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► To cite this version:

Amélie Breysse, Claire Mayer-Laigle, L. Haurie Ibarra, Frederic Mabilie, Cecile Barron. Preserving the structural variability in maize stalk through dry fractionation processes. Exploring Lignocellulosic Biomass - ELB 2018, Jun 2018, Reims, France. hal-01982730

HAL Id: hal-01982730

<https://hal.science/hal-01982730v1>

Submitted on 2 Jun 2020

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Preserving the structural variability in maize stalk through dry fractionation processes

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The composition and the structure of biomass makes it a wonderful source of raw materials for the production of energy or bio based material. As examples, the most inner part (the pith) of corn stalk, an agricultural by-product, shows an alveolar structure, similar to those of expanded polystyrene, responsible of insulating properties [1][2]. On other example are the vascular bundles of the pith and the ring, which also insure, a mechanical support for the plant, making them particularly interesting for reinforcement of composite materials. One of the challenges is to recover each plant part without damaging its structure to preserve the original properties. This can be achieve by dry fractionation processes, which allow to dissociate plant structures at the relevant scale, between 0.5-4mm. Dry fractionation diagram combining grinding (based on shearing solicitation) and separation step (based on size and density) have been developed at the kilogram scale in order to separate the rind from the pith of maize stem internode while preserving pith alveolar structure. The fractions with particle size higher than 1 mm, contain more than 92 % of pith and represent 41% of the initial pith. In addition, in the finest fractions (particle size < 1mm), the pith vascular bundles are dissociated from parenchyma cells, and a successful isolation of the vascular bunds has been realized using an electrostatic separator. The fractions containing the biggest pith particles were retained to produce thermal insulating materials, which present a thermal conductivity around 0.04 W/mK, close of those of commercial thermal insulating materials.

[1] N. Mati-Baouche N. et al. *Ind. Crops. Prod.*, 58 (2014) 244-250.

[2] M. Palumbo. (2015). Contribution to the development of new bio-based thermal insulation materials made from vegetal pith and natural binders: hygrothermal performance, fire reaction and mould growth resistance. Universitat Politècnica de Catalunya, Barcelona, Spain.