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Seasonal Variability of Rainfall Interception beneath Individual Ash Trees Afforested in a Semiarid Climate

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ABSTRACT

The aim of this research was to quantify the seasonal variations in rainfall interception (*I*) by individual ash trees (*Fraxinus rotundifolia* Mill.) during growing season (*GS*), and non-growing season (*NGS*) in Chitgar forest park located in the semiarid climate zone of Iran, near Tehran. From September 2012 to September 2013, gross rainfall (*GR*) and *TF* were collected through 6 and 12 rain-gauges, respectively, in an open area and under the tree crown. Rainfall interception was calculated as the difference between *GR* and *TF*. Fifty rainfall events were recorded and the cumulative *GR* was measured 156.0 mm. Over the study period, *GS*, *NGS* and *I* ranged 19.4%, 23.0%, and 16.2%, respectively. Significant positive correlations were observed between *I* and *GR* over the study period ($r^2= 0.780$), *GS* ($r^2= 0.743$), and *NGS* ($r^2= 0.903$) ($p<0.01$). During the measurement period, *GS*, and *NGS*, the percentage of the relative interceptions (*I: GR*) % were estimated to be 46.6%, 49.3%, and 41.6%, respectively. T-test suggested that there were significant differences between the (*I: GR*) % values within *GS* and *NGS* ($p<0.01$). It is important to select species trees with lower *I* values for plantation, since they increase the higher amounts of net rainfall (*NR*) in semiarid and arid regions where water availability is a limiting factor for plantations growth. Transpiration as well as litter interception of selected trees should be also considered.

Keywords: *Fraxinus rotundifolia*, rainfall interception, semiarid climate, seasonal variability.

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Investigation on The Vertical Structure and Spatial Associations of *Fagus orientalis* Lipsky using O-Ring Function in Kheyroud Forest, Nowshahr

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ABSTRACT

This study aims at analyzing the spatial pattern and associations of oriental beech (*Fagus orientalis* Lipsky) in different vertical classes in intact beech forests. Data collection was done in 25 ha oriental beech sample plot in Gorazbon district of educational and experimental forests of University of Tehran. Species and DBH of all trees with DBH > 7.5 cm were recorded. The location of each tree was determined using azimuth and distance method in order to map the tree positions. Height of trees was calculated using diameter – height model developed for Gorazbon district. Trees were then divided in 4 Height classes: <15 m (S), 15- 25m (L), 25-35 m (M) and >25 m (U). Number of trees in vertical layers of S, L, M and U was 32, 63, 55 and 17 per hectare, respectively. Univariate O-ring statistic was used to analyze the spatial patterns of *Fagus orientalis* at different tree height classes, and the bivariate O-ring statistic was used to analyze the interspecies spatial associations among these height classes. Programita software was used for all analysis. Results showed spatial pattern of oriental beech in height class (S) was clustered. In height class (L), spatial pattern was clustered up to distance of 21 m and then changed to random pattern. In height class (M), spatial pattern was aggregated up to distance 8 meter and then changed to random pattern and in height class (U), oriental beech showed random spatial pattern in all distances. Bivariate O-ring analysis showed positive correlation between trees at height class (S) and other height classes up to 30-40 m. Present study showed application of O-ring statistic in vertical structure analysis of forest ecosystems.

Keywords: *Fagus orientalis* Lipsky, Kheyroud forest, O-ring function, spatial associations, spatial point pattern, and vertical structure.

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Effect of Forest Road on Herbaceous Diversity and Tree Regeneration (Case study: Patum and Namkhane districts, Kheirud forest)

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ABSTRACT

Forest road construction is one of the effective factors for ecological changes affecting the diversity and species composition in roads edges. This research was performed in Kheirud forest to evaluate the herbaceous diversity and tree regeneration establishment in different distances from road edge. For this purpose, we sampled herbaceous and tree species regeneration in 0,5,10,25, 50 and 100 m distances from road in down and up-hill sides. Biodiversity indices (Shannon and Simpson), richness index (species number) and evenness index (Pielou) were calculated to determine the degree and magnitude of road effects on herbaceous and regeneration diversity. The results showed that the species diversity, richness and evenness indices were not significantly related to down and up slopes while these attributes were significant to distance from the road. Distance from road edge was a significant factor which affects the composition and distribution of herbaceous plants and tree regenerations. Based on the results, among the environmental factors carbon, nitrogen and pH were major determinants of species distribution and abundance of road to interior forest gradient. These results are expected to provide critical information for decision makers to design careful and appropriate forest roads to minimize damages of habitats for regeneration establishment and also help to select the proper species for bioengineering.

Key words: diversity, evenness, forest roads, herbaceous plants, richness, tree regenerations.

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Size and Distribution of Dust Particles Deposited on Leaves of *Fraxinus rotundifolia*, *Platanus orientalis*, and *Robinia pseudoacacia* Trees in Paveh, West of Iran

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ABSTRACT

Capturing efficiencies of suspended particles by trees justify their uses for preventing the transport of dust over longer distances. This ability is increasingly important in threatened areas with dust invasion. The purpose of this study was to compare the size and distribution of particles deposited on the leaves surface of *Fraxinus rotundifolia*, *Platanus orientalis*, and *Robinia pseudoacacia* trees, in Paveh, west of Iran. Leaf samples were randomly collected from different heights of 10 individual trees in four main directions and washed off thoroughly by distilled water. Dust particles of the solutions were oven dried. Measurement of dust particles was done by a particle size distribution instrument, Fritsch analysette22. The measurement of particle size distribution showed that the particles deposited on the leaves surface ranged from 0.65 to 105 micron. A small percent of the particles deposited on the leaf surface of *F. rotundifolia* had a less than 10 micron diameter (4.15%). The diameter of particles deposited on the leaf surface of *P.orientalis* (33.4%) and *R. pseudoacacia* (23.6%) were less than 10 micron. *P.orientalis* was found to be more effective for dust-retaining particles with less than 10 micron (PM₁₀) in size compared to *F. rotundifolia* and *R. pseudoacacia* trees. The results of this study will open up an avenue for identifying and selecting the appropriate trees for plantation in endangered areas by dusts according to the type, size, and distance from emission sources.

Keywords: *Fraxinus rotundifolia*, *Platanus orientalis*, *Robinia pseudoacacia*, and Suspended particles

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Assessing Trees Canopy Cover by Using Ikonos Satellite Imagery Retrieved from Google Earth and Field Measurements (Case Study: Iran; Sari)

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ABSTRACT

One of the most important information in urban forestry is acquaintance of urban landscape's area. Nowadays, in several countries various methods are used to achieve this aim. Since there is not any complete method to study the urban forest's status in Iran, it is impossible to manage these resources properly. Hence, in this research, systematic random sampling methods and Ikonos satellite imagery in Google Earth software were used to assess the area of canopy cover of road trees for evaluating the accuracy of satellite images in their canopy cover estimation. The systematic random sampling was also considered as the base for comparisons. The crown of trees in street margins was calculated, and then the canopy of these trees in satellite images scale 1/2000 was also calculated. After georeferencing and geometric correction of the images in ENVI software, canopy cover and area of each tree on the street were measured. The results of paired t-test ($df = 118$, $t = 1.69$) showed that the outcomes of two calculation methods do not have any significant difference (in 95% confidence level). The result of regression analysis showed that satellite images could be used in estimating road trees canopy cover ($R^2=0.95$). Therefore, regarding to the results of this research, assessment of urban forest canopy cover using satellite imagery could be proposed to calculate the total canopy cover of road trees and increase the awareness of changes in these valuable resources in short periods of time.

Keywords: Canopy cover, Inventory, Sampling, Street margins trees.

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Dead Trees Effect on Beech and Hornbeam Regeneration in the Mixed Beech (*Fagus orientalis* L.) Stands of Northern Iran

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ABSTRACT

The establishment and survival of seedlings are one of the main objectives of forest management which ensures continues production. This reaserch aims at investigating the dead trees effect on beech and hornbeam seedlings in Masal's forests. For this purpose, 30 dead trees were selected, and the control trees were selected in four geographical aspects around the dead trees. They were the same as dead trees in terms of species and diameter. In general, 30 and 120 sampling plots were laid out around the dead trees and control trees, respectively. The quantity and quality of seedlings (crown symetry, being multi-trunk and monopodial growth) were recorded. In addition, the volume of dead trees was calculated by measuring their diameter and height, and also their decay classes were studied. According to the results, abundance of seedlings doesn't significantly differ among decay and canopy coverage classes, whereas dead tree's diameter classes significantly affect the seedlings abundance. The forked seedlings were significantly higher than other forms of stem growth. Abundance of seedlings, in terms of quantity and quality (forked-form) around the dead trees showed significant differences with control trees. Based on the findings of this research and the overall impact of dead trees on regeneration, it is recommended that large dead trees are considered as a seedbed in the management of natural regeneration in forest stands.

Key words: dead trees, forest stands, oriental beech, regeneration, silviculture.

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Studying the Growth and Morphological Characteristics of Euphrate Poplar and White Poplar Hybrids in Experimental Nursery of Khuzestan Province

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ABSTRACT

Populus alba because of fast growing and relative adaptation of to dry and semi-dry climate conditions and *P.euphratica* due to having tolerance to salinity are important native species. Cuttings of 18 clones (*P.alba x P.euphratica*), a single reciprocal crossed clone (*P. euphratica x alba*) and two other *P. alba* clones were planted, surveyed under a RCBD with three replicates (each replicate includes 10 individuals per plot) in Kushkak research station during February 2010. Germination percentage (GP) was measured in early growing season of the first year and collar diameter (CD) and height (H) were recorded in late growing season of the second year. Nine morphological characteristics of 30 randomly collected leaf samples were also measured in the middle of the second growing season. ANOVA showed significant differences among all investigated traits except for GP. During the two-year experiment, *P.euphratica x P.alba* 44/9 with 6.75 m H and 6 cm CD, and *P.alba* 58/57 with 2.51 m H and 2.1 cm CD had maximum and minimum growth, respectively. Furthermore, PCA showed *P.euphratica x P.alba* 44/9 was completely different from other hybrids because of correlation with nine out of 14 investigated traits. Therefore *P.euphratica x P.alba* 44/9 was evaluated the best poplar hybrid during the two-year study in climatic conditions of the north of Khuzestan province.

Keywords: growth traits, hybrid, Khuzestan, morphological traits, *P.alba*, *P.euphratica*.

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Investigation on the Regeneration and Vegetation Composition in the Edge of Forest Roads

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ABSTRACT

In order to evaluate the effects of forest road on regeneration and vegetation composition in district No. 2 Shafaroud, a road was selected with the length of 400 m that the altitude, aspect and slope variations and species composition were similar. Five transects in the right and five transects in the left sides of road were established as perpendicular. In each transect 5, 15, 25 and 35 m distances were determined from the road edge. Type and number of trees and shrubs species regeneration in 100 m² sample plot, and type and cover percentage of herbaceous species by using minimal area method were recorded in 64 m² sample plot. Herbaceous species was classified into two groups using Two-Way Indicator Species Analysis: *Primula heterochroma* and *Lolium temulentum* L. - *Rumex conglomerates*. Results indicated that species composition of plots in road edge was different compared to plots located inside the forest and they were classified into two separate groups. Among the regenerations *Alnus subcordata* had significant difference in term of abundance between different distances from the edge of the road. This species had more abundance in the edge of the road. The results of the present study would be useful for evaluating the ecological effects of roads on sites with similar conditions.

Keywords: forest road, Jaccard's index, regeneration, two way analysis, vegetation.

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Drought Resistance of Wild Pear (*Pyrus boissieriana* Buhse.)

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ABSTRACT

Trees are important sources of wild germplasm for sustainable horticulture and forestry. Wild pear (*Pyrus boissieriana*) germplasm was collected from a forest ecosystem (Jozak and Darkesh, north Khorasan) and its resistance potential to drought stress was surveyed in a greenhouse. In six-month seedlings, signs of leaf rolling appeared after 18 days without water (drought simulation). Gas exchange parameters, such as net photosynthesis, stomatal conductance, and transpiration decreased with increasing drought over time. Decreasing net photosynthesis caused negative effects on growth and leaf expansion and caused the seedlings to drop their leaves. In contrast, there was no effect of drought on root and shoot biomass compared to control plants. Mean xylem water potential was -0.66 and -2.22 for control and stressed seedlings, respectively. The water potential of xylem led to decreasing in RWC (%) and finally electrolyte leakage increased about 45%. We did not observe any negative effect of drought on chlorophylls a and b, but the carotenoid content increased. We found no increase in the proline content of the stressed plants. Finally, wild pears are able to tolerate the drought for about 18 days, by decreasing some physiological parameters (gas exchange, xylem water potential, and relative water content), and by increasing some antioxidant systems like carotenoid. Complementary researches conducted in the field and studies of gene and protein expressions are necessary before wild pear could be used as a source of germplasm.

Keywords: Pigments, resistance mechanism, wild pear, wild ecosystem, water withholding.

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Comparison of LbL Nanotechnology and Refining on the Properties of Pulp and Paper Made from Recycled Fibers

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ABSTRACT

In this study, polyelectrolyte multilayers (PEM) were created using Layer-by-Layer nanotechnology. Recycled fibers were subsequently treated with cationic starch (CS) and anionic starch (AS) multi-layers with each layer constructed at neutral pH for 10 min. Also, to compare the proposed CS/AS PEM system with mechanical refining, the pulp was refined for 25 min to the freeness of about 291 mL. CSF using a Valley beater, and finally, handsheets (60 g/m²) were made from both types of refined and unrefined pulps and their characteristics were evaluated. The results showed that in PEM forming the charge inversion of fiber surface took place at a higher value of zeta potential compare to the machine refining, and led to an increase in the electrostatic absorption of particles like cationic starch. Consistent with the above result, after beating the OCC pulp to the freeness of 291 mL.CSF with a paper density of 0.545 g/cm³, the tensile index and bending resistance were measured at 37.92 N.m/g and 12.2 mN, respectively. However, in CS/AS multilayer systems paper strength dramatically increased without a significant increase of density. In the CS/AS multilayer system at the 7th layer a density of 0.445 g/cm³, tensile index of 33.51 N.m/g ,and bending resistance of 21.4 mN were measured. Adding 0.001M NaCl (conductivity, 140μS/cm) to the CS/AS multilayer system these values were measured 0.472 g/cm³, 36.65 N.m/g and 25.6 mN, respectively. Therefore, these results indicated that CS/AS PEM systems are comparable and competitive with beating or refining from a strength improvement point of view.

Keywords: Beating, Bending resistance, Cationic and anionic starch, Polyelectrolyte multi-layers, Recycled fibers.

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Using Wood Anatomical Proxies to Study the Effect of Climate on Black Alder (Case Study: Forest Park of Astara)

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ABSTRACT

Although the effect of ground water level on radial growth of black alder has attracted the attention of scientists in the recent years, to comprehensively interpret the results of such studies we need to investigate the independent influence of climate on ring width and other wood anatomical features of this species. Hence, in the current study the influence of climatic factors on the annual ring width and some vessel features of black alder were investigated in a Forest Park located in Astara (Northeast Iran). In this site, 11 trees were selected and after preparations cross sections were scanned from two or three pith-to-bark strips of each tree. After distinguishing the growth rings, tree ring width and some quantitative vessel features were measured in the last 20 growth rings of each tree using image analyzing software and their relationship with different climatic factors were studied at monthly, seasonally and yearly scales. Results indicated that in long term scales, only the average vessel lumen area show a statistically meaningful correlation with meteorological parameters. At this site, rainfall increased the vessel size while the evaporation rate had a negative effect on this feature. Since there was no age trend in vessel related chronologies and a greater strength and number of correlations were found in with the monthly climate, these features are recommended to be used in dendroclimatological studies using this species.

Keywords: Climate, Tree-ring width, Vessel features, Wood anatomy.

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The Study of Pulp-Plastic Composites Properties Produced from Bagasse with Different Pulping Processes

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ABSTRACT

In this study, the physical and mechanical properties of polypropylene composites reinforced with bagasse alkaline-sulfite-anthraquinone, soda-anthraquinone, monoethanolamine-anthraquinone chemical and mechanical pulps known as pulp-plastic composites (PPC) were investigated and the results were compared among the PPCs and with polypropylene composites reinforced with bagasse flour known as wood-plastic composite (WPC). The ratio of the matrix (polypropylene) to reinforcement agent (pulp) was 50:50 (w:w). The results showed that elastic modulus, tensile strength, bending strength and impact strength of the produced composites were significantly influenced by the pulping processes. Furthermore, the composites which contained chemical pulps had higher strength and dimensional stability as well as less water absorption than those containing mechanical pulp. In comparison to WPCs, the water absorption and dimensional stability of PPCs decreased and increased, respectively. Generally, the results showed superior physical and mechanical properties in the PPCs compared to the flour bagasse-plastic composites.

Keyword: Composite, Lignocellulosic material, Mechanical and physical properties, Polypropylene, Pulp.

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Investigation the Waste of Current Sawing and Offering a New Method of Sawing Based on Reverse Engineering

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ABSTRACT

This study, conducted in Iran, investigated the waste from common log sawing methods and proposed a new sawing method. The older methods were implemented due to the difficulties of carrying logs out of the forest. Since the development of sawmills and forest harvesting plans, it would seem necessary to change these old methods. The dimensions of wood products were collected to calculate the waste of old sawing methods. The computer software, Autocad 14, was used to simulate a sawing based on old sizes and nominal sizes and then the volumes of wood products were calculated to estimate the yields for old methods and new methods. The yields of two old sawing methods, double taper sawing and square sawing, were respectively estimated at 60.6% and 51.9%. The waste of re-sawing to manufacture wood products was estimated at 60% so that the total yield of sawing and re-sawing was reduced to 33.6%. In the new method, based on reverse engineering nominal, sizes of wet lumber thickness were estimated between 1.4 cm and 6.7 cm by adding contraction and sanding factors to final dimensions of the wood products. After sawing logs to a nominal thickness and producing lumber with a nominal width between 1.4 cm and 21.9 cm, the yield of sawing to manufacture wood products with a nominal dimension was estimated at 75.3%, so this new method is recommended as a best choice with the ability to increase yield up to 41.6%.

Keywords: Double toper sawing, Log, Lumber, Nominal sizes, Oversizing, Sawmill, Square sawing

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The Effect of Nano-Clay Particles and Compatibilizer on the Decay Resistance of Wood Plastic Composite

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ABSTRACT

The purpose of this study was to evaluate the effects of nano-clay particles and oxidized polypropylene as a compatibilizer on the decay resistance of wood plastic composite and compare it to *Coriolus versicolor* fungi. In order to provide oxidized polypropylene as the compatibilizer, polypropylene was oxidized in the presence of air oxygen for 2 hr by an internal mixer. Afterwards, wood fibers, polypropylene, nano-clay particles and oxidized polypropylene as a compatibilizer in a certain ratio were mixed in an internal mixer and pressed into plates of 150×150×2 mm³ nominal dimensions using a laboratory hydraulic hot press. Then, the decay test was carried out using a white rot fungus such as *Coriolus versicolor*. Results showed that the weight loss of composite due to decay was proportional to the nano-clay particle percentage, so that increasing the percentage of nano-clay particles from 0% to 4% was associated with less weight loss and decay. In addition, the samples without a compatibilizer showed more weight loss and decay than those having a compatibilizer. Morphology of the composites containing nano-clay particles were evaluated by using X-ray diffraction and transmission electron microscopy, results demonstrated that the distribution of Nano-clay particles in the field of the polymer was an intercalation type. This indicated the better stability of this class of composites compared to *Coriolus versicolor* fungi.

Keywords: Compatibilizer, *Coriolus versicolor*, Nano-clay, Oxidized polypropylene, Wood plastic composite.

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The Effects of Different Coatings on Some Surface Properties of Beech Wood

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ABSTRACT

The effects of wood coating with different compounds such as nano-zinc, nano-chitosan, chitosan, silicon oil and flax seed oil on the surface properties of beech wood, i.e. wood color change, surface roughness and wettability, were studied in the current research work. For this purpose, sample planks of beech wood were cut into $2 \times 10 \times 20$ cm³ pieces. The specimens were coated with the specified coatings and tested for colorimetric, surface roughness and water contact angle before and after the coating procedure. Results revealed that the wood color changed to quite darker due to coating with varying amounts. However, coating with the chitosan and the nano-chitosan provided less color change in the wood. The wood surface became resistant to water absorption due to increased wettability. Chitosan coated samples showed less color changes in comparison with the silicon oil coated ones which were quite darker. The beech wood surface became smoother with lesser roughness after a coating with the nano-zinc and nano-chitosan.

Keywords: Chitosan, Contact angle, Discoloration, Surface roughness, Nano-chitosan, Nano-Zinc oxide, Silicon oil.

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Processing of Clay Nanoparticles and Studying its Effect on the Antimicrobial Properties and Water Absorption of Sanitary Paper

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ABSTRACT

Clays have a layered structure and negative surface charge allowing the adsorption of water, bacteria, toxins, and drugs which make it suitable for water absorption and antibacterial applications. These properties, coupled with their widespread abundance, make clays attractive materials for the development of new antibacterial medicaments for infected wounds. This study was conducted to enhance the antimicrobial properties and water absorption of sanitary paper. Montmorillonite nano clay (Bentonite) (with a nanosize layered structure in the thickness), was processed with a homogenizer to achieve a stable colloidal system of nanosize in all dimensions. Then, different amounts of raw and homogenized nano clay were used to manufacture the paper and its effect on the antibacterial properties (against both *Escherichia coli* and *Bacillus subtilis*) and water absorption were evaluated. Results showed that nanoclay improved the paper's antibacterial properties, and homogenized nano clay was more effective than raw clay due to its much more specific surface area and adsorption. Moreover, this substance reduced the growth of *Bacillus subtilis* more than *Escherichia coli* bacteria. Also, the water absorption of the paper increased with the addition of nano clay and homogenized nano clay, although the effect of homogenized nano clay on this parameter was more prominent.

Keywords: Bentonite, Water absorption, Sanitary papers, Antimicrobial properties.

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Mechanical Properties of a Light Weight Wood Base Sandwich Panel Made From Sunflower Stalks and Poplar Layer Scrap

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ABSTRACT

Light weight wood base sandwich panels have certain special properties, the most important of which is a high mechanical strength coupled with its light weight. These panels could replace traditional structural systems in Iran. The purpose of this paper is to investigate the mechanical properties of light weight wood base sandwich panels made from sunflower stalk wastes and particles of poplar layers. To do this, melamine urea formaldehyde resin with ratios of 20:80, 35:65, and 50:50, particles of sunflower stalk, poplar layers wastes with a composition ratio of 0:100, 25:75, 50:50, 75:25, and 100:0, and poplar layer of 1.8 millimeter were made for surfaces of panels and manufactured in a one step press. Mechanical test such as modulus of rupture, modulus of elasticity, internal bonding, and compression parallel to board plane were done according to ASTM standards. Results of tests were analyzed with analysis of variance and classification of averages according to Duncan method tests with a reliability of 95%. The results showed the mechanical strengths improved as the melamine-urea formaldehyde ratio increased. Panels with pure sunflower and poplar obtained, respectively, the highest bending strength of 19 and 25 MPa, a modulus of elasticity of 6003 and 8004 MPa, and an internal bond of 0.31 and 0.43 MPa. In conjunction with the parallel pressure resistance, sandwich panels with a core of pure sunflower stalks with 6.9 MPa was the most resistant. Also, strengths were reduced as the ratio of sunflower stalks to particles of poplar layers increased in core layers.

Keywords: Low density panel, Mechanical properties, Melamine\urea formaldehyde, Sandwich panel, Sunflower stalk.

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Investigation on Soda Oxygen Delignification Reaction Kinetics of Old Corrugated Container (OCC) Pulping

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ABSTRACT

The reaction kinetics of old corrugated container (OCC) soda-oxygen pulping was investigated. Two levels of alkali (16 and 18% based on oven dry weight of the OCC) and three delignification temperatures (145, 165 and 175°C) were applied. The pulping duration was adjusted at 150 min and the measurements were conducted at 15 minutes intervals. The pulping consistency and oxygen pressure were constant at 10%, and 6 bar, respectively, in all pulping trails. At the end of each pulping interval, the kappa number of the pulp was measured, and the kappa number reduction trend was plotted against pulping time. Then delignification rates and coefficients of delignification reaction kinetics were calculated. It was revealed that the delignification proceeded in two different phases, called bulk and residual delignification. Based on the coordinates of both sections, the intersction point was determined as the transition point from bulk to residual delignification. Rate constant coefficient of both bulk and residual delignification were also calculated. The results of the kinetic study showed that when soda-oxygen delignification is applied to the OCC, the initial phase of the reaction was very fast, but as the delignification proceeds, the rate of delignification was reduced indicating the residual delignification phase. The results showed most of the lignin was removed in the initial 45 min of the reaction.

Keywords: Bulk phase, Delignification, Kappa number, Kinetic, Residual phase, Soda-oxygen.

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