



## Oxygen transmission rate



### What is oxygen transmission rate (OTR)?

Oxygen transmission rate (OTR) is a measure of the volume of oxygen that diffuses through a barrier over a given period of time. For bottled wine, the barrier for oxygen permeation is the closure. For bag-in-box, canned wine or wine in pouches, the barrier is the entire vessel or the weakest pathway for oxygen diffusion.

### Why is it important?

Oxygen drives many of the important sensory changes which occur in wine as it ages and indirectly results in the degradation of the key antioxidant sulfur dioxide ( $\text{SO}_2$ ), which is often measured as an indicator of the degree of development in bottled wines. However, it is only within the last decade that the sources of oxygen in packaged wine, and their relative importance, have been the subject of dedicated study.

### Impact on shelf life

The AWRI has undertaken several closure trials that have shown that closure OTR can have a significant impact on the shelf-life of a wine, with findings including:

- Very low OTR values can lead to the development of reductive attributes in the wine if appropriate precursors are present. The presence of metals in wine can exacerbate this issue.
- Low OTR values can lead to retention of fresh fruit characters.
- Moderate OTR values can lead to the development of cooked and stewed fruit characters.
- High OTR values can lead to significant oxidised characters developing over a relatively short shelf life.



## Commercial closures and typical OTR ranges

The most common commercially available closures used in the global wine industry are:

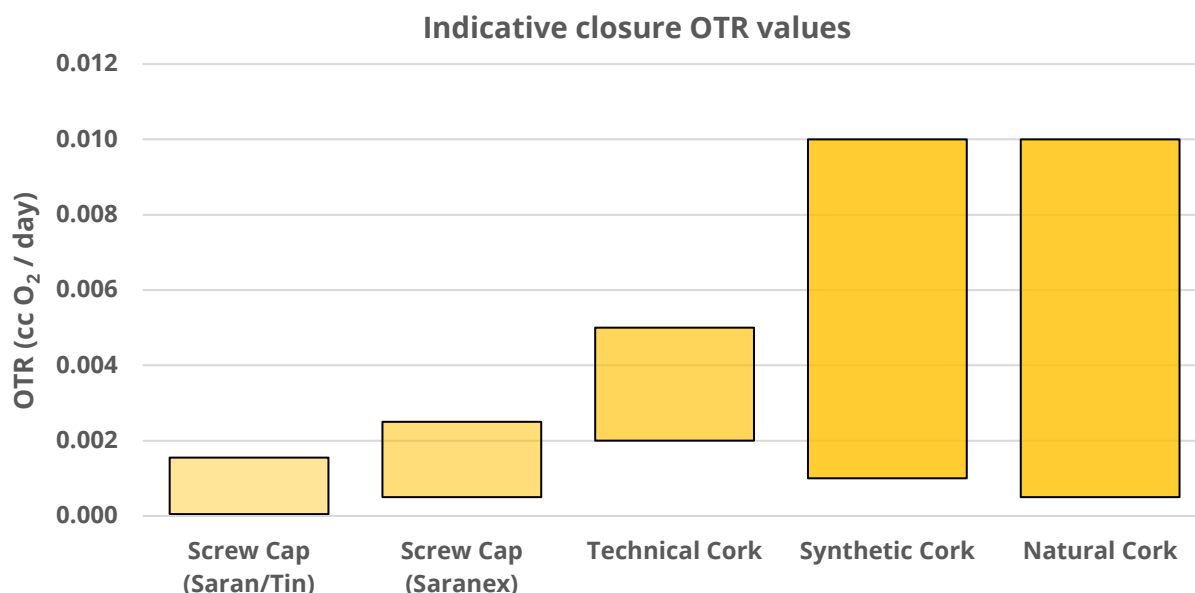
- natural corks
- agglomerated/technical corks
- screw caps (tin/saran and saranex liners)
- synthetic closures
- glass closures.



*Figure 1. Examples of wine closures used in the global wine industry*

Globally, cork-based closures (natural and agglomerated) share ~70% of the wine market, with screw cap and synthetic closures occupying a near even split of the remaining 30%. For the Australian wine industry, however, screw caps dominate the market, sealing ~90% of all bottled wine.

Figure 2 summarises typical ranges for OTR values for the closure types listed above. Synthetic closures typically possess values within the moderate to high OTR range, but there is significant variability among the products available. Natural corks can show high levels of variability in their permeability, depending on the grade of cork used. Technical/agglomerated corks have lower variability than natural cork stoppers with low to moderate OTRs. Finally, screw caps, have very low to low OTR values with a high degree of consistency. The two key liner materials in screw cap closures are saranex and tin/saran, with the former typically having marginally higher OTR values than the latter.



*Figure 2. Indicative oxygen transmission rate values for commercial wine closure types*

Closures with variable OTRs are also now becoming available in the marketplace. Suppliers of technical/agglomerated, synthetic and screw cap closures have all developed new closures with defined OTR values that can be tailored for differing wine styles and methods of winemaking. The ability to modulate the OTR of a closure has benefits for both winemakers and marketers, ensuring both functional and aesthetic requirements are met.

## How is OTR measured?

There are several methods that have been developed to measure the OTR of packaged wine:

### 1. Destructive OTR measurement

- Free SO<sub>2</sub> titration
- Coulometric detection
- Colorimetric detection
- O<sub>2</sub> titration
- Manometric method

### 2. Non-destructive OTR measurement

- Chemiluminescence

Of the methods described above, the Mocon® Ox-tran® method (an applied version of the coulometric detection method) and the chemiluminescence methods are the most widely used.



The Australian Wine  
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# Fact Sheet

## CLOSURES AND PACKAGING

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Since the development of the chemiluminescence method, there have been expansive trials showing good correlation between the two techniques.

AWRI Commercial Services currently offers the non-destructive chemiluminescence method to measure OTR as a service to industry.

### Contact

For further information on OTR or other packaging issues, please contact:

#### AWRI helpdesk

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