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Oxygen diffusion through natural raw cork

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One of the most encountered problems in wine industry is the oxidation of white wine during wine storage in bottle. The key factor involved in this phenomenon is the oxygen transfer. However the oxygen transfer through stopper during wine storage is not well studied. In the field of wine industry, the oxygen transfer rate (OTR) is commonly used as a mean to evaluate the stopper barrier efficiency [1]. It is now often indicated by some suppliers on technical data sheet. However, this parameter only represents a mass flow, which does not include the thickness of the material and the pressure gradient. Consequently, in literature, no diffusion and permeability values are given for materials used as stopper. Cork stoppers are the most used for wine ageing in bottle. Thus, it is important to better know its kinetics properties, in particular considering oxygen.

In this work a manometric method was developed, based on the study of Rabiot *and al*, 1999 [2]. It aims at measuring the intrinsic oxygen diffusion coefficient of raw cork. This set up consists in two gas compartments separated by the cork disc stuck into a sealed metal ring. Pressure is measured in the first compartment while the second one is maintained under primary vacuum conditions (10^{-2} hPa) during the time course of the experiment. In our conditions, the stationary state is reached very quickly in comparison to the total experimental time. As a consequence the conditions are fulfilled to use a simple analytical solution to Fick first law. Diffusion coefficients of 15 different samples of 3 mm thickness were measured for uncompressed cork. A large distribution is observed Fig1, spread over five decades with a maximum between 10^{-9} and 10^{-7} m².s^{-1}. From statistical analysis, we show that 2.5 % of stoppers would have a diffusion coefficient higher than 2 10^{-8} m^2.s^{-1} corresponding to an OTR equal to 103 mg.year^{-1}.stopper^{-1}, value from which

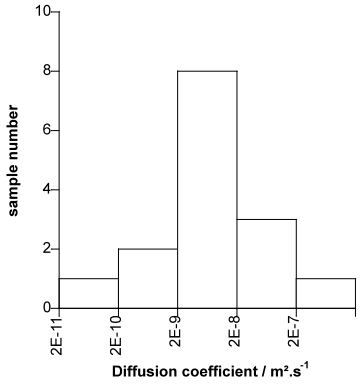

Figure 1 Distribution of diffusion coefficients of oxygen in 3 mm cork membrane at 298 K.

oxidation defects could appear during wine aging in bottle. This study gives for the first time a diffusion coefficient of oxygen through cork that takes into account the material heterogeneity.

References

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