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Cork is a wonderful plant materials whose low density, hydrophobic behavior and high elastic recovery allowed its use in many traditional and innovative applications such as cork stoppers, insulation boards, rubber composites, wall and floor covering, shock absorbers, biosorbtion, etc (Pereira, 2007; Silva et al., 2005). Cork exhibits a relatively homogeneous honeycomb structure composed of polyhedron cells filled with gas. Each cell is constituted of two hexagonal bases with prismatic faces. (Pereira, 2007). The fragmentation of cork in particles by milling processes (Rives et al., 2012) may induce two extreme scenariis depending on how the fracture path propagates in the tissues which could affect cork properties and processability : (I) a maximal cell preservation case for which the fracture path passes between the cells. In this case, all the cells present at the surface of the particle are preserved in integrality. (ii) A maximal cell degradation case for which the fracture path passes through the cells. In this case the cells at the surface of the particle are degraded and leaking gas, while only the cells in the center are preserved. A better understanding of the effect of milling on particules properties would be required to improve both the process and the product, opening the way to higher quality particles. To study this, cork particles were generated by a combination of milling and sieving to produce 18 discrete particle sizes from 0 to 3000 μm. The different fractions were precisely characterized in terms of particle shape, packing density, compressibility and elasticity. Microscopic observations were also performed to estimate the average cells dimensions and the percentage of degraded cells at the surface. The results indicate that milling does not affect particle shape, which could be assimilated to a slightly elongated parallelepiped. In addition, the characterization indicates that the finest fraction exhibits a higher compressibility but a lower elasticity. A geometrical mathematical model was developped, to which the experimental data were successfully fit. The analyses showed that although the milling of cork reduces its mechanical properties, this degradation is more strongly correlated to the number of degraded cells than to the particle size reduction. Therefore, significant optimization of the cork processability could be obtained by milling technologies which preserved the cell structure.

Keywords: fine milling, cork structure, biomaterial fractionation.

References:

1. Pereira, H., 2007. Cork: Biology, Production and Uses, New York: Elsevier. Elservier, Amsterdam.
2. Rives, J., Fernandez-Rodriguez, I., Gabarrell, X., Rieradevall, J., 2012. Environmental analysis of cork granulate production in Catalonia – Northern Spain. Resour. Conserv. Recycl. 58, 132–142.
3. Silva, S.P., Sabino, M. a., Fernandes, E.M., Correlo, V.M., Boesel, L.F., Reis, R.L., 2005. Cork: properties, capabilities and applications. Int. Mater. Rev. 50, 345–365.