Effect of recycling process on physical and mechanical properties of wood flour high-density polyethylene composites

E. Nadali[1*]
M. Layeghi[2]
Gh. Ebrahimi[3]
M. Jonoobi[4]
M.Chaharmahali[5]

[1] PhD student., Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[2] Assistant Prof., Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[3] Professor, Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[4] Assistant Prof., Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[5] PhD, Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

Corresponding author:
e.nadali@yahoo.com

Received: 2016/07/07
Accepted: 2016/09/13

Abstract

This paper reports the effects of recycling on physical and mechanical properties of wood flour high-density polyethylene composites (HDPE). Composite materials containing HDPE, wood flour, and Maleic Anhydride polyethylene (MAPE) were manufactured and subjected to a recycling process up to four times grinding and reprocessing under industrial conditions. A wide range of analytical methods including bending tests, modulus of elasticity, impact strength, water absorption tests, fiber length measurement and also scanning electron microscopy were employed to understand the effects of recycling on wood flour-HDPE composites. The results revealed that the recycled composites had low bending strength and modulus of elasticity values, compared with the reference counterparts, whereas the once recycled composite showed a high impact strength compared with both the reference and other more recycled composites. Results, as well, indicated that generally the recycled composites had low water absorption values as compared with the reference ones.

Keywords: composites, recycling, wood flour, mechanical properties, physical properties.

Effect of weathering on mechanical and physical properties of wood-polyethylene composite containing titanium dioxide nanoparticles, photo stabilizer and heat treated wood

M. Dahmardeh Ghalehno[1*]
M.R. Masteri Farahani[2]
M. Madhoushi[3]
D. Rasouli[4]
A. Shakeri[5]
I. Ghasemi[6]

[1] Assistant prof., Department of wood and paper sciences and technology, University of Zabol, Zabol, Iran

[2] Associate prof., Department of wood engineering and technology, Gorgan university of agricultural science and natural resources,Gorgan, Iran

[3] Associate prof., Department of wood engineering and technology, Gorgan university of agricultural science and natural resources, Gorgan, Iran

[4] Assistant prof., Department of wood engineering and technology, Gorgan university of agricultural science and natural resources, Gorgan, Iran

[5] Associate Prof., Department of chemistry, University of Tehran, Tehran, Iran

[6] Professor, Department of plastic, Iran polymer and petrochemical institute, Tehran, Iran

Corresponding author:
mmdahmardeh@yahoo.com

Received: 2016/09/12
Accepted: 2016/11/23

Abstract

Weathering of wood plastic composite is of major concerns. Weathering due to UV light and moisture results in the degradation of wood plastic composite. In this study, effect of weathering on mechanical and physical properties of wood-polyethylene composites containing titanium dioxide nanoparticles, photo stabilizer (tinuvin 328) and heat treated wood were investigated. The variable factors were titanium dioxide nanoparticles content (0, 1, 2 and 3%), raw material type (heat treated wood and untreated wood), tinuvin 328 (0 and 1%) and weathering time (0 and 1500h). The impact of weathering was investigated through the changes in the mechanical properties, contact angle and surface morphology of wood plastic composites. The result showed that flexural strength, tensile strength and contact angle of all samples decreased after weathering. Also, surface cracks on the weathered composites were observed with a scan electron microscope. According to the results, wood plastic composites containing titanium dioxide nanoparticles, heat treated wood and tinuvin 328 (photo stabilizer) showed less loss of mechanical properties and contact angle and fewer surface cracks after weathering compared with the control sample.

Keywords: titanium dioxide nanoparticles, heat treated wood, tinuvin 328, weathering.

Effect of Bene (*Pistacia atlantica*) gum on the physical and mechanical properties of oil-heat treated wood

Abstract

Cooling of oil-heat treated wood which is carried out at the final stage of thermal modification process can affect the properties of the modified wood. In the present study, poplar wood modified in canola oil (at 180, 200 and 220°C for 2 h) was cooled in the cold oil containing 0, 5 and 10% Bene gum (*Pistacia atlantica*) for 30 minutes. The weight gain percentage (WPG) of specimens ranged from 60.7 to 77.6 % and reduced by increasing the modification temperature; however, the WPG increased as a result of cooling the oil containing Bene gum. On the whole, cooling the oil containing Bene gum had no significant effect on the moisture exclusion and anti-swelling efficiencies whereas improved the water repellent efficiency. The results of dynamic contact angle measurement for 60 s also showed that cooling the oil with Bene gum reduced the wettability of the modified wood, even more. However, increasing the gum content from 5 to 10% had no significant effect on this property. As a result of adding the Bene gum in oil, the bending strength and compression strength parallel to grain were not changed but the impact resistance of the wood specimens modified at 180°C and modulus of elasticity of those modified at 220°C were improved. The results of ATR-FTIR showed that the peak intensity at wavenumber of 1745 cm^{-1} which is related to the stretching vibration of carbonyl group (C=O) was higher in the modified wood compared with the untreated wood probably due to the presence of oil in the modified wood.

Keywords: oil heat treated wood, Bene gum, physical and mechanical properties.

M. Mahmoud kia[1]
A. Tarmian[2*]
A.N. Karimi[3]
A. Abdulkhani[4]
M.R. Mastri Farahani[5]

[1] Ph.D. student, Department of wood and paper science & technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[2] Associate Prof., Department of wood and paper science & technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[3] Professor, Department of wood and paper science & technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[4] Associate Prof., Department of wood and paper science & technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[5] Associate Prof., Department of wood engineering and technology, Gorgan university of agricultural sciences and natural resources, Gorgan, Iran

Corresponding author:
tarmian@ut.ac.ir

Received: 2016/11/14
Accepted: 2017/01/04

Study on properties of wood-composite prepared from wood flour and recycled polycarbonate (used CDs)

Abstract

This study was aimed to investigate the properties of wood-plastic composites made from recycled polycarbonate polymer (used CDs) and wood flour at levels of 0, 10, 20 and 30%. Boards with 3-7 mm thickness were manufactured with a density of 1 g/cm^3. Hot press time and temperature were adjusted as 12 min and 190 ° C with a pressure of 130 bar. Fixed amount of 2 % N-(2-amino-ethyl) -3- amino propyl tri-methoxy silane was used as a coupling agent. Physical and mechanical properties, including strength and flexural modulus, tensile strength, impact strength, water absorption and thickness swelling of the boards were studied. The results showed that, compared with control samples (neat recycled polycarbonate polymer), the mechanical properties of prepared composites were increased by increasing the wood flour ratio from 10 to 30%. Also, the amount of 72 hours water uptake of the composites was measured as 0%. The thermal stability of the neat polymer was found to be better than the manufactured composites. The overall thermal degradation of the composites was increased by increasing the wood portion.

Keywords: wood plastic composite, recycled polycarbonate, wood flour, silan, thermal degradation.

A. Abdulkhani[1*]
R. Shamsi[2]
M. Faezipour[3]
P. Moradpour[4]
S. Izadyar[5]

[1] Associate Prof., Department of wood and paper, Faculty of natural resources, University of Tehran, Karaj, Iran

[2] M.Sc., Department of wood and paper, Faculty of natural resources, University of Tehran, Karaj, Iran

[3] Professor, Department of wood and paper, Faculty of natural resources, University of Tehran, Karaj, Iran

[4] Assistant Prof., Department of wood and paper, Faculty of natural resources, University of Tehran, Karaj, Iran

[5] Assistant Prof., Department of wood and paper, Faculty of natural resources, University of Tehran, Karaj, Iran

Corresponding author:
abdolkhani@ut.ac.ir

Received: 2015/05/29
Accepted: 2017/02/05

Verifying the Preston equation between the average of tracheid length and microfibril angle in Cupressus arizonica compression and opposite wood

Abstract

In a conifer, an increase in tracheid length is usually accompanied with a decrease in microfibril angle of S_2 layer (MFA). Preston proposed an equation relating these two features, quantitatively. However, this equation has less been verified in subsequent works. Hence, in this study, variation of tracheid length and MFA from pith to bark in compression and opposite wood of *Cupressus arizonica* was investigated and it was tried to determine the relationship between these two factors, quantitatively. Results showed that the tracheids are shorter and mean MFA is bigger in compression than opposite wood. Moreover, in both sides, mean tracheid length increased from pith to bark while MFA decreased in the same direction. A strong and negative relation was found between the mean tracheid length and MFA in both areas which was of nonlinear type when compression, and compression and opposite wood together were concerned. Overall, Preston equation between these two anatomical features was verified.

Keywords: reaction wood, microfibril angle, tracheid length, method of "inducing cracks on cell wall", wood anatomy.

R. Oladi[1*]
K. Pourtahmasi[2]
D. Parsapajouh[3]

[1] Assistant prof., Department of wood and paper science & technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[2] Professor, Department of wood and paper science & technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[3] Professor, Department of wood and paper science & technology, Faculty of natural resources, University of Tehran, Karaj, Iran

Corresponding author:
oladi@ut.ac.ir

Received: 2016/11/30
Accepted: 2016/02/12

Effect of de-ashing method of recycled paper sludge on its chemical compounds in a bio-refinery concept

Abstract

Paper mill sludge is a solid waste including residual fiber and ash produced in pulping and papermaking processes that, in this study, was supplied from Neka Pars Kaghaz Co. in Mazandaran provience and used as a raw material to evaluate its potantial for manufacturing high value-added products in a bio-refinery concept. After measuring its chemical compounds, above-mentioned sludge was de-ashed by 3 methods using air, CO_2 and stirrer. Then, chemical compounds in each de-ashed sludge was measured and compared with those before the treatments. Moreover, mineral oxide in recycled paper sludge was charecterized using XRF. Results show that de-ashing methods with CO_2, stirrer and air can decrease ash content of recycled paper sludge up to 28.4, 61.84 an 70.99 percent, respectively. Accordingly, cellulose content of it in the air de-ashing, stirrer and CO_2 bobles methods increased about 120, 121, and 64 percent, respectively. Also, de-ashing methods were succesfully act in the calcium oxide removal to 13 percent and basically effeciancy of this methods lies more in the removal of trace oxides. It is worth mentioning that the ash mainly includes of casium, silisium, aluminium and magnesium oxides. Investigation of mineral and organic compounds of recycled paper sludge showed that de-ashing with air is the most efficient in ash removal that can be used as pre-treatment before all processes to obtain high-value added products in a bio-refinery concept.

Keywords: recycled paper sludge, ash, de-ashing, bio-refinery.

R. Barzegar[1]
E. Rasooly Garmaroody[2*]
S.R. Jafari Petroudy[3]
S. Hamedi[4]

[1] M. Sc student, Department of cellulose and paper technology, Faculty of new technologies, Zirab campus, Shahid Beheshti university, Savadkooh, Iran

[2] Assistant Prof., Department of cellulose and paper technology, Faculty of new technologies, Zirab campus, Shahid Beheshti university, Savadkooh, Iran

[3] Assistant Prof., Department of cellulose and paper technology, Faculty of new technologies, Zirab campus, Shahid Beheshti university, Savadkooh, Iran

[4] Assistant Prof., Department of cellulose and paper technology, Faculty of new technologies, Zirab campus, Shahid Beheshti university, Savadkooh, Iran

Corresponding author:
e_rasooly@sbu.ac.ir

Received: 2017/01/04
Accepted: 2017/02/12

Investigation on physical and biometric properties of wood of the most important coniferous species at Neka low-land (Kuhsarkandeh)

Abstract

In this study, physical and biometric properties of wood and woody fibers of eight imported coniferous species in Kuhsarkndh Neka forestry project were studied. For this purpose, forty eight healthy trees from eight coniferous species (*Pinus taeda, P. radiata, P. Brutia, P. nigra, P. pinaster, P. longifolia, Cryptomeria japonica and Cedrus deodara*) were selected. A 10 cm disk from each tree was cut to calculate the physical properties of wood (critical density and volumetric shrinkage) and fiber biometry (tracheid dimensions and biometric ratios). After removing pith of trees, samples were prepared from all over the disk. The results showed that there is a significant difference between imported conifers in the terms of physical properties and fiber biometry. Maximum critical density and volumetric shrinkage, tracheid length, tracheid diameter, lumen diameter, cell wall thickness, flexibility ratio, slenderness ratio, and Runkel ratio belong to *P. Borussia, P. longifolia, P. longifolia, P. longifolia, P. longifolia, P. Brutia, Cryptomeria japonica, P. Brutia* and Cedrus, respectively. Density, tracheid length and biometric ratios (flexibility, Raunkel and slenderness) of studied species were within the desirable range for the production of paper.

Keywords: conifers, critical density, volumetric shrinkage, fiber dimensions, biometric ratios.

M. Farsi[1*]
M. Kiaei[2]
M. Montazeri[3]

[1] Associate prof., Department of wood and paper industry, Sari branch, Islamic azad university, Sari, Iran

[2] Associate prof., Department of wood and paper industry, Chalous branch, Islamic azad university, Chalous, Iran

[3] MSc, Department of wood and paper industry, Sari branch, Islamic azad university, Sari, Iran

Corresponding author:
moh_farsi@iausari.ac.ir

Received: 2016/08/24
Accepted: 2017/02/13

The trigonometric calculation of twisting angle in spiral stair from beech wood

F. Radfar[1]
H. Zarea Hosseinabadi[2*]
M. Layeghi[3]
P. Moradpour[4]

[1] M.Sc., graduated, Department of wood and paper sciences & technology, Faculty of natural resources, College of agriculture and natural resources, University of Tehran, Karaj, Iran

[2] Assistant prof., Department of wood and paper sciences & technology, Faculty of natural resources, College of agriculture and natural resources, University of Tehran, Karaj, Iran

[3] Assistant prof., Department of wood and paper sciences & technology, Faculty of natural resources, College of agriculture and natural resources, University of Tehran, Karaj, Iran

[4] Assistant prof., Department of wood and paper sciences & technology, Faculty of natural resources, College of agriculture and natural resources, University of Tehran, Karaj, Iran

Corresponding author:
hzareah@ut.ac.ir

Received: 2017/02/06
Accepted: 2017/06/07

Abstract

In this study, the experimental calculation of the twisting angle in the construction of wooden spiral stairs from beech (*fagus orientals)* on the scale of one sixth was carried out based on the SMA-R311 standard. The effect of radius on rake angle and the effect of handrail width and rake angle on twisting angle were also studied. The outer radius (11.5, 42.5 cm), handrail width (4.5, 8cm), and the door rake angle (15, 33 degree) were chosen as the variable parameters and the twisting angle was calculated using trigonometry. The results showed that as the diameter decreases, the stair rake angle increases. The results suggested that an increase in the rake angle leads to an increase in the twisting angle of the handrail, but an increase in the handrail width didn't have any effect on the twisting angle. The results showed non-linear changes of the rake and twisting angles.

Keywords: wooden spiral stair, outer radius, rake angle, twisting angle of the handrail.

Investigation on stress distribution at corner joints with wood polymer members using finite element method

Abstract

In this study, a comprehensive experimental and numerical investigation was carried out regarding structural performance of butted joints constructed with wood-polymer members (poly (furfuryl alcohol)) under combined stresses in comparison with control specimens. The aim of this research was to enhance performance of these joints in outdoor applications especially under combined stress. For investigation of this joints performance, specimens with two different values of furfurylation at 20% and 65% in comparison with control specimens were evaluated. Mechanical properties of specimens were determined according to ASTM D-143 and based on the results, materials properties were defined for the modeling. Proportional limit of loading value from experiments was compared with the result of FEM model. Result of FEM model completely confirmed experimental results and the validation of model was adequately performed. To understand the joint behavior at FEM model and to predict the fracture reasons, some properties of fracture mechanics related to wood polymer were used.

Keywords: finite element method, butted joint, combined stress, furfurylation and fracture mechanics.

H. Abdolzadeh[1*]
M. Layeghi[2]
Gh. Ebrahimi[3]
M. Ghassemieh[4]

[1] PhD, Department of Wood science & technology, Faculty of Natural resources, University of Tehran, Karaj, Iran

[2] Assistant Prof., Department of Wood science & technology, Faculty of Natural resources, University of Tehran, Karaj, Iran

[3] Professor, Department of Wood science & technology, Faculty of Natural resources, University of Tehran, Karaj, Iran

[4] Professor, Faculty of Civil engineering, College of engineering, University of Tehran, Tehran, Iran

Corresponding author:
h_abdolzadeh@ut.ac.ir

Received: 2016/07/09
Accepted: 2017/02/28

Investigating the effect of recycled polyethylene powder on physical and mechanical properties of three-layer particleboard

Abstract

In this study, the physical and the mechanical properties of three-layer particleboard produced by recycled polyethylene powder and wood particles were investigated. For this purpose, recycled polyethylene powder in different levels (0, 10, 20, 30, 40 and 50%) and urea – formaldehyde (UF) resin in two levels of 5 and 10% were used. Mechanical and physical properties including density, water absorption and thickness swelling after 2 and 24 hours immersion in water, bending strength (MOR), modulus of elasticity (MOE) and internal bonding (IB) were measured. Results showed an improvement in MOE, MOR and IB with increasing the proportion of recycled polyethylene in the board composition. Adding urea formaldehyde resin had a significant effect on the bending strength, modulus of elasticity and internal bonding. Water absorption (WA) and thickness swelling (TS) after 2 and 24 hours immersion in water decreased with increasing of recycled polyethylene content. The maximum of WA and TS after 2 and 24 hours of immersion in water were found in control specimens and the best value of these factors were found in the boards containing of 50 percent of recycled polyethylene. With increasing urea formaldehyde resin from 5 to 10%, MOR, MOE and IB increased and WA and TS after 2 and 24 hours decreased. The reinforcing role of recycled polyethylene in particleboard strength can result in the reducing of UF resin consumption in particleboard. Based on the finding of this study, recycled polyethylene and UF resin could be used for general purpose particleboard up to 40 percent and 5 percent of the oven-dry panel weight, respectively.

Keywords: three-layer particleboard, recycled polyethylene, urea formaldehyde resin.

S. J. Tabatabaii[1]
V. Vaziri[2*]
F. Faraji[3]
E. Kabiri[4]

[1] M.Sc. Graduated of wood composite products, Gonbad Kavous University, Gonbad, Iran

[2] Assistant Prof., Department of wood and paper science and technology, Gonbad Kavous University, Gonbad, Iran

[3] Assistant Prof., Department of wood and paper science and technology, Gonbad Kavous University, Gonbad, Iran

[4] Quality Control Expert of Sanate Choube Shomal company, Iran

Corresponding author:
vahidvaziri@gmail.com

Received: 2016/06/12
Accepted: 2017/02/28

Comparative investigation of treated bagasse and rice straw on physical and mechanical properties of natural fiber reinforced composites (NFRC)

Abstract

This study investigated the effects of lignocellulosic materials (bagasse and rice straw) and four pulping processes as fiber's treatment on physical and mechanical properties of natural fiber reinforced composites. Lignocellulosic material in form of pulp flour (alkaline sulfite anthraquinone, soda anthraquinone, monoethanolamine, and chemical–mechanical pulping), 5 wt.% maleic anhydride polyethylene as coupling agent and high-density polyethylene (HDPE) were used to produce bio-composites by injection molding process. Polymer-to-fibers ratio for all reinforced composites was 60:40 wt.%. Mechanical properties including tensile properties, flexural properties, notched Izod impact strength and physical properties such as water absorption and thickness swelling were evaluated according to ASTM standards. The results showed that treated fibers compared to untreated fibers led to an increase and a decrease of flexural modulus in bagasse and rice straw reinforced composites, respectively. On the other hand, these treatments increased tensile modulus of both bagasse and rice straw reinforced composites. The results indicated that flexural and tensile strength of bagasse composites were significantly higher than rice straw composite. In contrast, rice straw composites showed higher impact strength, water absorption (WA), and thickness swelling (TS) in comparison with the bagasse reinforced composites. The four pulping processes decreased WA and TS of both lignocellulosic composites.

Keywords: pulp, bagasse, rice straw, composite, HDPE.

S. B. Hosseini[1]
S. Hedjazi[2*]
L. Jamalirad[3]
M. Fatahi Amin[4]
S. Izadyar[5]

[1] MSc Graduate, Department of wood and paper science and technology, University of Tehran, Karaj, Iran

[2] Associate Prof., Department of wood and paper science and technology, University of Tehran, Karaj, Iran

[3] Assistant Prof., Department of wood and paper science and technology, Gonbad Kavous University, Gonbad Kavous, Iran

[4] MSc, Department of wood and paper science and technology, University of Tehran, Karaj, Iran

[5] Assistant Prof., Department of wood and paper science and technology, University of Tehran, Karaj, Iran

Corresponding author:
shedjazi@ut.ac.ir

Received: 2017/01/15
Accepted: 2017/03/12

Preparation and dynamic thermal analysis of zein, chitosan and nanocellulose nanocomposites

Abstract

The vast accumulation of materials and synthetic polymers, which can remain as contaminants in the environment and cannot be decomposed for a long time, is one of the problems in the plastic industry. The present study shows how synthetic polymers are replaced by natural ones through semi-industrial production method. Firstly, a masterbatch was prepared by mixing zein, nanocellulose and chitosan in a ratio of 3: 2: 5. A solution of chitosan and zein was prepared. Then, nanocellulose was added to the suspension and the ternary mixture and composite was prepared. The masterbatch was dried and grinded and films were prepared by adding zein matrix in 1, 3 and 5 percent nanocellulose to 1.5 and 4.5 and 7.5 percent of chitosan by extruding and pressing. Storage and loss modulus and loss factor of the treatments were assessed by Dynamic Mechanical Analysis (DMA) / Dynamic Mechanical Thermal Analysis (DMTA). It was observed that thermal properties were improved by increasing nanocellulose and chitosan to 3 and 4.5 percent, respectively. The glass transition temperature in this treatment was 88.3 °C. It was higher, in comparison with 5 and 1 percent nanocellulose and pure zein treatments, which were 85.6, 79.01 and 64.9, respectively. The peak of loss factor or the glass transition temperature of composites depends on the distribution of nanocellulose and a better interaction of nanocellulose and chitosan and zein matrix. The glass transition temperature decreased in more and less than 3 percent nanocellulose which shows its lower thermal properties.

Keywords: chitosan, composite, packaging, nanocellulose, zein.

Gh. Javadzadeh Moghtader[1]
M. Faezipour[2]
Y. Hamzeh[3*]
M. Jonoobi[4]

[1] Ph. D student., Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[2] Prof., Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[3] Prof., Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

[4] Assistant Prof., Department of wood and paper science and technology, Faculty of natural resources, University of Tehran, Karaj, Iran

Corresponding author:
Hamzeh@ut.ac.ir

Received: 2017/02/26
Accepted: 2017/06/04