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3D structural characterisation and deformation measurements of wood-based fibrous insulators under compression.

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This study has been developed in a context of eco-conception of materials for building. We interest here in wood based fibreboards used for thermal insulation, elaborated by non woven process currently used in textile industry and recently adapted to wood fibres. The behaviour of these high porosity materials has to be looked at carefully at different steps of their life, from consolidation of the fibrous mats to the use in service. Indeed, the macroscopic properties obtained after elaboration, which depend on the structure of the fibrous networks, have to be conserved when the material is submitted to stress during transport and storage. To this end, a very low-density wood based fibreboard has been compressed along its transversal direction. The experiment was carried out in ESRF synchrotron (ID19) and X-ray microtomographic images were recorded for each state of compression. Stipulating that the fibreboard is a discontinuous material essentially made of air, that the compression simply re-organises the spatial distribution of the fibres and does not involve their intrinsic mechanical properties, we are able to deduce the material points density variations along the thickness of the panel [1]. Good agreement is achieved between the macroscopic deformation of the sample and the microscopic compression rate evaluation. Then, the modifications of structural parameters are investigated by 3D image analysis [2], using tools derived from mathematical morphology [3, 4]. The relationship between the local structure and the behaviour of the wood fibreboard are deduced. It suggests that the microstructure of this very low-density material re-organises the distribution of the single fibres and of the bundles in the large free volumes, without individual compression of the fibres (or bundles). Finally, a modelling approach allows the local densification to be predicted and confirms the initial hypotheses about the local behaviour of the material. In particular, polyester bonds are not involved.

Key words: compression – fibres – microstructure – morphology - thermal insulation – wood - X-ray microtomography

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