

per production, elite trees can be defined as trees in which the wood has low lignin and extractives content and high polysaccharide (especially high cellulose) content. Wood extractives are undesirable in pulping processes due to its negative influence in the pulp yield and may be transformed into contaminants of products and equipments. They are polyphenolic groups, waxes, fatty acids, resins, soluble carbohydrates, etc. All of them combine to form a very little known soup, which affects not only the pulping process and the quality of products and processes, as some of them have even an environmental impact on effluents and aquatic life. Many experiments to produce better trees for pulp and paper production have been attempted either by breeding, genetic manipulation or nutritional management, such as flavonoid supplementation. The flavonoids are intermediates in phenylpropanoid metabolism in plants and its supplementation has been reported to have influence on lignification and growth on a large number of species by affecting the lignin pathway and metabolic processes.

Here we report results for flavonoid supplementation on young *Eucalyptus urograndis* trees. Samples were successively extracted with ethanol and water in a Soxhlet apparatus. Groups treated with direct flavonoid supplementation presented a significant reduction on extractives content when compared to control groups. This is an indication of the potential of flavonoid supplementation as a nutritional complement for forest industries regarding pulp and paper production.

Keywords: Flavonoid; extractives; *Eucalyptus*.

OP187

Potential Biomass Volumes from and uses for Beetle Killed Lodgepole Pine (*Pinus contorta* (Dougl. Ex. Loud.) from Colorado and Wyoming in the western United States

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The outbreak of mountain pine beetles in the western United States has left extensive areas of dead lodgepole pine, creating hazards to human health and property particularly along roads and within the Wildland Urban Interface (WUI). This situation has led to calls for the government to take action. We estimated the amount and cost of biomass potentially generated by a hazard abatement program. Over the coming 10 years as much as 5.1 to 7.6 million oven-dry metric tons of dead lodgepole pine could become available. Total harvesting costs could exceed \$US200 million. Given the length of time much of the material has already been dead, the rate at which treatments can be implemented, and the lack of sufficient primary processing infrastructure (sawmills or veneer mills) use of this material for higher value wood products is unlikely. Co-firing of coal fired power plants or other energy uses holds the potential to dispose of large amounts this material but the costs could be high. Chipping and hauling the material to an energy facility would add an additional \$US135 to \$US425 million depending on the location

of the dead stand. So even though there is enough material to co-fire 5 typical power plants for 11 to 17 years the annual cost for each plant could range from \$1.8 million to \$7.2 million per year and this could be more than the cost of coal. This presentation examines the potential to include higher value wood product options as a way to reduce overall costs.

Keywords: Wood to energy, dead timber, wood utilization.

OP188

Study of the use of organosolv lignin as bio-preservative of wood

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The service life of wood depends on the species, use and environmental conditions of exposure. The treatment of wood protect it against degradation by xylophagous agents, enhancing the durability of material up to 10 times, and reducing the deforestation around 12.5%. In this way, the use of treatments is necessary because increases the service life of material and protect against xylophagous agents who degrade the wood. The study and development of new preservative products for wood are necessary in order to substitute heavy metals-based preservatives, such as CCA (Chromated Cooper Arsenate) that entails environmental risks.

Lignin is considered as a residue in pulp and paper production processes, being mainly used as fuel in the recovery boiler for energy generation. However, more valuable uses of lignin could be developed for several interesting applications such as bio-preservative activity.

In this context, the present study aimed to evaluate the properties of eucalyptus organosolv lignin, obtained by using 60% (v/v) ethanol/water solution, in a solid/liquid ratio of 1:10, at 180 °C for 90 min. The resulting lignin samples were characterized by different analytical techniques such as FTIR, GPC, DSC and TGA. Furthermore, the antioxidant potential of lignin by ABTS and DPPH methods and the fungicide potential by ASTM D 2017 – 81 were analyzed.

The analyzed lignin showed neutralization and inhibition activities (antioxidant capacity). These characteristics demonstrated that lignin could be an excellent wood bio-preservative obtained from renewable sources.

Keywords: wood treatment, wood preservation, wood quality.

OP189

First Report on the Termiticidal Activity of Extracts of *Annona squamosa* (Annonaceae) Seeds and on its Active Constituent Squamocins.

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Termites inflict severe damage on wood and impede usage of several forest species. The biological metabolites could potentially replace synthetic termiticidal products which are becoming more restricted to use. *Annona squamosa* is well known for its edible fruits - tropical custard apple. Annonaceous tetrahydrofuran acetogenins have attracted much interest due to their broad range of biological activities, and seeds containing them are reported to show insecticidal and abortifacient properties.

Under the course our exploratory investigation of non food valuable products from less known forest species (here from Benin), the fractions obtained from defatted cake of *Annona squamosa* seeds with solvents covering a broad range of polarity, revealed a significant termiticidal activity, when applied at 5 - 10 mg/cm² (non-polar solvent) and 1.2 - 5 mg/cm² (case of a more polar solvent).

Based on the result (0: no attack) from the standard procedure EN 118, these extracts could be used for preserving wood under class of use number 1. A derivatization step with Kedde reagents A and B, elemental analysis C,H,O, HPLC/MS and proton NMR showed the presence of squamocin type acetogenins (MW 594 and 622 g/mole: C35H62O7 and C37H66O7) as main components of the most active fraction (100% mortality within 7 days for a sample applied at 2 mg/cm²).

Additional work will be undertaken to confirm the structure of most active compounds in the extracts, and to check whether some *Annona squamosa* seed extracts (non timber products of sustainable management of native forest) could show even higher activity to protect wood under more adverse conditions and be alternative active natural products to synthetic compounds.

Keywords: *Annona squamosa*, acetogenins, termiticidal activity, wood preservation, Benin.

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OP190

Linseed oil based waterborne UV/air dual cured wood coatings

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In this study, the effect four kinds of curing process including UV irradiation, UV irradiation + air curing, air curing + UV irradiation, and air curing on the films properties of the linseed oil (LO) based waterborne dual cured wood coatings were examined. Modified linseed oil (MLO) was prepared by transesterification of glycerol (GL) and LO with the mole ratio of 1.0. The waterborne resin was synthesized from MLO, dimethylol propionic acid (DMPA) and isophorone diisocyanate (IPDI), hexamethylene diisocyanate (HDI) and hydroxyethyl methacrylate (HEMA) by acetone process for providing a resin with C=C bonds of acrylic acid and fatty acid, respectively. And then the resin was neutralized by triethylamine (TEA) and dispersed into

water. After vacuum distillation to remove acetone, the waterborne resin was obtained. Raman and fourier transform infrared spectrometer (FTIR) were used to identify the formed products, and fundamental properties such as solid content, NCO content, molecular weight, viscosity, pH and particle size of the resin were also tested. The result showed that the waterborne resin was a pseudoplastic fluid and possessed reactive double bonds. The waterborne dual cured coatings were formulated by mixed the waterborne resin with photoinitiator Darocur 2959 and different Co, Zr and Ca metal dryer, respectively, for different curing processes. The waterborne dual cured coatings were cured through 4 kinds curing processes as mention above and the cured film properties were characterized. The results showed that the films properties such as hardness, tensile strength and heat resistance of the dual cured coating obtained from UV irradiation + air curing were equal to those of obtained from air curing. Furthermore, the elongation at break, bending resistance, gloss and weight retention of films from UV irradiation + air curing were better than those of air drying. The poor adhesion of traditional UV cured coating films could be improved by using the UV/Air dual cured coatings. As a conclusion, the linseed oil based waterborne UV/Air dual cured coating has a potential for using as a high efficiency, excellent performance and environmental protection wood coating.

Keywords: Dual cured; UV irradiation; Air drying; Wood coatings; Waterborne resin

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OP191

Wood-leather panels – A biological, fire retardant building material

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Facing increasing problems with raw materials supply for wood based panels recent developments in this field aim to diversify the material supply. Many attempts have been made to incorporate ligno-cellulosic materials such as straw (Han et al. 2001), rice husk (Leiva et al. 2007), bamboo or bagasse (Lee et al. 2006). The presented project focuses on a new way using waste residues from leather production for the development of a completely bio-based building material with improved material characteristics e.g. fire resistance.

Regarding the performance of wood-based panels, fire resistance is clearly among the largest issues. For instance, an untreated MDF panel shows a performance of D-s2,d0 according to the standard EN 13986 (M. Kaindl Holzindustrie), which means that the material is burning normally, shows smoking but creates no burning droplets. Comparatively new materials like fire-retardant MDF's are capable of showing a performance of B-s2,d0 which means that the material is fire retardant, shows smoking but creates no burning droplets (Finsa 2006). This performance is usually carried out by impregnation with inflammable salts such as borax.

Beside the price of such a material these materials always represent a mixture of natural and artificial resources which means merging a



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