ask the AWRI

Crown seals - Performing under pressure

Bottle ageing on yeast lees following secondary fermentation (*en tirage*) is a critical step in traditional method sparkling wine production. Winemakers can choose from several types of crown seal closures for use during bottle ageing. In this article, AWRI Senior Oenologist **Ben Cordingley** addresses questions about crown seal closures used during bottle ageing

What is a sparkling wine crown seal comprised of?

Crown seal caps are typically comprised of a metallic outer and polyethylene liner. Some liners include materials that absorb oxygen to limit oxidation. Caps can contain a built-in or separate bidule, which is a small plastic cup that intrudes into the neck of the bottle to aid lees capture during riddling.

Which metals are used for crown seals, and when should each be chosen?

Crown seals are typically made from three common metals:

- Electrolytic tinpate (ETP)
- Aluminium alloy
- Stainless steel

The most cost-effective crown seals often make use of ETP, a thin sheet of mild steel coated with one or more layers of tin. These seals can be susceptible to external rust and are not a suitable option for long term bottle-ageing.

Aluminium alloy closures offer greater resistance to corrosion, though corrosion can still occur if they contact acid or alkali. Aluminium Alloy caps are non-magnetic, which may limit compatibility with some bottling equipment.

Stainless steel closures are highly resistant to corrosion and are magnetic, making them compatible with most bottling equipment. Their strength reduces the risk of structural deformities, but they can be more difficult to apply and remove which can lead to increased wear on bottling equipment. Stainless steel is the most suitable for extended bottle ageing, though it generally comes at a higher cost.

What is the difference between the different liners used in crown seals?

The main difference between liners is their permeability to gases, which can suit varying bottle ageing durations and wine styles. Permeability of liners impacts both the amount of oxygen ingress into the bottle, and the loss of carbon dioxide from the bottle. High permeability liners tend to be more permeable to both carbon dioxide and oxygen. Carbon dioxide losses through the liner can be as much as 0.12 to 0.68 mL/day (Kemp *et al.*, 2015). Oxygen permeability rates range from 0.0006 to 0.0019 mL/day (Valade *et al.*, 2019). High permeability liners are more suited for shorter bottle ageing where a winemaker might be seeking more lees and oxygen interaction for a faster 'evolution' of the sparkling wine. Low permeability liners are suitable for extended bottle ageing, for preservation of primary fruit character and to benefit from a slow oxygen and lees interaction.

How much CO_2 can be lost through the crown seal liner?

The use of a low permeability liner will result in greater preservation of the carbonation when ageing in bottle over many years. Table 1 shows the impacts of different liner types on total CO_2 losses over a ten-year period for a liner rated for three different CO_2 loss rates- low (0.12 mL/day), medium (0.25 mL/day) and high CO_2 loss rate (0.68 mL/day).

It is typical for traditional method sparkling wines to have around 24 g/L of fermentable sugars added in the tirage liqueur, which when fermented completely gives approximately 6 gas volumes of CO_2 in addition to the concentration of CO_2 initially in the base wine. If a liner with a high CO_2 loss rate was used for extended bottle ageing, around a third of its carbonation would be lost over 5 years, and after ten years, more than half its carbonation would be lost.

Table 1. Total CO_2 loss over time using different crown seal liners

	Total CO_2 loss (percentage loss of 6.0 gas volume[1] starting CO_2)		
CO_2 loss rate	Low 0.12 mL/day	Medium 0.25 mL/day	High 0.68 mL/day
2 years	2.0%	4.0%	11.7%
5 years	5.0%	10.2%	27.5%
10 years	10.0%	20.5%	55.0%

1.Note that at 20°C, one gas volume of CO_2 in a bottle of sparkling wine is approximately equal to 1 bar of gauge pressure.

Do yeast lees protect against oxidation during bottle ageing of traditional method sparkling wine?

Yeast lees help protect wines from oxidation, but the rate of oxygen consumption decreases over time. Eventually, the rate of oxygen entering through the crown seal closure exceeds the lees' capacity to consume it. For a low permeability liner, this is likely to occur after around 3-years of bottle ageing on lees however, this may vary depending on the strain of yeast used for bottle fermentation (PonsMercadé *et al.*, 2021). After the rate of oxygen ingress exceeds the rate of oxygen consumption by yeast lees, the wine will be exposed to an increasing amount of oxygen as bottle-ageing continues and the rate of consumption of oxygen by yeast lees continues to decrease. The choice of seal liner should be guided by the wine's target style, taking into account desired oxygen ingress and ageing potential.

What is a bidule and what does it do?

A bidule is a polyethylene cup that is inserted upside down, extending to around 1.5 cm into the neck of the bottle before the crown seal is applied for secondary fermentation in bottle. The primary purpose of a bidule is to collect yeast lees during riddling to ensure a clean and complete disgorgement. Bidules can also help to improve the seal between the bottle glass and crown seal liner. The use of bidules is optional, and often requires additional equipment on the bottling line for their application. Alternatively, crown seals with integrated bidules extending less than 4 mm into the bottle neck may be used. Due to their shorter intrusion depth, built-in bidules are often not as effective as separately inserted bidules.

For help with sparkling winemaking related issues or any other winemaking or viticulture questions, please contact the AWRI helpdesk on helpdesk@awri.com.au or 08 8313 6600.

References

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