

Development of biodegradable antibacterial poly-lactic acid based packaging films with bioactive compounds

Abstract

Biodegradability and antimicrobial activity food packaging materials are among the most important parameters of the modern food packaging industry. For development of poly-lactic acid films to antibacterial compositions, different concentrations of essential oil of *Zataria Multiflora* or propolis ethanolic extract were added to the polymer using the solvent casting method. The antimicrobial activity of the composites was evaluated using disc diffusion method against the four common foodborne pathogens. Our findings showed that the resulting films were effective against all the tested bacteria and the composites containing the essential oil had a good capacity to limit the growth of foodborne pathogenic bacteria. Moreover, the addition of propolis ethanolic extract to films containing the essential oil increased the antibacterial properties of the films less than expected, which hydrophilic and hydrophobic nature of films constituents were likely the probable reasons of the results. Based on the results of this study and other similar studies, the biodegradable poly-lactic acid polymer can be considered as a desirable base polymer for development of novel antimicrobial films, especially in combination with herbal antimicrobial agents.

Keywords: poly-lactic acid, packaging film, antimicrobial, food, bioactive agent.

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Improving wet tensile strength of paper glass using PAE, CNF and CMC

Abstract

Today, with the introduction of new additives and nanostructures, investigations have been widely focused on improving paper properties while decreasing costs. One of the paper wet strengths is Polyamideamine Epichlorohydrin (PAE) that using high amounts of it is costly and may cause some systemic problems such as adhesion. In order to reduce the consumption of this material and improve bagasse paper wet strength, cellulosic nanofibers (CNF) and carboxymethyl cellulose (CMC) were used and the best treatments with the highest wet strength introduced. To measure paper wet strength, first, handsheets were immersed in 25°C distilled water for 10 minutes, then tensile tests done. In this study, 30 treatments were evaluated including separate and combined addition of CNF, CMC and PAE. Results showed adding these materials separately has lower influence on wet tensile strength, while adding CNF and CMC together with PAE significantly improved wet tensile strength of handsheets. One of the best treatments with higher wet tensile index was the combination of 3% PAE and 2% CMC, which kept 18% of dry tensile index of paper in wet state, while no sign of adhesion of materials on paper handsheet maker screen and cylinder was observed. In addition, the combination of 3% PAE and 1% CMC kept 16% of dry tensile index of paper in wet state. This treatment decreased suspension freeness less than the former one. Thus, it is introduced as the best treatment which increases wet tensile strength.

Keywords: CMC, CNF, PAE, paper making, paper wet strength.

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Preference of consumers in the selection of final woody products in different income quarters in households of Dorud city

Abstract

In the present study we tried first, to recognize the effective factors on the selection of wood products, based on the literatures reviewed as well as the opinion of the experts, consumers, agencies and the selling centers of wood products. And then, the importance of each factor was determined using the AHP method, which is one of the conventional methods of decision making, in the environment of Expert choice software. According to the results, major indicators were categorized into three groups of economic, technical and qualitative. Each of these groups was composed of seven sub-indicators. Then ranking of these indicators were done in quartile incomes in Dorud county in Lorestan province. In low-income groups, the technical indicators were higher in importance while in highest income group, qualitative indicators were significant. The price of the product itself in all of the quarters had the highest weight among the economic sub-indicators and its importance increases continuously by the decrease of income. In technical sub-indicators in all of the quarters, durability has the most importance.

Keywords: indicator, wood products, quartile income, analytic hierarchy process, Dorud.

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The effect of cellulose nanofibres on cationic starch efficiency in pulp and paper recycled from packaging waste paper

Abstract

Application of chemical additives is an effective approach to improve the properties of recycled paper products and process, which new additives introduction are always under challenge and question. Recently, Cellulosic Nano Fibers (CNF) as a nano-bio-material originated from the plant fibers received a great attention in different area such as papermaking, which acquainted the performance assessments regarding to the various conditions of the different furnishes. With this respect, the effect of CNF (0.1, 0.15 & 0.2% OD pulp) on the well-known performance of cationic starch (CS) (0.5, 0.75 & 1% OD pulp), as the most famous polymer used in papermaking, were studied in the pulp recycled from packaging brown waste papers. The results showed that addition of CNF after starch didn't improve pulp retention, but also declined starch performance in the recycled pulp retention improvement, continuously and corresponding to CNF usage increment. Also, the results obtained from dynamic drainage jar approved retention data, and the least pulp loss was occurred at the lowest CNF addition. Individually addition of CNF decreased the pulp freeness (CSF) and its addition after starch didn't positively affect CSF, significantly; and often decreased it. The CNF addition to the starch contained pulp had no meaningfully effect on tensile and burst strengths of the recycled paper and diminished tear strength, too. Generally, unlike the traditional retention-drainage systems comprising cationic polymer/nanoparticles, the application of cationic starch/cellulose nanofibers revealed no positive effects on the properties of pulp and paper recycled from packaging brown papers.

Keywords: cationic starch, cellulose nanofibers, recycled pulp and paper.

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Improving the mechanical and physical properties of particleboard produced from bamboo- industrial wood using polypropylene powder

Abstract

Decreasing of wooden raw material for industries has led to the development of non-wooden lignocellulosic resources such as fast-growing bamboo. In comparison with wooden species these non-wooden species are different, anatomically and chemically and their application mainly causes low quality composites. In this research different amount of industrial wood particles are replaced with bamboo particles (10, 20 and 30 percent). In order to improve the negative effects of presence of bamboo particles in the composites the polypropylene powder were used in two levels (5 and 10 percent). Different combinations of the aforementioned raw materials were manufactured in a hot press after being sprayed with UF resin. The physical and mechanical properties were evaluated according to European standards set of EN. Results showed that the maximum of MOR and MOE were found in the combination of 10 percent polypropylene and 20 percent bamboo. In addition, the increase in the amount of bamboo (30 percent) resulted in decrease in MOR and MOE. Increasing of bamboo has a negative effect on water absorption and thickness swelling after 2 and 24 hours but increasing of polypropylene from 5 to 10 percent had a positive effect on these factors. According to the results the composites manufactured of 20 percent of bamboo and 10 percent of polypropylene can meet the requirement of particleboards for carpentry to be used in dry conditions.

Keywords: non-wooden lignocellulosic resources, fast-growing, bamboo, polypropylene.

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Improving the mechanical and physical properties of particleboard produced from bamboo- industrial wood using polypropylene powder

Abstract

Decreasing of wooden raw material for industries has led to the development of non-wooden lignocellulosic resources such as fast-growing bamboo. In comparison with wooden species these non-wooden species are different, anatomically and chemically and their application mainly causes low quality composites. In this research different amount of industrial wood particles are replaced with bamboo particles (10, 20 and 30 percent). In order to improve the negative effects of presence of bamboo particles in the composites the polypropylene powder were used in two levels (5 and 10 percent). Different combinations of the aforementioned raw materials were manufactured in a hot press after being sprayed with UF resin. The physical and mechanical properties were evaluated according to European standards set of EN. Results showed that the maximum of MOR and MOE were found in the combination of 10 percent polypropylene and 20 percent bamboo. In addition, the increase in the amount of bamboo (30 percent) resulted in decrease in MOR and MOE. Increasing of bamboo has a negative effect on water absorption and thickness swelling after 2 and 24 hours but increasing of polypropylene from 5 to 10 percent had a positive effect on these factors. According to the results the composites manufactured of 20 percent of bamboo and 10 percent of polypropylene can meet the requirement of particleboards for carpentry to be used in dry conditions.

Keywords: non-wooden lignocellulosic resources, fast-growing, bamboo, polypropylene.

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The effect of dissolution time on wettability and certain properties of cellulose film produced using ionic liquid

Abstract

Wettability and some other physical and mechanical properties of cellulose films are as restricting factors in application of such biodegradable films. Since it is proposed that the dissolution process parameters may significantly affect the cellulose film structure and properties, in this research, the effect of dissolution time on wettability and some substantial properties of cellulose film was evaluated. In this due, cotton linter was dissolved in 1-butyl 3-methyl imidazolium chloride for 1, 3 and 5 hours, and following being washed with distilled water as an anti-solvent, the cellulose films were casted on petri-dishes and dried in 60 °C oven. In order to research the effect of dissolution time on chemical and physical structure of the films, FTIR and X-ray diffraction were applied. Moreover, mechanical properties, such as tensile strength, modulus of elasticity and elongation at break, and some physical characteristics as moisture absorption and water droplet contact angle were studied. FTIR spectra analysis revealed that following increasing the dissolution time, no change in chemical structure of cellulose films was observed. But, the analysis of XRD patterns demonstrated a minor rise in crystallinity index following increasing the dissolution time. In addition, it was revealed that the degree of polymerization, tensile strength and elongation at break decreased as dissolution time increased; while there was no significant change in modulus of elasticity. The highest moisture absorption rate in cellulose films was occurred early in the absorption diagram, and the increase in dissolution time, resulted an increase in water droplet contact angle at zero time.

Keywords: cellulose film, ionic liquid, dissolution time, wettability, mechanical properties.

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Survey of effective criteria for sustainable development of poplar wood farming in Iran by pair comparisons method

Abstract

Wood farming and its sustainable development according to forest poverty, many environmental hazards and current climate is one of the fundamental strategies. Therefore, this study was aimed at determination and prioritization effective criteria for sustainable development of poplar wood farming in Iran by using pair comparisons method. For this purpose, after review and interviews, 25 key indicators were identified. These criteria were divided into four major groups as: economic and social issues, protection and support of farmers, planting method and infrastructure indices. Prioritize these indicators and sub-indicators whit hierarchical diagram, questionnaires and matrix of paired comparisons were done and the priority rates of these criteria were evaluated by using the Expert Choice software. The results indicated that among 25 effective sub-criteria in sustainable development of poplar wood farming in Iran, the sub-criteria of annual household livelihoods (0.162), liberation of importing and exporting of poplar wood (0.135), providing new varieties and efficient such as modified seedlings (0.093), use of potential prone areas poplar farming (0.079), guaranteed purchase of products (0.067), financial incentives and loans to poplar farmers (0.058) and investment return after the 8 to 10 years (0.049) had the highest priorities, respectively.

Keywords: sustainable development, fast-growing trees, pair comparisons method, poplar wood farming, criteria and sub-indicators.

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Evaluation of lignocellulose nano-fiber absorbent efficacy in lead removal from aqueous solutions

Abstract

Water pollution by metallic ions such as lead from industrials, mine wastewater, automobiles is currently of great concern, since they are not biodegradable and tend to accumulate in living organisms, causing various diseases and disorders. Recently, great attention has been focused on the removal of metallic ions from aqueous solution using adsorbents derived from biomaterials and bio-Nanomaterials due to their natural, abundance, cost-effectiveness and inherent ability to react with metals. The present study aims to evaluate the performance of lignocellulose Nanofibers (cellulose nanofibers containing lignin and hemicellulose) as adsorbent for the removal of lead. The study of adsorption techniques were used in laboratory-scale batch. The effects of pH, initial concentration and dose adsorbent were examined. To study the absorption temperature, thermodynamic parameters such as Gibbs energy (ΔG), enthalpy (ΔH°) and entropy (ΔS°) were calculated. The results of this study showed that the highest removal efficiency was 99.8% at a Nano-absorbent concentration 0.3 mg/l, pH=6, and lead concentration of 10 mg/l. The batch isotherm studies showed that the adsorption data can be described by the Langmuir, Freundlich models. The Langmuir model was found to describe the adsorption data better in comparison with that of Freundlich. The results showed that lignocellulose Nanofibers had high ability to absorb high concentrations of lead from aqueous solutions. The results of thermodynamics express themselves spontaneously, thermally and increase the rate of reaction disorder. The TEM showed the adsorbents have fibers and the networking crystalline structure.

Keywords: biological adsorption, lignocellulose nanofibers, lead, aqueous solutions.

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Investigation of the impact resistance of the plywood made with adhesive enhanced with cellulose nanofibrils

Abstract

In this research, nanocellulose fibers were used as adhesive filler in the manufacture of plywood from wych elm (*Ulmus globra*). Then, the drop-weight impact of the plywood samples was investigated. For this purpose, the nanocellulose fibers were added to dry weight of urea formaldehyde adhesive at four levels of 0, 0.5, 1 and 1.5%. The "4-ply" plywoods were made with these adhesives that the layers in top and bottom were parallel and had two core layers perpendicular with top. In order to investigate the impact properties, plywood samples were tested in the drop-weight impact device. The maximum force on the samples, the displacement in maximum force, the energy consumed in the maximum force and the total absorbed energy were evaluated. The results showed that the sample containing 0.5% of the nanocellulose fibers had the best impact property and with increasing nanocellulose fibers, the impact properties were significantly reduced. Also, the impact resistances in the most of samples with nanocellulose fibers were better than the without nanocellulose (control) samples.

Keywords: mechanical strength, drop-weight impact test, plywood, adhesive, nanocellulose fibers, Elm (*Ulmus globra*).

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Effect of dry- heat and moist-heat aging on properties of papers treated with nano calcium hydroxide and nano chitosan

Abstract

Paper due to its structural properties, is gradually degraded by different destructive factors especially acidic hydrolysis. For this reason, deacidification of the old valuable papers in order to stop and neutralize this process and applying consolidation treatments for strengthening of degraded paper is necessary. In this study, for deacidification and consolidation, by using dispersions of Nano Calcium hydroxide and Nano Calcium Hydroxide with companion of Nano Chitosan in Ethanol, a Nano coat was applied on the paper samples. Also, in order to investigate the effect of deacidification and consolidation treatments, the samples were subjected to dry-heat and moist-heat aging. Then, pH, folding endurance, and brightness of the treated aged and unaged papers were studied. The results of studying the chemical, mechanical and physical properties of treated papers before and after aging showed that the use of calcium hydroxide nanoparticles led to an increase in alkalinity improved the brightness, while using Nano chitosan with calcium hydroxide increased the mechanical properties of paper. But after moist-heat aging, the folding endurance of treated papers with Nano calcium hydroxide - Nano chitosan had more decrease. Also, in terms of optical properties, the papers treated with calcium hydroxide nanoparticles had more stability in comparison to control samples and treated papers with combination of Nano calcium hydroxide and Nano chitosan.

Keywords: paper deacidification, nano, calcium hydroxide, chitosan, accelerated aging.

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Production of dissolving pulp from populus deltoides wood utilizing alkaline pre-extraction followed by soda-AQ pulping process

Abstract

Dissolving pulp is used as a raw material to produce numerous cellulosic derivatives like carboxymethyl cellulose, nitrocellulose, viscose, etc. The potential of dissolving pulp production from *populus deltoides* using alkaline pre-extraction followed by soda-AQ pulping process was investigated across this research. The yield loss of about 15% was achieved in pre-extraction stage through controlling the process parameters, and kappa number of the pulp has been reduced to about 40% with oxygen delignification. The results showed that the alkaline pre-hydrolysis has been affected on increasing the lignin removal rate of fibers. Using alkali catalyst in pre-hydrolysis liquor led to increasing α -cellulose and decreasing brightness level of the dissolving pulp. The α -cellulose and brightness level of dissolving pulp have been upgraded by utilizing higher levels of kappa factor in D_0ED_1 bleaching. Therefore, the produced dissolving pulp employing 0.45 kappa factor in D_0 stage due to its higher α -cellulose, brightness and purity has been more favorable in this research work.

Keywords: dissolving pulp, alkali-catalyzed pre-hydrolysis, soda-AQ pulp, Poplar, oxygen delignification.

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Cellulose extraction from spirulina wastes (*Spirulina platensis*) and isolation of cellulose nanofiber from it

Abstract

The purpose of this study was to extract pure cellulose from the waste spirulina alga (*Spirulina platensis*) using a method of chemical treatment and then isolation of cellulose nanofibers by applying a mechanical process. For this purpose, purification of spirulina algae (separation of fat and protein) was carried out during three stages of chemical treatment using a 2% Sodium hydroxide solution, followed by 3% sodium chlorite solution, which was buffered by acetic acid. The extracted cellulose fibers were then subjected to 1% dry weight suspension and passed through a high pressure homogenizer in order to isolate the cellulose nanofibers. Before and after chemical treatment, the infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and X-ray diffraction (XRD) were used to study the chemical and structural properties of the samples. Also, the diameter and length of the prepared cellulose nanofibers were measured by atomic force microscopy (AFM). The FTIR results showed that the chemical and mechanical treatment could successfully isolate cellulose and nanocellulose fibers which are totally compatible with previously studies. The analysis of SEM images showed that pure cellulose fibers were extracted from spirulina algae. In addition, the XRD analysis illustrated that the cellulose and nanocellulose fibers had similar diffractogram to the cellulose I. AFM images demonstrated that the nanofibers had average diameter of 37 nm while their length was several microns. It can be concluded that the isolation of cellulose nanofibers by using the high pressure homogenizer could be possible from the chemically treated cellulose fibers.

Keywords: cellulose, cellulose nanofibers, spirulina algae, purification.

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