# The beatability of wheat straw soda and monoethanolamine pulps

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## Abstract

In this study, the beatability of soda and monoethanolamine pulps was compared. The refining of pulps was done in pilot scale Voith refiner Model LR 40. The results showed that the maximum tensile and burst indices of monothanolamine pulp can be reached with consumption of 70 kWh energy in pilot scale Voith refiner and the increasing of energy more than this level has the adverse effect on these indices. In the case of soda pulp, increasing the energy up to 500 kWh has the linear relationship with tensile and burst indices. In comparison to the monoethanolamine pulp, the refining of soda pulp is more difficult and needs more energy. Using monoethanolamine pulp resulted in saving of energy by 70-80 % to reach the optimum strength indices.

**Key words:** wheat straw, pulping, monoethanolamine, soda, refining.

# Investigation on the effect of mixed rapeseed stalk residues with wood particles, and mixing of melamine and urea formaldehyde resin on properties of manufactured particleboard

**Abstract**

In this study, the possibility of using the rapeseed stalk mixed with industrial wood particles for manufacturing particleboard with target density of 0.7 gr/cm3 was considered. Variable factors such as mixing ratios of rapeseed stalk with industrial wood particles at five mixing levels of 0-100, 25-75, 50-50, 75-25 and 100-0 percent, mixing ratios of melamine resin to urea formaldehyde at three levels of 0-100, 15-85 and 30-70 percent, and kind of board (homogenate and layered) were considered. 10 percent resin based on oven dried weight of particles, 2 percent catalyzer based on oven dried weight of resin, press temperature and time with 170 OC and 7 minute, press pressure and rate with 30 Kg/cm3 and 4.5 mm/min were fixed. Then, the boards were manufactured and the physical and mechanical properties including modulus of rupture, modulus of elasticity, internal bonding, water absorption, and thickness swelling were measured according to EN standards. Results indicated that the modulus of rupture, modulus of elasticity, water absorption and thickness swelling of boards increased with an increase in rapeseed stalk loading; however, the internal bonding decreased. Also, the use of melamine urea formaldehyde resin improved the mechanical strength and dimensional stability of the samples.

**Key words:** particleboard, rapeseed stalk, industrial wood particles, melamine formaldehyde, dimensional stability, mechanical properties.

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# Influence of type and content of chemical foaming agent on the dynamic mechanical properties of high density polyethylene-flax fiber composites

**Abstract**

This study aimed to evaluate the influence of type and content of chemical foaming agent on the dynamic mechanical properties of high density polyethylene-flax fiber composites. Composites were prepared via melt mixing in an internal mixer, and then foamed using single-stage batch foaming method. Two types of chemical foaming agents including azodicarbonamide (ADC) and sodium bicarbonate (SB) were considered at three levels of 0, 2 and 4 per hundred resins (phr). The amount of flax fiber and coupling agent for all formulations was fixed at 60% and 2 phr, respectively. Static mechanical tests including flexural and tensile were performed on samples. The dynamic mechanical properties such as storage modulus, loss modulus and damping factor of composites were investigated. Morphology of the samples was also evaluated by scanning electron microscopy (SEM). Results indicate that the chemical foaming agent substantially increased cell size and reduced cell density and mechanical strength of composites. Moreover, the lowest mechanical strength was observed in foamed composites with SB. SEM confirmed that the type and content of chemical foaming agent had significant influence on density reduction of foamed composites. Finally, by an increase in the chemical foaming agent content, the storage modulus and loss modulus of samples decreased. However, by adding the chemical foaming agent to the composites, the damping factor increased. Foamed composites prepared with ADC exhibited inferior storage modulus compared to the SB.

**Key words:** foamed composite, azodicarbonamide, sodium bicarbonate, cell size, storage modulus.

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# The effect of nano clay and coupling agent on the physical and mechanical properties of polypropylene waste paper composites

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## Abstract

In this study, the effect of nanoclay particles and coupling agent on the physical and mechanical properties of polypropylene / waste paper composites was studied. To meet the research objectives, waste paper fibers with polypropylene in 50% by weight, nanoclay (0, 2 and 4%) and coupling agent (0 and 3%) were compounded in an internal mixer at 155°C and 60rmp and the samples were prepared by injection molding. The results showed that the physical and mechanical strength of composite improved in the presence of coupling agent. As well as water absorption, thickness swelling, flexural and tensile strength and flexural and tensile modulus were improved by increasing the nanoclay particles content. However, notched impact strength was reduced. Also, study on structural behavior of composite with x-ray diffraction showed that the nanoclay was distributed as intercalation structure in polymer matrix, and distance between layers were increased with increasing of nanoclay particles content.

**Key words:** waste paper, nanoclay, physical and mechanical properties, coupling agent, wood plastic composite.

# Investigation on some of physical and mechanical properties of polypropylene fiber/ wood /cement composites

## Abstract

In this study, some of the physical and mechanical properties of polypropylene fiber/ wood fiber/ cement composites were investigated. For this aim, three levels of polypropylene fiber, namely 2 wt.%, 3 wt.% and 4 wt.% were mixed with 15 wt.% of wood fiber mixed with cement in a rotary type mixer. The samples were formed by cold press method. Then water absorption, thickness swelling, flexural modulus, flexural strength, and impact strength of the manufactured composites were evaluated according to ASTM standard methods. The results showed that polypropylene fiber exhibited a positive effect on physical and mechanical properties of the wood-cement composites. The physical test results indicated that the hybrid composites containing 4% PP fiber/11% wood fiber exhibited the lowest water absorption and thickness swelling values. The mechanical test results also indicated that greater flexural strength and impact strength can be achieved by addition of 4% polypropylene fiber to wood- cement composites. Also, the three point bending test results showed that the addition of PP fiber from 2 to 4% decreased flexural modulus of the wood- cement composites, continuously.

**Key words:** wood- cement composites, polypropylene fiber, wood fiber, mechanical strength.

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# Influence of furfurylation on practical properties of beech plywood

## Abstract

In this study, the influence of furfurylation on practical properties of beech plywood was investigated. Furfurylation of beech layers were performed by impregnation and heat catalyze up to 30% and 70% weight percent gain. Plywood specimens were made by 2 resins (Urea Formaldehyde and Methylene Diphenyl Diisocyanate). Practical properties of furfurylated specimens were investigated and compared to untreated specimens. Modulus of rupture (MOR), modulus of elasticity (MOE), shear strength, water absorption and thickness swelling were determined. Results revealed that by increasing the furfurylation level, modulus of elasticity (MOE), water absorption and thickness swelling (dimensional stability) improved. But modulus of rupture (MOR) just increased up to 30% furfurylation and decreased in higher levels of furfurylation. Furfurylation had a negative effect on shear strength of bond line and decreased by an increase in the furfurylation level.

**Key words:** furfurylation, beech plywood, physical and mechanical properties.

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# Investigation on physical behavior of styrene wood-polymer in different concentrations of monomer

## Abstract

This research was conducted to study the effect of different concentrations of styrene lumen monomer on the physical properties of beech wood. Physical test samples were prepared according to ASTM-D1037 standard and treated with vacuum-pressure method at five concentration levels; 0, 40, 60, 80 and 100 percent of soluble monomer. For polymerization, treated samples were heated in oven for two 24-hour periods at 90 and 103ºC respectively. Monomer and polymer absorption, density variation, water absorption, swelling and anti-swelling efficiency (ASE) were determined. According to the results, Monomer and polymer absorption increased by an increase in monomer concentration, and they were reported to be 38.2% and 26% in the highest level, respectively. With an enhancement in polymer absorption, density of wood increased from 0/63g/cm³ in control to 0/91g/cm³ in the highest monomer concentration level that reduces pores in wood-polymer structure. Absorbed polymer enhancement decreased hydrophilicity and dimensional changes of treated samples, so that water absorption and swelling volume of the samples saturated with 100% concentration of monomer were decreased 64% and 45.3% after the longest immersion time. Highest Anti-swelling efficiency of Styrene-saturated samples was determined to be 56.15% in the maximum concentration level of treatment.

**Key words:** styrene, wood–polymer composites, physical behavior, water absorption, anti-swelling efficiency.

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# Long-term water absorption and thickness swelling and determination of their characteristics in wood flour/polypropylene/Nano $SiO_2$ nanocomposite

## Abstract

The objective of this study was to investigate the effect of nano $SiO_2$ on long-term water absorption and thickness swelling, humidity coefficient diffusion and thickness swelling rate of wood plastic composite. For this purpose, 60% wood flour, 40% polypropylene, 2 per hundred compounds (phc) MAPP were mixed in an internal mixer (HAAKE). Nano $SiO_2$ with 0, 1, 3 and 5 (phc) ratios as a reinforcing agent was also used. Finally, test samples were fabricated by using the injection molding machine. Then, long-term water absorption and thickness swelling of samples were measured after 1848 hours according to the ASTM standard. Humidity coefficient diffusion and thickness swelling rate were also calculated for a closer look at long-term water absorption and thickness swelling behavior in wood plastic nanocomposite. To ensure the formation of hydrogen bonds between hydroxyl groups of $SiO_2$ nanoparticles with hydroxyl group of wood flour, Fourier transform infrared (FTIR) spectroscopy tests was used. The results showed that water absorption behavior of nanocomposite is according to Fick's law. In addition, with an increase in $SiO_2$ nanoparticles, long-term water absorption, thickness swelling and humidity coefficient diffusion decreased in wood plastic nanocomposite. The results of infrared spectroscopy confirmed the hydrogen bond between the nano SiO2 and wood flour. Statistical analysis showed that after 1848 hours of immersion, nano $SiO_2$ had a significant effect on water absorption and thickness swelling at a confidence level of 99%, so the sample with 5% silica nanoparticles was chosen as the best treatment.

**Key words:** humidity coefficient diffusion, thickness swelling rate, nano $SiO_2$, infrared spectroscopy, long-term water absorption.

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# The influence of treatment and shelling ratio on the mechanical properties of particleboard manufactured from Canola (*Brassica napus*) stalk particles

**Abstract**

In this study, the effect of particle size in surface layers and shelling ratio on the mechanical properties of there-layered particleboard was investigated. The there-layered particleboards were manufactured from treated canola (Brassica napus) particle. The shelling ratio at three levels (2.82:16mm, 5.33:16mm and 8.6:16mm), particle sizes at two levels (>1.25 and <1.25 mm) and treatment type of particles at three levels (untreated, water-leached and acid-leached treatment) were selected as independent variables. The mechanical properties of panels i.e. modulus of rupture (MOR), modulus of elasticity (MOE), and internal bonding strength (IB) were tested according to the EN standards. Results showed that using the canola particles with the dimension of >1.25 mm in surface layers of panels caused an increase in MOR, MOE, IB. Besides, it was determined that increment in particle size on surface layers and using water – leached treatment improved the mechanical properties of panels. According to the results, with the usage of canola stalks particles treated with hot-water used in core layer, applying particles with the dimension of >1.25mm on surface layers of three-layered panels, shelling ratio of 2.82:16mm and 5.33:16mm, desirable MOR and MOE can be obtained.

**Key words:** Particle size, three-layered particleboard, particle treatment, mechanical properties, canola stalk.

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# Study of physical and mechanical properties of produced strawboard using bio epoxy tannins resin

## Abstract

Bio-epoxy tannin resin was made from tannin reaction with epichlorohydrin in an alkaline condition. Fourier transform infrared spectroscopy confirmed the epoxy groups of glycidyl reaction of the tannins, and the epoxy number of final resin was 7.2%. Straw boards were made with bio-epoxy tannin resin, using two variable temperatures (180 and 200 °C) and two variable times (7.5 and 10 minutes). Physical and mechanical strengths such as water absorption, thickness swelling (after 2 and 24 hours immersion appears in water), internal bonding, modulus, and flexural modulus were measured and compared with the standard EN312-4. The results showed that the straw boards made in 200 °C and 10 minutes of press time, had the highest level of physical and mechanical properties. All the produced boards in this research had the Europe standard level of mechanical properties for public use and acquired the functional properties comparable to petroleum-based synthetic adhesives.

**Key words:** strawboard, epoxy tannin resin, internal bonding, wheat straw.

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# Thermal and colorimetry properties of bleached wheat straw/LDPE biocomposites

## Abstract

This research was done to study the thermal and colorimetric properties of bleached wheat straw/polyethylene biocomposites. Thus, wheat straw was bleached using different natural and/or chemical bleaching methods. The bleached wheat straw and the pure polyethylene were then mixed in ratio of 40 to 60 by twin screw extrouder at 145OC. Maleic anhydride polyethylene was also applied in %10 of polyethylene weight. Thermal and colorimetric properties of treatments were evaluated and compared to control sample (pure polyethylene). The results showed that the unbleached wheat straw composite had the lowest lightness value. Biocomposites containing bleached wheat straw pulp with xylanase and hydrogen peroxide 1% had the highest lightness value after pure polyethylene. The results of the thermal behavior of the composites from DSC curves showed that the melting temperature of bleached wheat straw pulp with xylanase and hydrogen peroxide1% composite was higher than pure polyethylene and the others. The maximum and the minimum decomposition temperature of the composites belonged to the unbleached wheat straw (424.76°C) and the bleached wheat straw pulp (354.23°C), respectively.

**Key words:** biocomposite, bleaching, colorimetric properties, thermal properties.

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# Performance of nano fibrillated cellulose (NFC) and chitosan bio-polymeric system on recycled pulp and paper properties of old corrugated containers (OCC)

## Abstract

Application of dry strength additives is regarded as a sustainable strategy toward improvement of recycle paper properties, and utilization of bio-based materials has been enhanced in this aspect extensively, respecting to different technological and environmental issues. In order to improve products properties, researches have focused on natural and processed forms of cellulose and chitosan as the most abundant biopolymers with unique characteristics. Effects of the biopolymers, chitosan and nano fibrillated cellulose (NFC), individually and combined together, on recycled pulp and paper properties showed that density and strength indices of paper (tensile, burst and tear), pulp drainage and retention during sheet formation were improved with a reduction in the material loss compared to the blank. Chitosan addition caused significant enhancement on all of the strengths, density and pulp retention and also a reduction in material loss. Dewatering of the pulp suspension (CSF) was significantly improved by chitosan presence, with decline resulted from the higher addition level. The resulted developments were attributed to polymeric character, structural similarity and high bonding ability of chitosan with cellulosic fibers. Individual addition of NFC produced boost in the pulp retention, paper density, tensile and burst indices and fall in pulp freeness, material loss and tear index. Anionic nature, high specific surface area and hydrogen bonding ability of NFC were ascribed to these. Application of NFC just after chitosan as a complex mechanism in papermaking wet end not only had no effect in density and strength indices of recycled paper (except NFC 0.15%), but also reduced the strengths in some cases. In the complex, the pulp properties were fluctuated compared to chitosan treatment, but were prior compared to nano fibrillated cellulose.

**Key words:** chitosan, nano fibrillated cellulose, recycled pulp & paper properties.

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