harvesting residues presented great volumetric expansion. For the tension resistance by diametric compression, the lowest value was observed for coffee husk. The results found show the great potential of energetic utilizing of the briquettes made with coffee husk.

Keywords: briquettes; energetic density; volumetric variation; higher heating value.

PP188

Optimization of Galactoglucomannans and Acidic Arabinans Recovery in Softwood

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The pulp and paper industry is currently in a transition situation and needs to produce additional products which can increase both the mill profitability and the overall mill energy efficiency in order to convert mills into biorefineries. Autohydrolysis of softwood chips, used as raw material in a paper mill, was studied to simulate one of the aspects of industrial hydrolytic steps of a thermomechanical pulping process. Based on industrial process steam conditions, the operations were performed at laboratory scale. Both compositions of pulps and hydrolysates were determined as a function of the residence time and the severity of the treatment. It was found that the amount of glucans and Klason lignin in solid residues showed moderate cellulose and lignin degradation caused by hydrothermal treatment and that acidic arabinogalactans were largely affected and depolymerized, even at low severity ($\log(R0) < 2$). The percentage of residual arabinans in the pulp after hydrolysis seemed to be a good indicator of the severity of the treatment and can provide an effective guide for an industrial process optimization. A hydrolytic step performed at a severity of $\log(R0) = 1.8$ resulted in the extraction of 100% of the water-soluble acidic arabinogalactans. These polysaccharides are released and accumulated into process waters. They constitute the main part of the "anionic trash" released in mechanical pulping, which can form complexes with various cationic polymers used by the paper industry.

Keywords: Autohydrolysis; hemicellulose; thermomechanical pulping

PP189

Seed Oil and Defatted Cake Proximate Composition of Non Timber Product *Annona squamosa* (Annonaceae) Grown in Benin

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Annona squamosa L. is a small tree which grows wild in many places in the tropical regions and locally called "xwingle" in Benin. Its produces edible fruits, typically globular or heart-shaped which are highly appreciated and the seeds are much neglected. Recently, our works have started to be greatly concerned about identifying new oil sources from a large number of oil bearing seeds grown in Benin.

We report here on the chemical composition of seed oil (ASSO) and defatted cake (ASDC) of A. squamosa. Fatty acid composition, chemical properties of oil, unsaponifiable fraction, amino acids, lignocellulose and carbohydrates were analyzed by standard analytical procedures. Our objective is to update and to widen available data in order to check and confirm the interest of the seeds as a readily available by-product resulting of the consumption of the fruit pulp for human food.

The extracted lipids (33.7%) were examined for fatty acid composition by gas chromatography. Linoleic (25.4%) and oleic (47.4%) acids were the predominant unsaturated fatty acids, while palmitic acid (12.6%) and stearic acid (11.6%) were the major saturated acids. The iodine value of 92g/100g indicates that the seed oil is a non-drying type. The unsaponifiable fraction (1.0wt-%) whose composition was not investigated previously especially for the sterol fraction, the major sterol is β-sitosterol (68.7wt-%) and tocols (143ppm) show α- and γ-tocopherol as major components (26.5 and 73.5wt-%). The defatted cake is rich in proteins (25.5g/100 g), potassium, and fibers (Van Soest; NDL 60.1%, ADF 34.7% and ADL 7.4%).

This work is part of a study aiming at adding value to underused forest biomass. Next step will deal with anti-termite properties of A. squamosa cake.

Keywords: Non timber product, Annona squamosa, seed oil, defatted cake, chemical composition, Benin.

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PP190

Experimental TGA device for the determination of cellulose pyrolysis behaviour at elevated pressure

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Forestry lignocellulosic biomass is a major renewable energy sources in the world. Carbon generated by Nature through photosynthesis process, could potentially be considered as a neutral energy carrier in term of the greenhouse gas emissions, if it is produced is assured through sustainable plantations use. Cellulose is the main component of biomass (50% in weight on a dry basis in average) and its conversion into high density energy carrier like charcoal, gives relatively low charcoal yield (< 15%).

The development of more efficient conversion technologies in terms of yield of charcoal is of primary importance for both developing countries than for industrialized countries. In the first case, the firewood and charcoal are the main sources of energy to the people. In the second case, the development of sustainable energy sources

from biomass for biorefinery applications are of primary importance.

The work aims to present our first results of the cellulose pyrolysis kinetic study at Elevated Pressure by specific Thermogravimetric Analysis (TGA-EP). The aims are (i) to assess the influence of pressure on the pyrolysis reaction kinetics and, (ii) to determine charcoal yield benefit.

After a brief presentation of the TGA-EP equipment developed in the laboratory, a more detailed discussion is done about the treatment of the technical constraints like weigh measurement at elevated pressure (buoyancy). Advantage and limitation of the detailed equipment in term of result and potential studied are discussed.

A preliminary study on cellulose pyrolyis at elevated pressure is presented. The work was done with commercial microcrystalline Sigmacell cellulose type 50 (30 mg) provided by Sigma-Aldrich, for pressure conditions between 0.1 MPa and 1 MPa, and at a constant heating rate up to 1000 °C. The inert atmosphere conditions were performed by carrying in constant nitrogen gas flow rate (30ml/min). The results indicate a significant increase of the charcoal yield (>60%) compared to atmospheric condition results and suggest a significant involvement of secondary pyrolysis reactions.

Keywords: Engineered wood; wood composites; material selection; wood material science

PP191

Comparison Of Energy Value And Proximate Analysis From Raw And Pyrolysed Wood Biomass And Palm Kernel Shells

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Palm Oil processing yield a considerable quantity of palm kernel shell (PKS), which has been predominantly used as fuel through direct combustion. This form of combustion does not effectively utilize the energy potential of PKS. Likewise, the wood processing industries in Nigeria operates with efficiency of about 45%, turning out a large quantity of wood residues which are burnt off, causing environmental pollution. Therefore, this study examines the energy value and proximate analysis of raw biomass and bio-char produced from selected sawmill residues Apa (Afzelia africana) and Palm kernel shells (Elaeis guineensis) in slow pyrolysis with a view to establish the variation in their energy level and the possibility of using them as biofuel on commercial scale in Nigeria. Sawmill residues and Palm kernel shells collected in Akure Ondo State Nigeria, were converted to bio char in a fixed-bed reactor at 400o C, 600o C, and 800o C. The energy derivable at each temperature was measured viz ; Heating value and proximate value for both raw and combusted residues using AOAC 1975.The Energy value for non combusted Afzelia africana and Palm kernel shell were found to be 33.31MJ/Kg and 32.90 MJ/Kg, Ash content of 1.08% and 2.23%, Volatile matter 77.86 % and 79.32% and Fixed carbon21.06% and18.45% respectively. The proximate for combusted Fixed Carbon ranged from73.65±0.51 to 92.32±0.91 for Palm kernel shell and 56.38±0.23 to95.36±0.53 for Apa. The Volatile matter ranged from 1.29±0.52 to 22.28±0.11 for Palm kernel shell and 2.05±0.04 to 42.31 ±0.22 for Apa. The Ash content ranged from 4.07± 0.17 to 6.39±0.02 for Palm kernel shell and 1.31± 0.52 to 2.59± for Apa. The gross energy recorded for Palm kernel shells ranged from 59.72 MJ/Kg ± 1.18 to 118.53 MJ/Kg ± 1.69 and 52,52 MJ/Kg ± 1.69 to 98.39±0.41 MJ/Kg for Apa .

The higher Gross energy and Fixed Carbon recorded for Palm kernel bio-char, makes it a potential substitute fuel for domestic and industrial use where energy from wood is required to power their boilers. Also, Low Sulphur content reported for PKS by various researchers makes it an environmental friendly source of energy.

Keywords: Gross Energy, Proximate, Bio char, Palm kernel shell

PP192

Fractionation of wood by LGF organosolv cooking

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A novel Lignofibre (LGF) organosolv process has recently been developed at VTT. In this sulphur-free process, both alcohols and organic acids can be used as solvents in the presence of phosphinic acid (H3PO2). By proper selection of the cooking parameters, the LGF process is suitable for the fractionation of hardwood and softwood species, and also annual plants. Besides the cellulosic fibres, also lignin and hemicellulose fractions may be recovered. The potential target products are biobased materials as well as bioethanol and other chemicals obtained via biotechnical routes.

The yield and recovery of wood components is largely affected by the selection of solvent. LGF cooking of birch (Betula pendula) in acetic acid produces xylan-poor pulp, and only lignin can be recovered by alkaline extraction of the fibers. Acetic acid is a suitable solvent for softwood, but for hardwoods also ethanol is well applicable. In this case, less xylan degradation takes place, and also hemicellulose fraction can be recovered.

The LGF organosolv process in ethanol has been studied as pretreatment technique for bioethanol production using various Eucalyptus species as raw materials. The cooking conditions have been varied, including phosphinic acid charge, temperature and cooking time, and glucose yield in enzymatic hydrolysis has been evaluated. The cooking was followed by alkaline extraction of the fiber fraction to produce hemicellulose free fibers for more efficient bioethanol production. The LGF cooking in acetic acid has been applied to Eucalyptus, birch and pine (Pinus silvestris). In this case, the main aim was in the fractionation of the wood to recover biopolymers for material applications. The paper summarizes results obtained in two EU projects: LignoDeco (EU/Brazil, FP7-KBBE-2009-3-244362) and Afore (FP7- NMP-2008-4.0-6).

Keywords: organosolv, fractionation, fiber, cellulose, lignin, bioethanol

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