in the national context that would take into account the main principles of the green economy and their application in different sectors of wood production, processing and utilisation. In particular, the paper presents the results of the analysis of the production potential of wood and the prognosis of its development, with a specific attention paid to the possibilities of wood felling by tree species (coniferous and broadleaves) and the representation of the quality grades of wood assortments.

Based on the present state of wood utilisation in Slovakia, a proposal of the simplified basic model of wood material flows was developed covering the flows of the main raw wood material groups: roundwood, pulpwood, fuelwood and a separate flow of energy wood. The proposed wood flows cover the primary and secondary wood sources and their utilization while taking into account apparent domestic consumption. This basic model will serve as a reference basis for the comparison with other wood use options.

Variant models will be based on the proposed changes to the current state resulting from the analysis of and discussion on the factors affecting wood flows. As a part of the project, carbon monitoring and its quantification in harvested wood products is performed for the purposes of modelling and optimization of wood utilization.

Keywords: wood flows, wood products, wood felling, wood assortments, carbon balance

THE EFFECT OF NANO-GRAPHENE OXIDE ON PHYSICAL AND MECHANICAL PROPERTIES OF PARTICLEBOARD

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In this research, the physical and mechanical properties of 3-layered particleboard made of industrial wood chips and UF resin consumption of 10 wt% with four levels of grapheme nano oxide including 0, 0.25, 0.50 and 0.75 percent based on the dry weight of UF resin and tow pressing times including 4 and 5 minutes were studied. The results showed that by increasing the amount of graphene nano-oxide from 0 to 0.75 percent and pressing time duration up to 5 minutes, dimensional stability of the boards improved. It means that thickness swelling after 2 and 24 hours immersion in water decreased significantly. Also, the addition of graphene nano oxide to the boards has a significant effect on internal bonding. It means that increasing the amount of graphene nano-oxide has increased the adhesion of the boards to a significant level. On the other hand, the press time had a positive effect on internal bonding of the boards. Somehow, byincreasing the amount of graphene nano-oxide and the increase in press time, the internal bonding of the boards increased significantly, and all boards had a higher adhesion than the European standard.

Keywords: Graphene nano-oxide, Dimensional stability, mechanical properties, Internal bonding.

INVESTIGATION ON USING ALKALI SULFIT-ANTHRAQUINONE (AS-AQ) LIQUOR POWDER AS COUPLING AGENT FOR WHEAT STRAW FLOUR-POLYPROPYLENE COMPOSITE

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In this research, the effect of the wood filler content and coupling agent (MAPP) on the physical and mechanical properties of Polypropylene composite reinforced with wheat straw flour from the annual harvesting of wheat straw, were studied. For this purpose, the wheat straw flour in three levels of 30%, 40%, 50% and four levels: 0%, 5%, 10%, 15% of alkali sulfite-anthraquinone liquor powder as compatible, were used. Then, the physical and mechanical properties of samples, including thickness swelling after 2 and 24 hours of immersion in water, bending strength, bending modulus, tensile strength, tensile modulus, were measured. The results showed that by increasing wheat straw flour, the bending strength and tensile strength were decreased but the thickness swelling, bending modulus and tensile modulus were increased. It was also found that by alkali sulphite-anthraquinone liquor powder as compatible, thickness swelling, bending strength, bending modulus, tensile strength and tensile modulus were improved. The results revealed that at increased consumption of wheat straw flour and adding compatible leads to improve quality of the interface and significant changes especially dimensional stability and MOE, are achieved.

Keywords: Alkali sulfite-anthraquinone liquor, polypropylene, wheat straw flour, coupling agent.

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

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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. One way ANOVA analysis have been proceeded to indicate relationships of glue joint shear strength between pairs of tested panels, and showed that there were no statistically significant differences between them.

Keywords: Solid wood panel, Glue joint shear strength, PU adhesive, Thermally treated boards

THE IMPORTANCE OF THE MINORITY TREE SPECIES IN THE WOOD PROCESSING

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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 autochtonous 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 (M*alus sylvestris* Mill.). The study explaines different reasons for endangernment of this species, the possible uses of its wood and neccessary 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.

Keywords: minority tree species, european crab apple, wood processing, rare wood

INVESTIGATION ON DIMENSIONAL STABILITY OF PARTICLEBOARD MANUFACTURED FROM TOBACCO STALK WASTES AND INDUSTRIAL WOOD PARTICLES

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In this study, the dimensional stability of particleboard manufactured by industrial wood particles and agricultural wastes including tobacco stalks was investigated. For this purpose, different ratios of tobacco stalk wastes and industrial wood particles were used including 0:100, 30:60 and 60:40. Also, UF resin was used as 12 wt% and 14 wt%. Then Thickness swelling within 2 and 24 hours immersion in water was measured. The results showed that increasing the amount of tobacco stalk particles increased the thickness swelling within 2 and 24 hours immersion in water, but all of the boards had optimum standard of EN. It means that increasing the amount of tobacco stalk particles even up to 60 percent had no negative effect on dimensional stability in accordance with EN standard. In addition, increasing the amount of UF resin had a positive effect on reducing thickness swelling and improved dimensional stability of the boards.

Keywords: Dimensional stability, Tobacco stalk wastes, Urea formaldehyde resin.

THE EFFECTS OF STEP OVER, FEED RATE AND DEPTH OF CUT ON THE SURFACE ROUGHNESS OF THE MEDIUM DENSITY FIBERBOARDS PROCESSED WITH CNC MACHINE

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Medium density fiberboard (MDF) is used extensively in furniture production in all over the word. One of the most important reasons for the preference of MDF is the easy shaping of its surfaces. In the past, the surfaces of the MDF boards were processed using conventional machines. Nowadays, Computer Numerical Control (CNC) machines are used in the processing of the MDF boards. CNC machines is operated using some computer control command which provide the action of the machine. The code file consisting of these commands contains some adjustments such as step over, spindle speed, feed rate, dept of cut, machining strategy, step down, plunge rate etc. These adjustments change the surface roughness of the processed section of MDF board. In this study, the influence of depth of cut (2 and 6 mm), the step over (20%, 40%, 60% and 80%) and feed rate (3, 5 and 7 m/min) settings on the surface roughness of MDF were investigated. According to the obtained data, it was concluded that the surface roughness increased as the depth of cut, the feed rate and the step over are increased.

Keywords: CNC machines, surface roughness, stepover, feed rate

3D PUZZLE TOY: RECYCLING OF CORRUGATED BOARD WASTE AND A NEW SECONDARY USAGE AREA

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A corrugated cardboard (CC) comprises of a corrugated layer interposed between two liner layers (Gök, Akpınar, Selçuk, & Vergili, 2017). Some errors can occur when corrugated cardboard is being produced. These faults are often caused by adhesion problems and the production of hunchback cardboard. In such cases, the products cannot be used and are transformed into waste.

In this study toy designs were made by using faulty and production excess paper produced in Ankutsan AŞ. Thus, a secondary usage area is provided to the corrugated box waste. These toys are designed as they can be built by interlocking to each other. These designs cut with CNC router machine from corrugated cardboard. Designed as a three-dimensional puzzle, these toys are a healthier choice than plastic toys for children because they are made from paper-based natural materials. They are also nature friendly due to the recycling instead of being thrown after the use of the toys.

3D corrugated cardboard toys are inexpensive and easy to access, and are also a kind of intelligence-enhancing toys that children will assemble themselves. In addition, these toys can be turned into a game more than once by being disassembled and assembled. It is aimed that the toys obtained in this study will be delivered to children without toys through the related associations and organizations and social awareness will be created in this respect.

Keywords: 3D puzzle, recycling, corrugated cardboard, CNC, social awareness

IDENTIFICATION OF CUPRESSACEAS CHILEAN AND ARGENTINEAN ENDEMIC INCLUDED IN APPENDIX I OF CITES, THROUGH DART TOFMS

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Larch (Fitzroya cupressoides ((Mol.)) Johnst.)) and the Guaitecas cypress Pilgerodendron uviferum (Don) Florin) are two of the three species of conifers in the family Cupressaceae endemic to southern Chile and Argentina that are closely related morphologically. Both are listed as Appendix I in the Convention on international trade in endangered species of Fauna and Flora Silvestres (CITES), whose purpose is to ensure that international trade does not pose a threat to its survival. Collaborative research of Chile and the USA, developed a project which aimed to study the chemical -molecular expression of these species by analyzing the heartwood with a DART TOFMS (Direct Analysis in Real Time (DART) Time-of-Flight Mass) Spectrometry (TOFMS), which has the advantage of being very rapid, requires very small sample size and is reliable. In essence it is a robust tool useful to identify shipments of finished products or timber suspected of being illegal.

This study reviewed the macro and microscopically features of heartwood reference samples for both species, whose provenance was known, and evaluated the chemotype produced by the DART TOFMS.

The obtained spectra were analyzed statistically using supervised and non-supervised classification algorithms.

The mass spectra results obtained from small pieces of heartwood for both species, reveals that their identification is feasible in a few seconds, with a statistical certainty of 99%. Clearly the evolutionary selection of resins developed different strategies for these closely related species, and this chemical signature is helpful for identifying species source when illegal trade is suspected.

Keywords: Forensics, illegal lumber, Pilgerodendron uviferum, Fitzroya cuppresoides, multivariate statistics

CHEMICAL CONSTITUENTS FROM BARK OF *PINUS DENSIFLORA*

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Pine tree (*Pinus densiflora*) belongs to the family *Pinaceae* and are distributed in East-Asian countries, especially in Korea, northeast China and Japan. The tree has been used for oriental medicine, and also for health food and dietary supplements.
The wood and bark were collected and ground after drying, then immersed with 70 % aqueous ethanol for 3 days, respectively. After filtration, the extracts were fractionated with *n*-hexane, chloroform, ethyl acetate (EtOAc) and H_2O, then freeze dried after condensation.
Total flavonoid and polyphenol contents were investigated and glucose uptake activity, one of the antidiabetic tests, was also evaluated. Total flavonoid and polyphenol contents were higher in inner and outer bark than in wood. Glucose uptake activities on wood and bark were also similar to insulin used as the positive control in all of fractions.
EtOAc soluble fraction of bark were chromatographed on a Sephadex LH-20 column using MeOH, H_2O, various aqueous MeOH-H_2O and EtOH-hexane as eluting solvents. The isolated compounds were elucidated as (+)-catechin (1), (-)-epicatechin (2), taxifolin (3), taxifolin-3'-*O*-*β*-D-(+)-glucose (4), quercetin (5) and quercitrin (6) by spectral and literature data, and also by comparison with the authentic samples.
Based on the above results, it can be suggested that the pine bark extractives can be a natural resource for manufacturing supplementary health products.

Keywords: Pine tree (*Pinus densiflora*), column chromatography, flavonoid and polyphenol contents, glucose uptake activity, health products

THERMAL CONDUCTIVITY OF CROSS LAMINATED TIMBER (CLT) WITH A 45° ALTERNATING LAYER CONFIGURATION

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Cross-laminated timber (CLT) has increasingly become a viable alternative to other structural materials, mainly because of its excellent properties related to sustainability, energy efficiency, and speed of construction. This has resulted in the recent emergence of a significant number of CLT buildings constructed around the world. Cross-laminated timber panels consist of lumber boards stacked and glued in layers, which run perpendicular to each other, making them dimensionally stable with high in- and out-of-plane strength and stiffness. Thermal conductivity is used to estimate the ability of insulation of material. Thermal conductivity of wood material has varied according to wood species, direction of wood grain, specific gravity, moisture content, resin type, and addictive members used in manufacture of wood composite panels. The aim of this study is the comparison of two types of CLT panels consisting of boards either with grain direction aligned at 45° or at 90°, in terms of their insulation properties. In the study, spruce (*Picea orientalis L.*) was used as a wood species, and was used polyurethane for CLT panels. Thermal conductivity of CLT panels was determined according to ASTM C 518 & ISO 8301. As a result of this study, it was indicated that thermal conductivity values for 90° layers were higher than the values for 45° layers.

Keywords: Cross-laminated Timber, Grain Direction, Spruce, Thermal Conductivity

SUSTAINABLE CORRUBOARD FURNITURE DESIGN

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The furniture industry mostly uses wood-based raw materials. Since wooden furniture is heavy and bulky, moving it is a problem. Nowadays, demounted wooden furniture is produced to facilitate transportation. However, demounting furniture deforms when it is disassembled and it is often difficult to combine. Besides these, processing of wood and production of furniture is a tedious and costly process.

In this study, corrugated cardboard furniture (CCF) designs were made by hand drawing and using AutoCAD program to solve the disadvantages of wooden furniture. Than furniture designs were cut off from corrugated cardboard with CNC router machine. Corrugated cardboards used in this study provided from Ankutsan Inc. R&D Centre. The designed CFF is combined with the interlocking systems, so no coupling parts are required like screws. There is no problem of screws become stripping. It is lightweight and easy to carry. It can be easily assembled at the desired location. It is a suitable solution for people who take furniture for a short time, especially students and frequent travellers. These are environment friendly because it can be recycled when the usage time is over.

Keywords: Corruboard, Corrugated Cardboard, Furniture, Sustainable Furniture

EXPANSION OF THE SUBTERRANEAN TERMITE (*RETICULITERMES FLAVIPES.* KOLLAR) IN CHILE

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The species of subterranean termite that is seriously affecting homes in Chile wood was identified as *Reticulitermes flavipes* Kollar, an xylophagous insect detected for the first time in 1986 in Santiago, Chile, as recorded in the records of the Museum of Natural history and of the Servicio Agrícola y Ganadero (SAG). Estimated its introduction occurred in the 60´ in contaminated packaging wood coming from the United States.

Since its detection, this urban plague has shown a rapid expansion and aggression, verifying an increase of complaints in different areas of the Metropolitan Region and V Region of Valparaíso. Early studies indicated the existence of 80 outbreaks of infestation in 29 communes of the city of Santiago. In the Region of Valparaiso, the year 2004 there were 56 focus in different communes.

This study aimed to detect the area where the pest is currently present and put on alert the authorities related to its effects and control, as well as the causes of its expansion. For which a survey was designed with open and closed questions addressed to municipal managers of the handling of complaints and/or control.

The results indicate that there has been a rapid expansion to other communities of the city of Santiago in the Metropolitan region; as well as in the region of Valparaiso. This shows a rapid and great adaptation of the insect to different climate and soil conditions, generating significant economic losses and discomfort to the owners of the affected homes. The causes include: general ignorance about the insect, transport of infested material, inadequate constructive design, almost no use of preventive measures for the protection of wood and curative control in the affected homes.

Keywords: subterranean termite, Reticulitermes flavipes, pest species, survey, termite expansion

EFFECTING OF SOME QUALITY PROPERTIES OF PRESS PLATES IN DIFFERENT FORMS ON MELAMINE COATED PARTICLEBOARD SURFACES

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In this research, it was aimed to determine the effect of the press sheets (chipboard covered with melamine resin impregnated decor paper) with different forms on the surface properties (cigarette fire, water vapor, and resistance to hot pots). For this purpose, 8 mm thick test plates pressed with melamine resin décor papers were obtained by using press plates with four different surfaces (NTR, HGS, BUTE, STR). According to test results; mean values of resistance to cigarette fire (were prepared according to TS EN 14323) were NTR (4), BUTE (4,33), HGS and STR (4,66); mean values of water vapor resistance (were prepared according to TS EN 14323) were determined as NTR and BUTE (5), HGS and STR (4,66). Despite that, it has been found that the average values of press sheets with different forms give a similar result. Despite that, it has been found that press sheets with different forms give similar results (5) in the mean values of the resistance to hot containers (were prepared according to TS EN 438-2).

Keywords: Particle board, Decor paper, Press sheet form, Surface properties