

3D characterisation of a multi-scale foam

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1. Introduction

To decrease the variability caused by environmental dependency, agglomerated cork is preferred to cork for mechanical applications. It also allows to overstep the anisotropy of natural cork by randomly arranging cork cell orientation and to mold pieces with a more complex geometry. However the microstructure of this material is still not fully reviewed, even if it could strongly influence its mechanical behaviour and its specific strain mechanisms. Only the microstructure of natural cork has been quite studied. Concerning the spatial organisation, only the macroscopic defects of natural cork, like lenticular channel (also called lenticels) or ants galleries, were investigated by using either neutron tomography [1], Compton tomography [2] or X-ray tomography (spatial resolution of 2 mm and 50 μm) [3]. Those techniques were used to study the correlation between cork quality (given by surface analysis) and internal defects of cork stoppers. The aim of this work is to study the microstructure of cork agglomerates and to give the first quantitative data at several scales (cells and beads).

2. Materials and Methods

To obtain agglomerated cork, natural cork is ground and sieved to classify it by size. small beads ($\varnothing = 0.5 - 1 \text{ mm}$) are mixed together with a thermoset furan resin. It is then uniaxially compressed into a $1000 \times 500 \times 150 \text{ mm}^3$ block at a 0.39 density. Afterwards the crossing is made in an autoclave. Two types of resolutions are adopted in order to either study the beads or the cork cells. The first $8.5 \mu\text{m}/\text{voxel}$ resolution gives the structure at the granulate scale. A resolution of 1

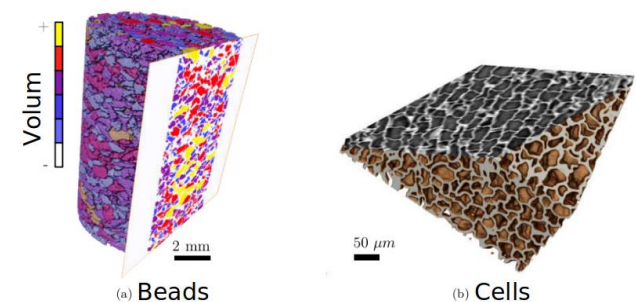
μm was then adopted in order to distinct the cell walls. In order to isolate the meso-scale (the bead scale), a median filter was successfully used. Otherwise, for beads and cell walls, classical post-treatment techniques were used.

3. Results and Conclusion

The post-treatment of the tomographic data provided a large number of quantitative data at the two scales (Fig. 1). They allowed to explain the transverse isotropy of the material behaviour by the organisation of the beads due to the manufacturing process.

4. References

[1] A. Lagorce-Tachon, 10.1016/j.jfoodeng.2014.10.023



[2] A. Brunetti et al., 10.1016/S0168-583X(02)01289-2.

[3] V. Oliveira et al., 0.1016/j.jfoodeng.2015.05.019

Figure 1. 3D reconstruction of the two scales of agglomerated cork