The effect of concentration of anionic starch solution in paper surface sizing on physical and strength properties of recycled paper

Abstract

Surface sizing of paper by anionic starch was carried out to study its concentration effect on physical and strength properties of recycled paper. For this, hand sheets (100 GSM) of mixed recycled pulp containing 1% cationic starch were prepared and treated by the sizing agent on the sheet surface at various concentrations (0, 3-10%). Application and concentration increment of the starch solution resulted in a higher retention on the surface and lesser penetration into the paper structure (Z direction), contributing to a better hydrophobicity of sized paper and a significant reduction in water absorption of the paper; with the highest reduction in the Cobb test up to the solution concentration of 5%. Also, the results revealed that strength properties of bending stiffness, burst and tensile indices increased due to the anionic starch treatment, its consequent absorption and penetration into the paper thickness. The improvement rate was more predominant using up to the 5% concentration. Penetration of a part of sizing agent into the porous structure of paper and resulted improvement in fiber bonding are possible and probable. However, higher concentration and viscosity of the starch solution contributed to the lesser penetration and bonding formation with higher retention on the paper surface which resulted in continuous improvement in paper smoothness. With the sizing solution thickening, tear index decreased due to starch film formation on the paper surface with brittle character. In general, increasing of the anionic starch solution up to the 5% could be reported as an optimum level.

Keywords: surface sizing, anionic starch, water absorption, physical and strength properties.

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Determination of effective criteria for location selection of WPC plants from agricultural residues in Iran by AHP technique

Abstract

This study was aimed to determine the effective criteria for location selection of WPC plants made from agricultural residues in Iran. For this purpose, after field studies and literature review, six criteria including "products and materials", "regulations", "technology and humanitarian issues", "economy", "infrastructure and environmental" and also 30 sub-criteria were identified. The priority rates of these criteria and sub-criteria were evaluated by AHP (analytic hierarchy process) technique. The results indicated that among 30 effective sub-criteria in location selection of the WPC plants from agricultural residues, amount of waste supply (0.087), continuity of waste supply, cost of waste supply, amount of sales and export, granted facilities, and less hazards for the environment and forest, had the highest priorities; which were rated as 0.071, 0.067, 0.065, 0.064, and 0.062, respectively.

Keywords: location site selection, analytical hierarchy process, group decision-making, WPC, agricultural residues.

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Wood anatomy and physical and chemical properties of fast growing Athel tamarisk (*Tamarix aphylla* L.)

Abstract

Athel tamarisk (*Tamarix aphylla*) is a fast growing, evergreen tree succeeding in the most soils and can tolerate the saline conditions. Despite its ecological importance and wide distribution in central and southern parts of Iran, wood properties of this species has little been concerned. However, the potential of this species in cellulosic industries of Middle East dry countries has recently been focused. Hence, to study wood anatomy and physical and chemical properties of Athel tamarisk, 3 stands were selected and felled from Zabol region (Sistan and Baluchestan province, Iran). Wood anatomical features of this species were studied and listed according to the IAWA list of microscopic features for hardwood identification. In addition, lignin distribution in xylem was studied using fluorescence microscopy. Calculating fiber biometry features assessed that although fiber quality is not superior but meets the standards of paper production, comparing other commercially-used hardwoods in this industry. According to chemical composition analysis, cellulose content of this wood is rather low (39%) which could be a result of large amount of thin-walled paranchyma cells in xylem. Lignin content is a bit higher than average hardwoods and this component is concentrated in vessels and fibers. Physical properties of studied wood samples (specific gravity and shrinkage values) were in the range of other light-weight and fast-growing hardwoods and thus this wood is expected to have similar end-use quality.

Keywords: Tamarisk, wood anatomy, fluorescence microscope, fibers, lignin.

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Application of cellulose nanofibers to be replaced with the imported long- fiber pulps in papers made from bagasse

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Abstract

In this research, different additives including cellulose nanofibers, cationic starch, and polyacrylamide were added to bagasse pulp as their impact on the handsheet strengths were investigated aiming to replace them with imported long-fiber softwood pulp in Pars paper factory. For this purpose, 3% bleached bagasse cellulose nanofibers, 3% unbleached nano-lignocellulose fibers, 0.5, 0.7 and 1% cationic starch, and 0.03, 0.05 and 0.1% cationic polyacrylamide were added separately to bagasse pulp. In the next stage, 3% bleached bagasse cellulose nanofibers and 3% unbleached nano-lignocellulose fibers along with 0.5% cationic starch or 0.05% cationic polyacrylamide were used. The results showed that adding cellulose nanofibers along with cationic polyacrylamide or starch increases handsheet strengths, significantly. Yet, the best treatment was the addition of 3% nano-lignocellulose along with 0.5% cationic starch which resulted in the higher tensile and burst strengths and lower tear and fold strengths than that of adding 12.5% long fibers to bagasse pulp. The paper made by this process showed an increase of 16.57% in tensile index, 8.47% in burst index, 9.77% in tear index, and 168.85% in folding strength, compared with the paper made from pure bagasse pulp.

Keywords: bagasse, cellulose nanofibers, lignocellulose nanofibers, starch, papermaking.

The effect of using waste newspaper in surface layers on physical and mechanical properties of three-layer particleboard

Abstract

In this study, physical and mechanical properties of particleboards made from recycled newspapers in the surface layers of 3-layers planes were investigated. Coarse and fine wood chips and recycled newspapers with the dimensions of 0.5 × 4 cm2 were used. The variable in this research was the ratio of recycled newspaper to wood chips (at five levels; 0:100, 15:85, 30:70, 45:55, and 60:40). Urea-formaldehyde resin was used at 10% content on dry weight basis of the wood particles and newspaper and ammonium chloride was used as a catalyst to 2% of the dry weight of adhesive. Physical and mechanical properties of panels were measured according to EN Standards. The results showed that panels containing recycled newspapers at the level of 45% had the highest bending strength and modulus of elasticity. Internal bonding and screw holding strength decreased with the increasing of recycled newspaper and control sample had the highest strength. Water absorption and thickness swelling increased with increasing of recycled newspaper portion. On the basis of results of this study, it can be concluded that the particleboard containing recycled newspapers in the surface layers up to the level of 30% can be used for general purpose boards and interior fitments (including furniture) in dry condition applications.

Keywords: particleboard, recycled newspaper, surface layers, physical and mechanical tests, EN standard.

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Effects of washing method on the bagasse pulping characteristics processed by the sulfur dioxide- ethanol-water (SEW) method

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Abstract

SO2-ethanol-water (SEW) pulping can be considered a hybrid between solvent and acid sulfite pulping processes. Recently, this process has been paid attention to separate the principal components of lignocellulosic materials i.e. cellulose, hemicelluloses and lignin. The main objective of this study was to investigate the effects of washing method on the bagasse pulping characteristics processed by the acidic fractionation of sulfur dioxide-ethanol-water (SEW) method. Variables included two washing pulp methods (water and 40 v/v% ethanol-water solutions), pulping duration (30-100 min.), and temperature (120 and 135 OC). Then, pulps were washed twice with 40% v/v ethanol-water at 60°C (L: W 2 L kg-1) and with deionized water at room temperature (L: W 20 L kg-1). The results showed that the final pulp yield decreased due to the greater solubility of lignin in 40 v/v % ethanol-water compared with the conventional systems (washing by water). This decrease was statistically significant at the level of 1%. Pulping result at 120 and 135 °C at different time periods showed that with an increase in the pulping duration, kappa number is reduced.

Keywords: recovery, pulping, so2-ethanol-water (SEW), washing method, Kappa number.

Study of the antibacterial effects and physical characters of paper coated with nanoclay and homogenized nanoclay

Abstract

Antibacterial papers such as food packaging papers are important for human health. In this study, with the aim of the production of environmentally-friendly antibacterial paper, nanoclay was selected as an agent with antibacterial effect. Since the effectiveness of nanoclay depends on the amount of its negative charge, nanoclay was homogenized using a homogenizer to obtain a homogeneous structure with more negative charge. Due to the negative charge of fibers and clay nanoparticles, nanoclays were combined with starch at the levels of 1, 3 and 4%, and the resulting suspension was applied to the surface of the paper as an overlay using auto-bar coater. Antibacterial and physical properties of papers were evaluated. The results showed that nanoclays had a significant effect on inhibiting the growth of bacteria and were able to reduce the growth of bacteria even at low levels of consumption. Water absorption of papers decreased and their resistance to air increased. Hence it can be concluded that homogenized nanoclay can be a desirable agent in the production of packaging papers with low water absorption, high resistance to air and resistant to bacterial microorganisms.

Keywords: coating of paper, nanoclay, homogenized nanoclay, antibacterial and physical properties.

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Identifying and prioritizing indicators and effective solutions to optimize the wood consumption in construction of classical furniture by using AHP (case study: Qom province)

Abstract

The aim of this study was to identify and prioritize the indicators and provide effective solutions to optimize the use of wood in construction of classical furniture using the analytic hierarchy process (AHP) (a case study in Qom). For this purpose, using studies and results of other researchers and interviews with experts, the factors affecting the optimization of wood consumption were divided into 4 main categories and 23 sub-indicators. The importance of the main and sub-indicators were determined by AHP using Expert Choice software. The results showed that the original surface design and human resources are of great importance. In addition, among 23 sub-indicators, effective on optimization of the wood consumption in construction classical furniture, ergonomics, style, skill training and inlaid in classical furniture industry, respectively, had the highest importance with the weight value of 0.247, 0.181, 0.124 and 0.087. Overall, using of specialized labor was a prior solution.

Keywords: optimization, classical furniture, Qom, analytic hierarchy process.

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Comparing the impact of climate variables on healthy and declined stands of Persian oak (*Quercus brantii* Lindl.) in the "Khorram Abad"

Abstract

In this study, using dendroclimatology (a branch of the science of dendrochronology), the impact of climate variables on normal and declined oak stands was studied near the city of "Khorram Abad", Iran. After the selection of 12 samples from healthy trees and 12 trees from declined ones, breast height (1.30 m) discs were prepared. Then, the samples were scanned and ring width was measured using Corel Draw software. Using TSAP and ARSTAN softwares, cross dating between samples were done and chronology was prepared, respectively. From the nearest meteorological station, rainfall and temperature data were obtained and their effects on growth rings of trees was investigated using Pearson's correlation coefficient. The results of this study showed that both chronologies were equally affected by climatic factors. The temperature during the growing season and before it had a similar effect on both chronologies. Until 2010, the growth of trees was almost the same, but from this year onwards, curve of declined trees dropped in growth, probably due to the impact of pests and the deterioration in trees. From this year onwards, despite the significant increase in precipitation, compared with previous years, increasing growth of the declined trees was not found and this means that due to the factors causing deterioration and thus reducing the activity of cambium, the trees have lost their re-growth and even with the improvement of environmental conditions, there was no possibility of growth resumption.

Keywords: *Quercus brantti*, decline, ring width, temperature, precipitation.

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Effect of cell wall modification of styrene wood polymer with maleic anhydride and glycidyl methacrylate on thermal and mechanical behaviors and natural durability of composite

Abstract

This research investigated the effect of maleic anhydride and glycidyl methacrylate on thermal and mechanical behaviors and natural durability of wood polymer made from hornbeam and styrene monomer. Samples of mechanical and biological tests were prepared in five levels; control, modified with maleic anhydride (MA), styrene (ST), maleic anhydride/styrene (MA-ST) and maleic anhydride/styrene/glycidyl methacrylate (MA-ST-GMA), according to ASTM D143 and EN113 standards, respectively. Impregnation was performed by vacuum- pressure method using experimental cylinder. Samples treated by MA were heated in oven for 4 hours at 120ºC. After the impregnation with styrene monomer, polymerization was performed in oven at 90ºC for 24 hours, and subsequently at 103±2ºC for the same period. Bulking of modified wood with MA, the presence of ST in the cell cavities, and interaction between polymer and cell wall through modification with MA and GMA were confirmed by scanning electron microscopy. Formation of network structure due to the reactions between ST, GMA, MA and wood resulted in an improved thermal stability of composite. Weight gain was increased from 24.69% to 42.83 and 44.42 in MA-ST and MA-ST-GMA samples, respectively, due to modification in styrene samples. The lowest porosity (21%) was observed in MA-ST-GMA samples. The highest improvement of mechanical properties was measured in MA-ST-GMA samples compared with the control. MA with double bonds and carboxylate group showed a high reactivity with wood and polymer. In addition, difunctional GMA monomer caused better adhesion of polymer to cell wall through the reaction by hydroxyl group or MA and styrene monomer. A significant improvement in the mechanical properties of modified levels can attributed to interaction of polymer complex with modified cell walls and uniform distribution of polymer in cell lumens. Cell wall modification with MA and presence of GMA prevented the development of fungi mycelium through reduction and blocking of hydroxyl groups, changing the hollocellulose structure, and the presence of polymer in wood as a hard physical barrier.

Keywords: wood–polymer, mechanical properties, glycidyl methacrylate, maleic anhydride, decay resistance.

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Measurement of fiber saturation point of wood using differential scanning calorimetry: measurement fundamentals and experimental results

Abstract

In this research, fundamentals of measuring the fiber saturation point (FSP) using differential scanning calorimetry (DSC) method were explained. This method is based on the assumption that free water is frozen but bound water remains unfrozen in low temperatures. Thus, the FSP can be calculated by measuring the enthalpy of melting of frozen wet samples. This method measures the amount of energy absorbed or released by a sample when it is heated or cooled. Results showed that the DSC method may yield a higher FSP value compared with the widely accepted value of 30%, depending on the wood species. Both thermal and chemical (acetylation) modification methods reduced the FSP but in the acetylation method, there was no linear correlation between the weight gain percentage and FSP.

Keywords: fiber saturation point (FSP), differential scanning calorimetry (DSC), thermal modification, acetylation.

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Effect of fungal pre-treatment of poplar chips on paper brightness reversion

Abstract

Unbleached kraft pulp made from poplar chips, pre-treated by Trametes versicolor in one, two and three weeks (bio-kraft pulp), was used as a raw material in this study. Above-mentioned pulps were characterized in the terms of lignin content and groups effective on the brightness reversion (carbonyl, carboxyl and hexenuronic acid); after each step of bleaching, using ECF method at DED sequences. In order to evaluate the brightness reversion, 60 g/m^2 standard handsheets made from pulps were treated by thermal and UV ageing and then their brightness were measured. Results showed that by increasing pre-treatment duration, in all bleached treatments, lignin content increased excluding D1 step in three-weeks pre-treatment. Carbonyl groups reached the lowest content in one-week pre-treatment (third step) and 2-weeks pre-treatment (first step) and carboxyl groups and hexenuronic acid decreased after 3 steps sequence bleaching. Effect of thermal treatment on brightness reversion was considerably more than UV treatment. In addition, papers from pre-treated chips for one and two weeks had minimum brightness reversion and papers made from chips after three-weeks fungal pre-treatment had maximum brightness reversion due to more carbonyl and hexenuronic acid. In this respect, two-weeks pre-treatment was confirmed as an optimum fungal pre-treatment.

Keywords: carbonyl, carboxyl, hexenuronic acid, brightness reversion, chlorine dioxide, *Trametes versicolor*.

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