



Improved closure performance through use of membrane technology

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Abstract

Membrane technology can control the permeation of oxygen into wine. It is used by the wine industry in pre-bottling micro-oxygenation techniques and more recently it is being used post-bottling, by a number of leading premium and large wineries, in innovative membrane cork technology. Membrane technology can also be used to inhibit taint and flavour transmission into wine. This paper reports on the results of independent trialling of a membrane cork by The Australian Wine Research Institute (AWRI) and compares it to other cork based closures and screw caps in the trial. The trial results demonstrate that the membrane technology improves closure performance by inhibiting oxidation, similar to screw cap, while at the same time also inhibiting the reduced character that developed in the screw cap wine. This work also demonstrates that a build up of methyl mercaptan and dimethyl disulfide (DMDS) is linked to the development of reduced character in the screw cap wine.

Introduction

The most recent scientific studies confirm what has been generally accepted for the

last 400 years: that oxygen is intimately involved in the aging process of bottled wine. The research has identified that too much oxygen can prematurely oxidise wine, small amounts of oxygen through the closure can accelerate wine development/ maturation and that too little oxygen can result in the development of reduced characters in wine [Skouroumounis, 2005; Hart, 2005]. Leading researchers have recently acknowledged that oxygen ingress is actually one of the major factors determining wine development in the bottle and that complete oxygen barrier is not ideal for wine [Goode, 2006a; Allen, 2006]. It therefore stands to reason that membrane technology that can control the transmission of oxygen can play a fundamental role in controlling wine development.

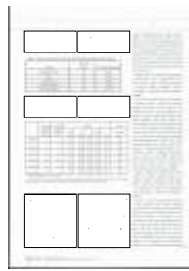
The application of membrane technology to natural cork originated from Australian research during the 1990s. After commercial release in 2004 it became one of the fastest growing new closure technologies, growing to 30 million bottles per annum within 18 months. It is now rapidly spreading into the largest wine producing regions of

the world. Membrane technology for cork was actually developed to inhibit taint and flavour transmission into wine, however, it was discovered during the work reported here, that the oxygen transmission properties of the membrane could play an important role in optimising wine development and improve closure performance.

Independent testing of membrane cork

The AWRI conducted a wine bottle closure trial in May 1999. Due to demand by closure producers, a second trial was set up on a commercial basis, and closure producers were invited to submit their closure together with a fee. In return for this fee, the closure producers were presented data on the performance of their closure.

A membrane cork closure developed by ProCork Pty Ltd which uses natural cork combined with membrane technology was submitted to the AWRI commercial closure trial. The membrane cork is now commercially available in France, Australia, New Zealand and Italy. The membrane consists of a series of layers which are able



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to regulate oxygen, reduce taint entering the wine and reduce flavour scalping from the wine [Tran, 2005].

The AWRI Commercial Closure trial commenced in September 2002. The wine was a premium 2002 Semillon from the Clare Valley, the same wine used in the 1999 trial. It was made under normal winemaking conditions. The wine was bottled at Vinpac International, Angaston (ISO 90001:2000 certified and ISO 17025:1999 certified).

The detailed methodology and results are given in a poster summary published in the Conference Proceedings of the 12th Australian Wine Industry Technical

Conference 2004 [Tran, 2005].

AWRI analysed the wine from the trial (described above) on a six-monthly basis for sensory and chemical properties including sulphur dioxide. The average free SO₂ measured on 12 replicates at 24 months is given below in Table 1 for the membrane cork, Diam, screw cap and cork of two grades and lengths. It can be seen that the membrane technology when applied to cork has the highest average level of free SO₂, as well as the lowest standard deviation of 4.0 per cent compared to 4.3 per cent for the screw cap wine, indicating a very tight and consistent seal with the membrane cork.

Table 2 gives the methyl mercaptan results measured by ETS Laboratories, St Helena, California, and some of the AWRI sensory data both determined at the 24 months for the wines in the Commercial Closure trial. The data shows that methyl mercaptan and dimethyl disulfide (DMDS) are present in the screw cap wine where the sensory attribute of flint/rubber is high. Methyl mercaptan and DMDS are indicators of reduced wine [Ribereau-Gayon, 2000] and flint/rubber is also one of a number of sensory attributes that are recognised as indicating a wine is

Table 1: Free SO₂ measured at 24 months [Eichinger, 2004a; Banister, 2005]

Closure	Free SO ₂ (mg/l)	Standard Deviation
Membrane Cork	25	4.0%
Diam	24	8.3%
Screw Cap	23	4.3%
Cork Ref 2 44mm	22	13.6%
Cork Ref 3 38mm	18	16.7%

	ETS analysis	ETS analysis	AROMA					PALATE
	Dimethyl Disulfide DMDS (ng/l)	Methyl Mercaptan (ng/l)	flint/rubber	oxidised	Citrus	Overall Fruit	honey	Overall fruit flavour
Membrane Cork	nd	nd*	0.7 (0.3)	0.1 (0.1)	4.6 (0.3)	5.1 (0.5)	0.9 (0.2)	5.4 (0.2)
**Diam P0	nm	nm	0.1 (0.1)	0.3 (0.3)	4.1 (0.2)	4.4 (0.5)	1.5 (0.4)	4.9 (0.3)
**Diam P1	nm	nm	0.2 (0.1)	0.3 (0.0)	4.1 (0.2)	4.3 (0.4)	1.6 (0.2)	4.8 (0.0)
Screw cap	1100	600	1.7 (0.1)	0.2 (0.2)	4.3 (0.3)	4.5 (0.5)	1.0 (0.3)	5.5 (0.2)
Cork Ref 2	nd	nd	0.3 (0.2)	0.3 (0.1)	4.2 (0.3)	4.9 (0.4)	1.5 (0.3)	5.1 (0.3)
Cork Ref 3	nd	nd	0.1 (0.2)	1.0 (0.8)	3.6 (0.5)	4.0 (0.5)	1.5 (0.1)	4.6 (0.4)

*nd = Not detected, nm = not measured
 **The Oenoe UK web site and a previous publication [Banister, 2005] both indicate the Altec closures in the report [Eichinger, 2004b] are Diam closures. The data for the more permeable Diam P2 is not shown here.



reduced [Ribereau-Gayon, 2000; White, 2005]. The reduced character was not observed in the wine at the beginning of the trial nor at six months. It has formed in the period between six months and 24 months in the screw cap wine and not in the other wines. It is therefore concluded that post bottling reduction has occurred in the screw cap wine and not with the other closures.

Table 2: 24 month: DMDS and Mercaptan concentration (ETS Laboratories) and some sensory data (standard deviation in brackets) AWRI Commercial Closure Trial (2002) [Eichinger, 2004a; Eichinger, 2004b].

Some of the sensory data from Table 2 is plotted in Figure 1 against the relative

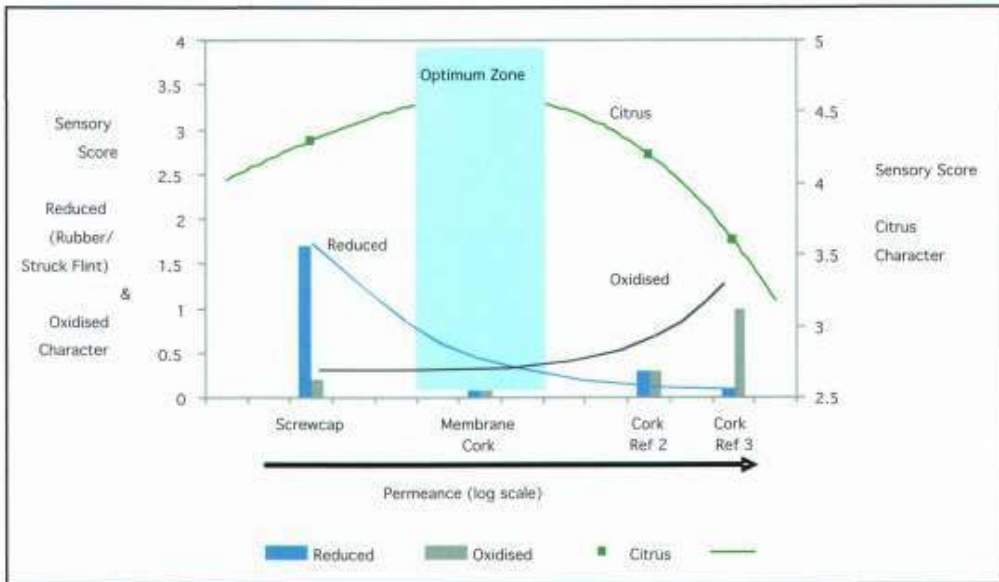
oxygen permeance of the closures. The permeance data is now available on the various closures used [Mills, 2005; Hart, 2005; Godden, 2005; Aracil, 2004]. The Figure displays a reduction/oxidation saddle curve which appears characteristic and may be related to wine variety. This saddle curve is also found when other published trials [Skouroumounis, 2005; Hart, 2005] are analysed by the method used here. Figure 1 is experimental evidence of the "optimum closure oxygen transmission curve" shown at the 2005 Rutherglen Wine Show Seminar [Gibson, 2005] and the "closure zone curve" presented in Wine Bottle Closures [Goode, 2006b].

Figure 1 Reduced, Oxidised and Citrus sensory attributes plotted against the

relative closure permeance (Log Scale): AWRI Commercial Closure Trial (2002) - 24 months for Screw cap, Membrane cork, Cork Ref 2 - 44 mm, Cork Ref 3 - 38 mm

Figure 1 shows the membrane cork sits in the optimum region where oxidised character is minimised, reduced character has not become too intense and the citrus sensory attribute is maximised. It has significantly lower reduced character than screw cap and lower oxidised character than cork. The membrane cork has the highest average score for citrus aromas when compared to screw cap and other closures. It is subjective as to where the bottom of the reduction/oxidation saddle

occurs. It can be taken, that the optimum is where the fruit attributes are maximised or plateau, oxidation is low and reduced characters are still just barely perceptible. The membrane cork closure is at this point, where it benefits from lower oxidation without the quality loss caused by the high reduction levels found in the screw cap wine.





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Conclusions

The membrane technology used in the commercial membrane cork in the AWRI Commercial Closure Trial was shown to allow wine to develop without excessive development of reduced or oxidised characters. The membrane technology was shown to perform better than the screw cap and other cork based closures because it

retained the highest levels of free SO₂ and fruit characteristics without the higher levels of reduced characters seen in the screw cap control or oxidised characters seen in the cork controls.

The results show that membrane corks with the membrane technology used in the trials here will allow winemakers to optimise oxygen permeation post bottling

and obtain bottle development uncompromised by oxidation or excessive reduction.

Correlation of tests carried out by ETS laboratory in USA to the sensory characters of the wine have shown that the post bottling reduced character in the screw cap wine in the AWRI 2002 Commercial Closure trial is in part related to a build up of methyl mercaptan and dimethyl disulfide (DMDS) in the screw cap wine that did not build up in the other closures in the trial.

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(For a list of references used in association with this article, go to: www.winetech.co.nz/references.htm).

** Participation in and reporting of the independent AWRI "Commercial Closure Trial" does not imply an endorsement by AWRI. The data used in this article should be read in conjunction with the full AWRI report*



EasyLab offers simple approach to winery process control applications

Recently introduced by Scios Limited the Erbsloh EasyLab has rapidly gained acceptance as a simple, quick and cost effective system for determining analytical parameters required for process control in grape must and wine.

The EasyLab provides rapid results for 10 important analytical parameters to allow control of fermentations and the application of different treatment agents and technical aids. The tests available cover a broad range of analyses from fermentation control including primary and malolactic, as well as determination of any de-acidification demand. An index of physiological ripeness and grape press performance can be gained from the polyphenols test kit and wine stability ensured using the free and total sulphurous acid tests.

The key to the EasyLab system is the pocket-sized battery powered Reflectometer. Each separate test kit is provided with a bar code for setting the EasyLab up for the parameter required. The individual test kits include 50 test strips and clear instructions for use.

According to Scios results from the system have been compared with those from accredited laboratories using traditional analytical methods and performance claims are quite sustainable.

US wine-producing giant, Baron Herzog owned by Royal Wine Corporation has forced a change in name of one of New

Zealand's leading boutique winemakers.

Herzog Winery, making wine under their family name with roots dating back to 1482 in the proprietor's native Switzerland, has had to change the name of their wines to comply with Baron Herzog's global registration of the Herzog name.

This took effect recently in Europe and the United States while the battle to keep using the name in New Zealand and Australia continues.

Hans Herzog and his wife Therese came to Marlborough in the mid-nineties and purchased a 30-acre block of land that had inspired Hans with its potential.

Though continuing to spend New Zealand winters in Switzerland each year, Hans was enthused by the quality of wine he was able to achieve and eventually they made the decision to move permanently to Marlborough.

Included in the move was the couple's Michelin-starred restaurant, now the much-heralded flagship for their range of wines.

Baron Herzog is a producer of mainly kosher wines aimed at the Jewish communities in the United States. Last year saw the opening of the company's new facilities just south of Santa Barbara – more than 7,000 square metres compared to Hans Herzog's tiny cellar where he makes the family's total production of just 3,000 cases.

Herzog Winery has renamed their label 'Hans', a name change they says endorses their commitment to their product.