

The future of wood products' trade and industry in Iran

Abstract

The last two decades consisted of a steady decrease in timber production levels in Iran in order to preserve the Hyrcanian forest as the only source of industrial wood. Consequently, under the so-called “the Forests’ Breathing Plan” in 2017 the Islamic Parliament of Iran stipulated that any wood exploitation from Iranian forests will be prohibited beginning in 2020. In order to respond to increasing wood demand and the cessation of the domestic production of natural-forest wood, the future prospect for the production and trade of wood commodities must be assessed. The main objective of this study was to predict the monetary values of domestic production, imports, exports, and prices of wood products in Iran through 2030 under the Forests’ Breathing Plan. The assessment was performed using the Global Forest Products Model (GFPM) and for three categories of wood products: unprocessed wood, semi-processed wood products and pulp and paper. The GFPM is a partial equilibrium model that forecasts wood demand based on the growth rate of gross domestic product in each country and predicts price by establishing equilibrium between demand and supply. The results indicate that the growth of domestic production will be larger for the second category of wood products than for pulp and paper. The import of unprocessed wood will reach nearly USD 200 million in 2030 and the production and import values of semi-processed wood products will increase 2.2 and 2.6 times, respectively, compared to 2015. Nevertheless, the total trade balance of wood products will deteriorate by 91% for Iran. Compared to pulp and paper, the increase in the price of the unprocessed and semi-processed wood will be greater. Overall, the global position of Iran’s trade and production of wood products will not improve significantly except for the import of unprocessed and semi-processed wood during the period examined.

Key words: domestic production, export, forecasting, forests’ breathing plan, import, wood price.

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The effect of load and relative humidity on bending creep behaviour of hornbeam in three altitudes (Case study: Nowshahr Meshelak habitat)

Abstract

This study aimed to investigate the effect of load and relative humidity on the bending creep behaviour of hornbeam lumber (*Carpinus betulus*) in three altitudes. For this purpose, nine hornbeam trees at altitudes of 400, 800 and 1100 meters above sea level were selected from the forestry projects of Meshelak Nowshahr. From mature wood at breast height diameter of trees, 324 clear samples were cut. The prepared samples with the dimensions of $2.5 \times 2.5 \times 41$ cm were conditioned in a room with the temperature of 20 C and relative humidity (RH) of 35, 65 and 95 %. After three weeks of conditioning, three points bending test was done for determining the maximum of bending load on 81 samples. 10, 20 and 30% maximum of bending load (MBL) were measured and then four points bending creep test was measured for determining creep parameters on 243 samples at times period of 14 hours loading and 10 hours unloading in acclimatized room conditions. Finally, creep/recovery, creep modulus and relative creep of samples were calculated. Results indicated that the effects of load and relative humidity on creep parameters was significant; the maximum and the minimum relative creep were observed in 95 and 35% RH, respectively and the maximum and the minimum creep modulus were observed in 35 and 95% RH, respectively. The maximum and minimum relative creeps were observed in 30 and 10% MBL, respectively and the maximum and minimum creep modulus were observed in 10 and 30% MBL, respectively. Results also showed that the increasing of bending properties caused a decrease in the creep parameters.

Key words: hornbeam, altitude, load, relative humidity, creep/recovery, creep modulus, relative creep.

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The effect of shellac as coating material on acoustic properties in white mulberry wood (*Morus alba*) and walnut wood (*Juglans regia*)

Abstract

In this study, the effect of coating with lacquer (Shellac) on acoustic properties was investigated by forced flexural vibration in free-free beam in white mulberry (*Morus alba*) and walnut wood (*Juglans regia*). For this purpose, the samples of both species with dimensions of $2 \times 15 \times 140$ mm (length, width, height) were prepared according to ISO 3129 standard. The samples of both species for integrated humidity were kept in a climatic chamber for three weeks in climatic system ($20 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ RH) and then the first step of forced vibration test for measuring basic properties of the both test samples were performed on them. White mulberry and walnut wood were coated by Shellac (lacquer) and samples of both species were kept again in a climatic chamber for three weeks for integrated humidity. The results showed equal variations in the specific gravity in both coated samples of white mulberry and walnuts. The modulus of elasticity, acoustic coefficient and acoustical conversion efficiency values after coating were reduced in both species. However, the drop in values was greater in mulberry than walnut. The reason behind this was related to a change in the specific gravity in both species after coating with Shellac, in a way that change in frequency in mulberry wood was more than walnut. Damping vibration was increased under the effect of coating in both species. That's because the different effect of alcohol to dissolve extractives in mulberry and walnut wood and different nature and role of these substances in each species. This change in damping factor in mulberry was more than walnut wood.

Key words: force vibration, mulberry, walnut, shellac, acoustic properties.

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The effect of bagasse pith xylose on yeast growth kinetic in bio-products manufacture

Abstract

In order to extract xylan, bagasse pith was treated with different dosage of soda after alkaline pre-treatment and sodium chlorite bleaching. Extraction percentage was calculated and after that, samples were characterized by using FT-IR. Produced xylan was converted to xylose with diluted acid hydrolysis and after treatment with active carbon and ultrasonic, reduced sugar was measured by HPLC. Then, extracted xylose was added into yeasts media of *kluveromyces marxianus* and *Pichia stipites* to evaluate its effects on their growth kinetic. Results showed that by increasing soda dosage, xylan extraction percentage increased. Also, hydrolysis-alone process -without active carbon and ultrasonic- can produce more sugar. Evaluation of yeast's growth kinetic showed that the speed of yeast growth in media including xylose was more than glucose; hence, the efficiency of these yeasts is more for C₅ sugar and it can be used for bio-products manufacturing.

Key words: xylan, bagasse pith, dilute acid, *Kluveromyces marxianus*, *Pichia stipites*.

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Effect of paper deacidification with nano calcium hydroxide and nano hydroxyapatite, accompanied with nano cellulose and nano chitosan on its anti-fungal properties

Abstract

Several factors cause the degradation of cellulose and paper subsequently; among them, acidic hydrolysis is the most important one. Many historical books and documents are gradually weakened and destroyed due to acidic hydrolysis and reduction of the degree of polymerization of cellulose. So, deacidification and strengthening treatments are necessary for valuable old papers to stop these processes. Since the paper is a good substrate for growth of some destroying fungi, applying a suitable restoration treatment to stop or delay the growth of these destroying microorganisms - in addition of increasing the pH and preparing alkaline conditions for paper- has been considered. In this study, in order to deacidification and strengthening of paper, with different combinations of nano calcium hydroxide, nano hydroxyapatite, nano cellulose and nano chitosan in an alcoholic solvent (ethanol), a nano coat was applied on the surface of the sample paper. To study the anti-fungal properties, biological aging was done on treated paper with a fungus (*Aspergillus niger*). For this purpose, after preparing culture medium, treated papers were inoculated in separate petri dishes and after incubation period, the amount of fungal growth was studied. Also, tensile strength test was done on treated samples. Results of anti-fungal and tensile strength of treated papers showed that deacidification treatments by preparing an alkaline condition increased the pH of paper and the paper treated with a complex of nano calcium hydroxide and nano chitosan, and also treated samples with nano hydroxyapatite had the lowest fungal contamination. Treated papers with nano calcium hydroxide and nano chitosan also showed better tensile strength properties. Although applying nano cellulose in treatments had the less anti-fungal resistance, but improved the tensile strength of treated papers.

Key words: paper deacidification treatment, nano hydroxyapatite, cellulose nano fibers, chitosan, *Aspergillus* fungus.

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Acoustically quality evaluation of date palm samples from the pith to the bark

Abstract

This paper investigated the radial variations of acoustical and mechanical properties of date palm from the pith to the bark. Cubic samples with dimensions of $2 \times 2 \times 35$ cm³ (Radial \times tangential \times longitudinal) were taken in distance of 3, 6, 9, 12 and 15 cm toward the bark. To evaluate dynamical properties of date palm, flexural vibration method was applied on cubic experimental samples. Further the specimen then were utilized for measuring MOE and MOR in static bending test. More details were also attained by anatomical analysis. The results showed that the acoustical parameters of the propagated wave (the internal friction, the acoustic conversion efficiency as well as the acoustical impedance) were constant while increasing the distance between pith and bark. The highest values of acoustic coefficients found for samples near the pith and partially increased while moving to the bark. The density variations were less important in radial direction of date palm disk. The MOE and MOR values varied significantly in the radial direction and were maximum for samples in distance of 3 cm. As they reached to the distance of 15 cm from the center, the given parameters dramatically decreased. Finally it can be concluded that the quality assessment of date palm based on the acoustical parameters is not reliable. While construction materials need more strength, samples from the outer parts of date palm disks are suggested.

Key words: quality evaluation, acoustically, date palm, pith, bark.

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Effect of environmental changes (temperature and moisture) on destructive behavior of the white rot fungus *Trametes versicolor* on chestnut-leaved oak

Abstract

The aim of this study was to determinate the destructive behaviors of the white rot fungus *Trametes versicolor* on oak at different ambient temperatures and moistures. Hence, test fungus was collected from Radar Poshte forest and after purification; it was verified in the NCBI by molecular method. Thereafter, the wood samples were cut and exposed to fungus for mass loss determination at three temperature (10, 20, 30°C) and three relative humidity levels (45, 65, 85%) for 8 weeks. Destructive patterns of decayed wood sample was also examined by microscopic method. The results indicated that a change in moisture content was more influential on destructive behavior of fungus than temperature. Moreover, 20°C of temperature and 65% of relative humidity was the optimal environment for fungal activations. On the other hand, the microscopic investigations showed that *Trametes versicolor* produce simultaneous whit rot at all exposing conditions. Hence, it can be concluded that a shift in destructive behavior of this fungus which has already been reported is influenced by environmental factors other than temperature and moisture content.

Key words: fungal destructive behavior, *Trametes versicolor*, simultaneous decay, oak.

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Investigation on embedment strength of metal fasteners in wood engineered product in comparison with EC5 predicted values

Abstract

The purpose of this study was to introduce new wood engineered products and predict their strength in combination with the metal fasteners for timber structures construction. Investigation of steel dowel connections is an important issue that has attracted much attention today. There are many innovations in the constructions with the change in wood engineered products. For this research, a new combination of wood-based products was used; three layered structures consisted of birch plywood and OSB layers bonded by a single-component polyurethane resin in four configurations. The connections used in this study were steel dowels in 6 mm and 8 mm diameters. After producing new layered products, the embedment strength of samples was evaluated and compared to amounts calculated by engineering functions of resistance prediction according to EC5. Results showed that, the effect of the layered composition type as well as the steel dowel diameter was significant on the embedment strength of connection. Increasing of dowel diameter improved the embedment strength of materials. The compound with more contribution of plywood had higher embedment strength. The important point and purpose of this study was to evaluate the ability of EC5 in prediction of new engineered wood product strength, which revealed that the behavior of four material types could be predicted by EC5 with a sufficient accuracy and all material types had strength without failure occurrence and according to prediction.

Key words: embedment strength, steel dowel, EC5, failure, engineered wood product.

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Investigation on physical and mechanical performance of wood-based composites after laboratory accelerated aging

Abstract

The aim of current study was to determine the physical and mechanical properties of wood-based composites commonly used in Iran's market before and after accelerated aging. Accelerated aging process was performed based on ASTM D1037. Specimens of particleboard and medium-density fiberboard (MDF) made of wood and bagasse were obtained from various factories. Physical properties including density, water uptake and thickness swelling (after long-term water soaking), and mechanical properties including flexural strength, modulus of elasticity and internal bonding before and after aging were studied. The most density loss was observed in MDF after aging, while particleboard specimens were less damaged. Water absorption and thickness swelling of MDF specimens were less than those of particleboards during long immersion, due to the smoother surface and lower permeability. After aging, water uptake and swelling increased in all boards due to hydrolysis of resin and bulking of the boards. After aging process, highest reduction in flexural strength and modulus of elasticity was observed in MDF although a significant reduction was observed in particleboard. Internal bonding of specimens were higher than standard level before aging process; but this property decreased significantly after aging, due to hydrolysis of resin in alternating drying-wetting conditions.

Key words: accelerated aging, wood-based composite, physical and mechanical properties.

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Using pruned mulberry branches for particleboard manufacturing

Abstract

In this study, the pruned branches of mulberry trees mixed with industrial wood chips were used in the manufacturing of particleboard. Then, the physical and mechanical properties of the boards were investigated. For this purpose, the study variables included the amount of mixing of mulberry branches with industrial wood chips in four levels (0/100, 10/90, 20/80 and 30/70) and the amount of urea formaldehyde resin at two levels (12 and 14% of the dry weight of the wood chips). The results showed that increasing the amount of particles obtained from mulberry tree branches up to 20%, had no negative impact on the physical and mechanical properties of the boards. Increasing the amount of these particles up to 30 percent had a negative impact on the physical and mechanical properties of the boards. However, with increasing the amount of urea formaldehyde resin up to 14%, dimensional stability, bending strength, modulus of elasticity and internal bonding of the particleboards can be improved.

Key words: mulberry branches, internal bonding, bending strength, urea formaldehyde resin, industrial wood particles.

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Investigation on the physical properties and internal bonding of HDF made of oxidized fiber

Abstract

Current research was conducted to investigate the physical properties and internal bonding of high-density fiberboard (HDF) made from oxidized fibers and different amount of glue. For surface modification, fibers were treated with 40% nitric acid. After gluing fibers with urea-formaldehyde (7% and 9% based on the dry weight of fibers), the boards with a the density of 0.9 g/cm³ were made by hot pressing at 175°C in 4 minutes. The results of spectroscopy confirmed the reduction of hydroxyl functional groups and the increase of the carboxylic group due to oxidation. The results of short term immersion test in water showed that in boards containing oxide-modified fibers and 9% urea-formaldehyde glue, the minimum water absorption and thickness swelling were obtained with the means of 78.5 and 28.65%, respectively. Spring back of modified boards containing less glue was affected by the stresses release and debonding of the wood elements that resulted in internal bonding loss.

Key words: nitric acid, oxidized fiber, internal bonding, thickness swelling, water absorption.

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The effect of nano-clay particles and compatibilization of oxidized polypropylene in molten phase on the mechanical and physical properties of wood plastic composite

Abstract

The purpose of the research was to examine the effect of nano-clay particles and compatibilization of oxidized polypropylene in molten phase on the mechanical and physical properties of wood-plastic composite made from polypropylene and *Phragmites australis* flour. For this purpose, polypropylene in molten phase was oxidized in the vicinity of air oxygen and 1-dodecanol alcohol for 2 hours. Then *Phragmites australis* flour with the weight ratio of 50% and the polymer phase was mixed with the compatibilizer at two levels (0 and 3%) and nano-clay particles at three levels (0, 2, 4%) in an internal mixer for 6 min under the temperature of 165°C. Finally, the test specimens were prepared by using the hot press with the dimensions of 150×150×2 mm. The mechanical and physical properties including tensile and flexural modulus and strengths, Izod impact strength, long term water absorption and thickness swelling were examined according to ASTM standards. The results showed that the using oxidized polypropylene as compatibilizer improves all physical and mechanical properties of the composite. They also showed that increasing nano-clay particles, the physical and mechanical properties of the wood-plastic composite improve, except for the Izod impact strength. The structural studies of composite and the way the nanoparticles are distributed using x-ray diffraction spectroscopy and SEM images showed that the distribution of nano-clay particles in polymer matrix is of the type of intercalated structures.

Key words: wood-plastic composite, nano-clay, oxidized polypropylene, SEM, *Phragmites australis*.

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