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► To cite this version:

Amélie Tribot, Cédric Delattre, Claude-Gilles Dussap, Eric Badel, Philippe Michaud, et al.. X-ray microtomography applied to bio-based composites made of by-products from forest and agricultural industries. 12th Symposium of the European Society of Biochemical Engineering Sciences, European Society of Biochemical Engineering Sciences (ESBES). DEU., Sep 2018, Lisbonne, Portugal. 2 p. hal-01847691

HAL Id: hal-01847691

<https://hal.science/hal-01847691>

Submitted on 5 Jun 2020

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X-ray microtomography applied to bio-based composites made of by-products from forest and agricultural industries

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Keywords: X-ray microtomography, Bio-based composite, Lignosulfonates, Lignin, Corn cob

Depletion of fossil resources has resulted in a rising interest in renewable feedstock such as biomass, which has a tremendous potential to replace chemicals and/or materials from petro-chemistry. The development of a bio-based composite made of by-products from forest and agricultural industries was performed in this study. The matrix was composed of wood-lignin which is a complex natural polymer of phenylpropane units. Lignin was used under its sulfonated form after sulfite processing (lignosulfonates raw material). The reinforcements or fibers consisted of corn cob agricultural residues. Observation of the internal structure of the bio-based composite was done with X-ray microtomography technique. As soon as the object to analyze has varying density gradients in its substructure, an accurate map of the variation of X-ray absorption can be provided. With this non-invasive and non-destructive image technique, individual projections recorded from different viewing directions were used to reconstruct 3D image at a spatial resolution better than 1 micrometer. Fiber-matrix interface was satisfying since good compatibility between corn cob particles and lignosulfonates matrix was observed. Defects and cracks present in the matrix didn't progress at the fiber-matrix interface where cohesion stays stronger. Quantification of fibers, voids, and porosity was done with image analysis.

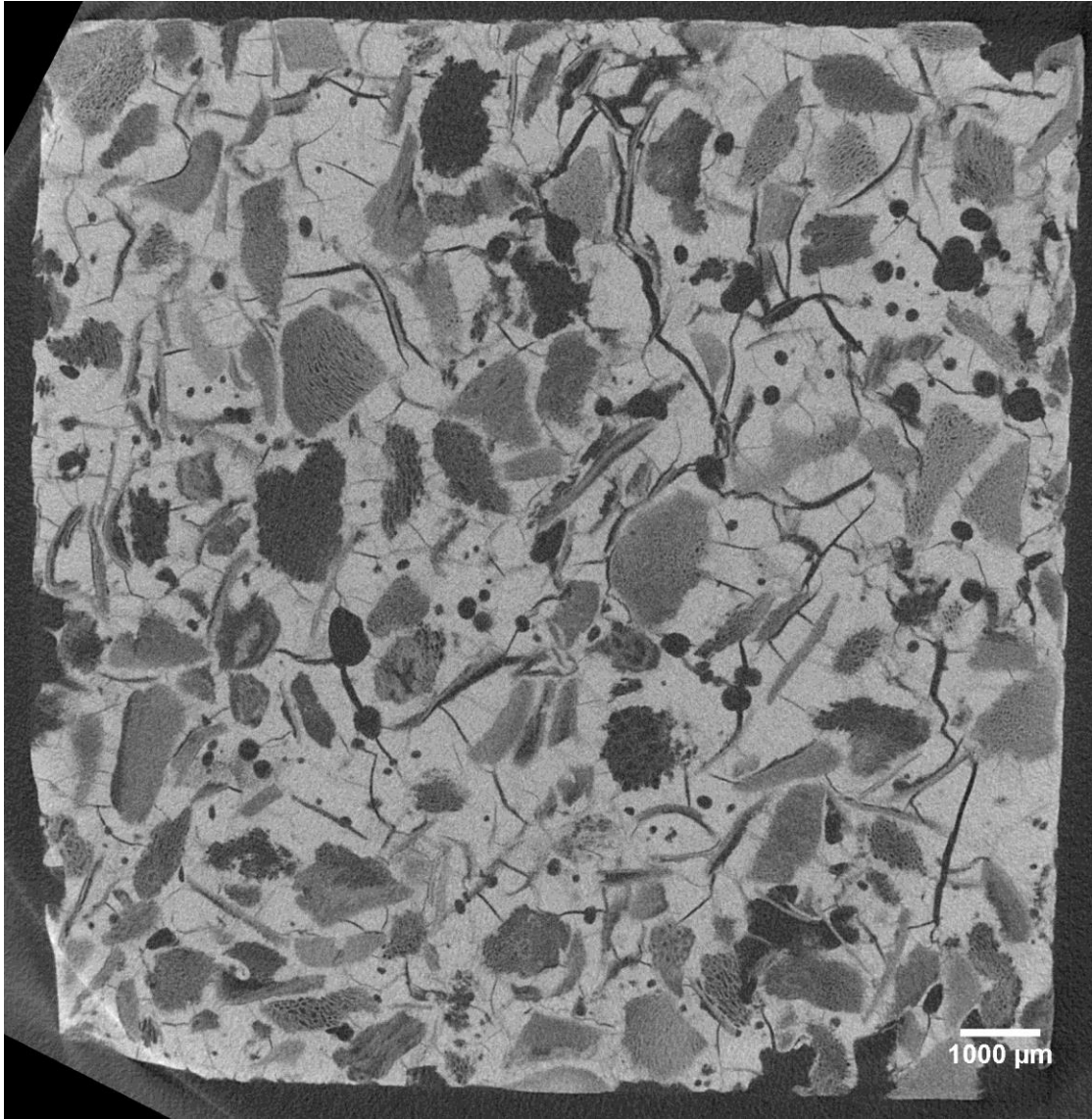


Fig. 1: 2D slice acquired by X-ray microtomography of a biocomposite sample with lignosulfonates matrix and 22.5% corn cob fibers, compacted with a 0.275 MPa pressure. Resolution is 8 μm per pixel.