

On the Permeability of Cork – Preliminary Results

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MOTIVATION

Cork is extensively used for stoppers in wine bottling. Its mechanical properties make it an excellent choice for such use. However, in recent years many wine producers start using other non-natural alternatives. However, it is believed, that cork is not a passive stopper but it helps the evolution of wine. In the frame of this work, we are evaluating the permeability of cork for gases. The main goal, is to check if its permeability is selective or not, if some gases flow through the cork better than others. Since cork essentially consists of empty cell walls, selectivity may still be present as in living cells. At this stage, we are presenting only results with helium. Although helium is not a gas related with wine, the permeability may be easily measured with a good helium mass spectrometer leak detector.

INTRODUCTION

Initially the cork was cut in three different sections, transverse, radial and tangential. However the preliminary measurements were only made for the last two mentioned sections, as the transverse and radial are similar.

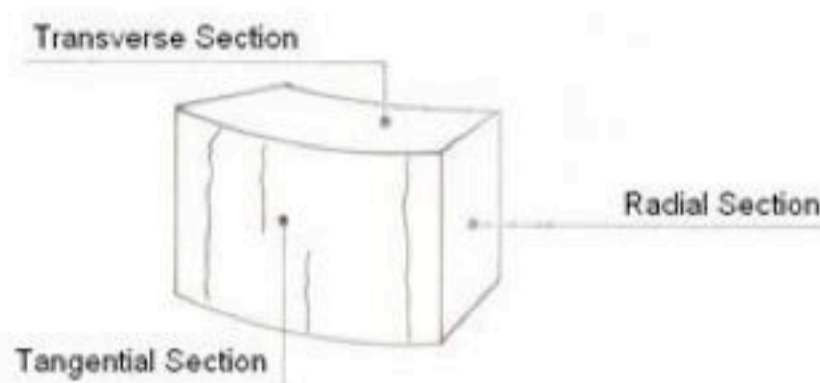


Fig. 1 – Sections in a board of cork. [1]

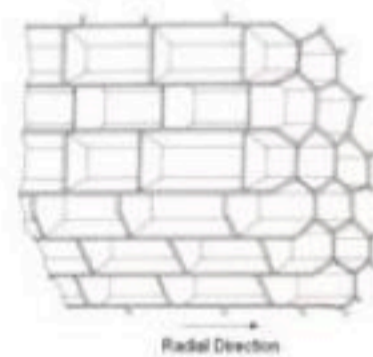


Fig. 2 – Schematic of cork cells. [1]



Fig. 3 – Cork cells in a tangential cut. [1]

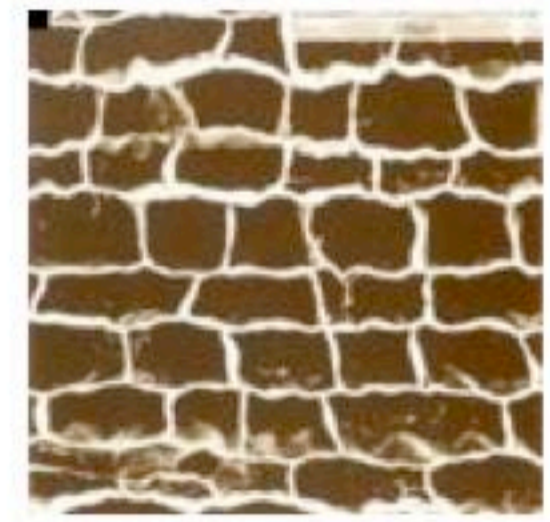


Fig. 4 – Cork cells in a radial or transverse cut. [1]

EXPERIMENTAL

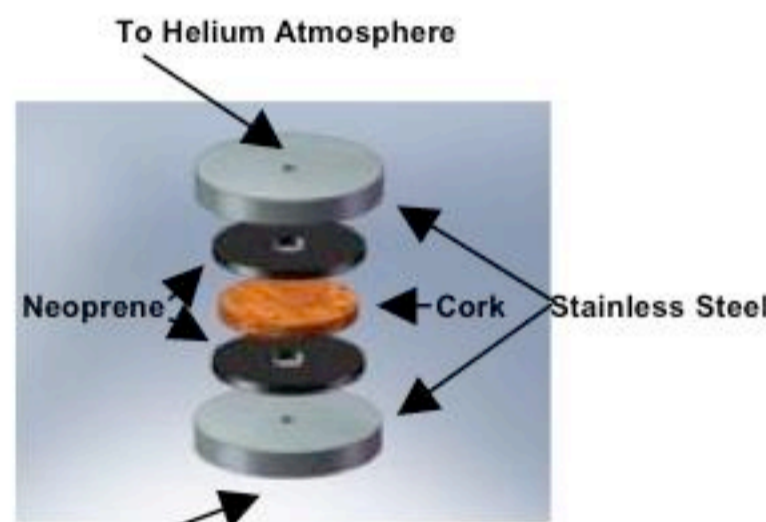


Fig. 5 – Schematic of the device used to test the cork.

For connecting the cork to the leak detector a device was made to ensure that the helium could only reach the leak detector by passing through the cork.

The different sections were then tested at two helium pressures 0 and 1 bar (relative pressure).

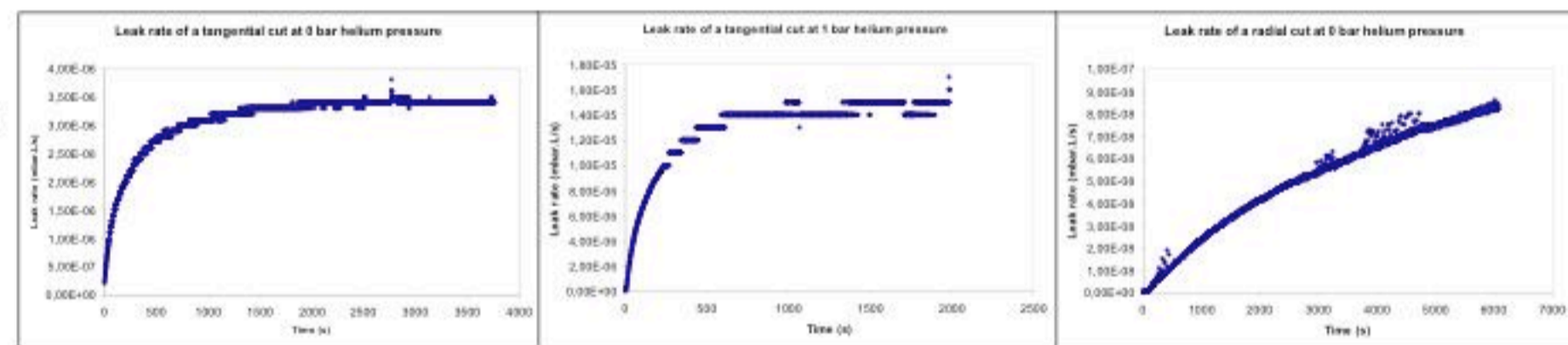


Fig. 6 – Leak rate results obtained for both cut at different helium pressures.

The testing results show a increase of helium leak rate in the form of: $a(1 - e^{-t/\tau})$

With an increase of helium pressure we get an increase of the final leak rate, but hardly any difference in the time constant of the fitting function, about 200 s for each of the tangential tests in Fig. 6. A difference in the time constant is observed when we compare the results for the two different sections, having the radial cut a time constant of about 4000 s.

Although all results show the same basic form, in some (Fig. 7) we can observe a particular behaviour of the cork, where it seems to be letting out some bursts of helium and then returning to the to normal behaviour.

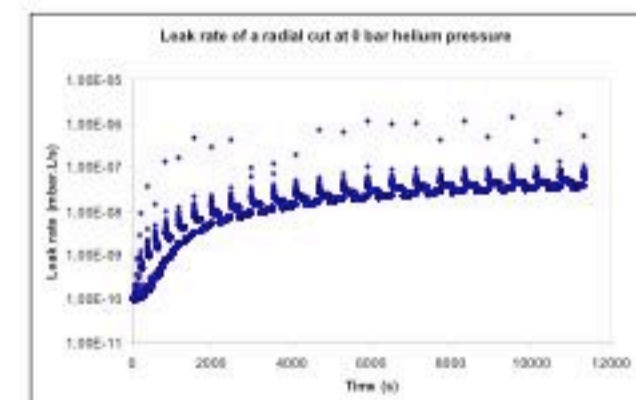


Fig. 7 – Bursts of helium through a radial section of cork.

CONCLUSION

With this preliminary study one can see that cork is permeable to helium. Furthermore it can be observed that the permeability is greater through a tangential section than through a radial one. The shorter time constant of the increase of leak rate in the tangential cut clearly states that it is easier for the helium to pass through the cork in this direction. The particular behaviour observed in some of the test result states that a further study must be carried out, in order to achieve more reliable and statistical meaningful results.

REFERENCES

[1] M. A. Fortes, et al – A Cortiça, IST Press, 2004.



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