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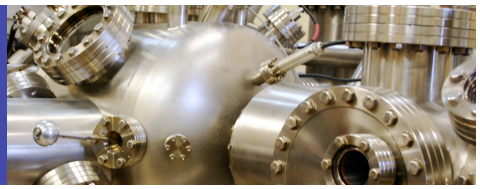

Gas released from cork after bottling

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Motivation

- Evolution of wine after bottling is affected by the continuous supply of oxygen through the closures.
- Where from comes the main contribution of oxygen after bottling?
- From outside though the cork closure or from the cork itself?
- How much gas is released from inside a cork stopper under typical bottling conditions?
- How fast the gas from a cork stopper is released?

Bottling and the gas inside the closure

The experiment design had in mind that the typical compression rate (volume change / uncompressed volume) of a cork stopper is about 40%.

Taking in account that cork has a void volume ranging 70 to 80%, cork cells pressure after bottling may reach more than 2 atm, becoming a source of (pressurized) gas that may 'leak' to both sides of the closure along many weeks.

Three typical starting headspace pressures were used: 60 mbar, 1007 mbar and 3020 mbar (absolute pressures) – corresponding roughly to vacuum bottling, balanced pressures bottling and bottling without any prior pumping.

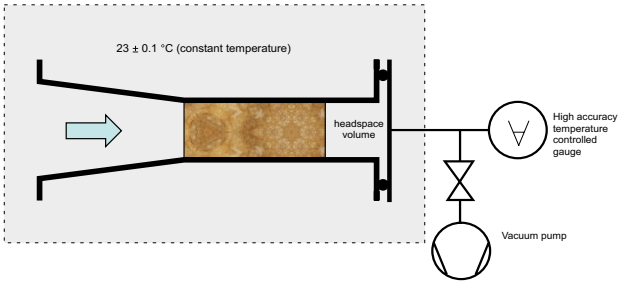
The stopper volume is about 20.4 cm^3 prior to insertion and 11,5 cm^3 after insertion. Assuming that cork is made of 75% void volume (empty cells) and the rest in uncompressible, the absolute pressure inside cork cells after bottling is about 2.4 bar. This corresponds to 1.4 bar above atmospheric pressure. The amount of compressed air inside such typical closure is about 8.9 mL (STP).

Materials and methods

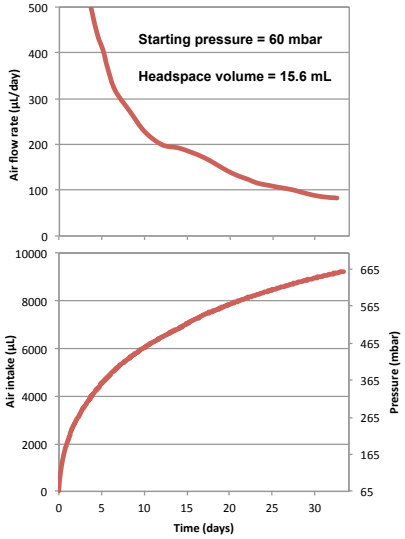
The headspace pressure was monitored for several days after the introduction of a cork stopper in a bottleneck like holder specially built for this purpose in stainless steel.

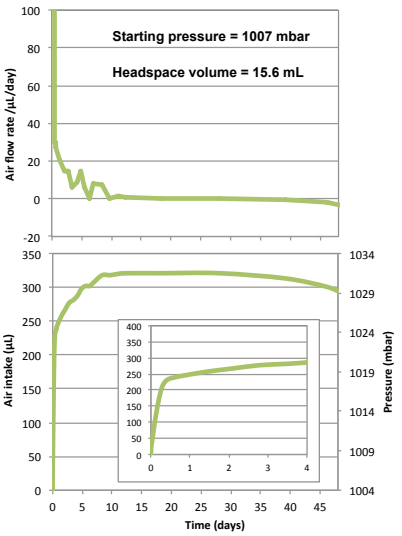
This holder was kept inside a climatic chamber at a constant temperature of 23.0°C ±0.1 °C. The bottleneck was slightly conical 18 mm to 19 mm in diameter The stoppers were introduced slowly with the help of a screwable cylinder (about 10 seconds), later removed.

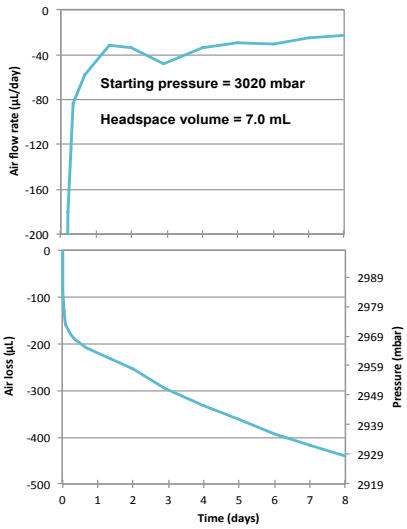
All parts, including the stoppers were thermalized in the climatic chamber before experiment start.



Results







Conclusions

The gas is released in the first 2-3 weeks and then the cork behaves as permeable membrane. There is an intense flow rate in first hours, slowing down in next days. While the headspace pressure is lower than the cells pressure, the gas inside the cork is an additional and significant source of gas, speeding up the headspace pressure increase. Then, the gas flow becomes ruled by cork permeability.

In the case of bottling without prior pumping, the gas released by cork is towards the atmosphere since the typical headspace pressure after bottling is higher than the cork inner pressure.

The total amount of gas released from cork seems to be less the 1 mL as shown in the experiment performed at balanced pressures. Due to the natural variability of cork, results among distinct samples should be compared with caution.

Table 1- Sample and experimental data

Starting pressure (mbar)	Manufacturer class	Mass (g)	Size (mm)	Density (kg/m^3)	Permeability (µL/(cm.atm.day))
60		3.3605		165	416
1007	Superior	3.6431	44 x 25	179	269
3020		3.7534		184	21

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