Characterization of Eucalypt LignoBoost™ lignin for the production of lignin nanoparticles

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Lignin is one of the most abundant renewable resources found on Earth and has the potential of being the source of fuels, chemicals and materials for a wide range of industrial applications. For instance, lignin nanoparticles (LNPs) can be applied as biobased polymers, UV blocking materials, hydrophobic coatings, antimicrobial and antioxidant agents, among others. LNPs can be produced by solvent exchange and their chemical and physical properties may vary considerably, depending on the source, extraction procedure and recovery of the starting materials. For this reason, a detailed lignin characterization must be the first step towards its application in advanced materials or in any other conversion process. In this work, a comprehensive characterization of a technical eucalypt Kraft lignin from the LignoBoost™ process has been carried out with regard to its chemical composition (ash and carbohydrate content, carboxyl and methoxyl groups, aliphatic and phenolic hydroxyl groups and S-G-H ratio) and physical-chemical properties (solubility in various organic solvents, molar mass distribution and thermal properties). Also, batches of LNP were produced by solvent exchange using acetylated and non-acetylated lignin and their properties were tentatively correlated with the composition analysis of the starting material.

Physico-chemical properties of bio-oil produced from *Ficus exasperata* Sawdust using *Vacuum* Reactor

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This study was conducted to investigate and estimate bio-oil produced from biomass (wood residue) of *Ficus exasperata* through pyrolysis at varied temperature. The energy and chemical potentials of this species in various forms has not been discovered and technical information on the wood for biomaterial and bio-refinery usage is not available. The physico-chemical and compositional analyses of the bio-oil were achieved through carbon-hydrogen-nitrogen-Oxygen (CHNO) studies, calorific value, Fourier Transform-Infra Red (FT-IR) spectroscopy and Gas Chromatography-Mass Spectrometry (GC-MS). The pyrolysis resulted in low bio-oil yield and high amount of bio-char at 600°C, whereas at temperature 500 and 550°C, pyrolysis produced significant amount of bio-oil with less bio-char yield. Temperature difference significantly influenced the CHNO content ($p<0.05$). Carbon content increased with increase in temperature (76.39, 77.42 and 78.45%) at 500, 550 and 600 °C respectively. While Hydrogen, Nitrogen and Oxygen content decreased with increase temperature. The calorific value of bio-oil gave high heating value of 3.4Mj/Kg. The chemical components identified in bio-oils were classified into five major groups such as Hydrocarbons (Aliphatic and Aromatic), ketones, Amines, Oxygenated phenols and Ethers. The noticeable acid in the oil are the Oxylic, Phtalic and Benzoic acid. The study on bio-oil from *Ficus exasperata* biomass revealed its potentials for fossil fuel substitution and bio-chemical production.

Physical and chemical characteristics of wood from eucalyptus clone GFMO-27 / *Propriedades físico-química da madeira do clone de eucalipto GFMO-27*

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Considerando a ampla variedade de espécies e clones de *Eucalyptus*cultivados no Brasil, informações sobre as propriedades da madeira tornam-se cada vez mais necessárias. O objetivo deste trabalho foi determinar as propriedades físico-químicas da madeira do clone GFMO-27 nas alturas de 0, 25, 50 e 100% da altura comercial do tronco. A análise química imediata nos discos de eucalipto foi determinada baseando-se na metodologia descrita na norma ABNT/NBR 8112/83, com adaptações, e a massa específica básica a norma ABNT NBR 11941. A quantidade de materiais voláteis, cinzas e carbono fixo nas alturas avaliadas do clone GFMO-27 foram semelhantes, bem como sua massa específica básica. Além disso, não houve correlação significativa entre a massa específica e a análise química imediata. Os teores de materiais voláteis, cinzas e massa específica básica aparente não diferiram nas alturas estudadas. Os teores de carbono fixo diferiram somente a 50% da altura e topo. Com isso, a madeira do clone GFMO-27, aos 5 anos, poderá ter um uso mais amplo, em qualquer posição do fuste por possui características semelhantes.

A pilot scale of torrefied wood pellet production for serving small community enterprise and supply chain of bioenergy production

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The aim of this research was to find optimal technique for upgrading rubberwood residues to the next generation of bio-solid fuels – black pellets. After air dry condition to reduce their moisture content, abundant wood chips from traditional sawmill were gradually fed into a pilot-scale rotating drum reactor for turning them to black chips under controlled conditions (maximum temperature and tighten oxygen). The influence of fed and rotating speed was studied, therefore chips were fed into the reactor at 25, 50, and 75% by volume and the angular-speed was set at 5, 10 and 20 rpm, respectively. The results showed that the reaction time depended largely on the feed load of wood chip. The more feed load, the longer reaction time needed. However the angular-speed did not related to the residence time directly, it effected on the heating value of black chip products. Their testing properties revealed that when the lower angular-speed applied, the higher heating value and lower yield received. The heating value of torrefied chips increased about 17% compared to that of the original. Next, black chips were ground and mixed with three additives - cassava starch, corn starch, and glycerin - with percentages by weight of 1, 2 and 5, respectively. The properties of black pellets were tested following EN 14961-2 Standard. It was cleared that production yield could reach 56.21%, while almost properties -calorific value, mechanical durability, ash fusion, etc. – passed the standard - only bulk density (max; 381.50 kg/m^3) still not met the standard requirement.