18 Corks, screw caps, and closures

Forty years ago, all wine bottles were sealed with natural cork. There was no debate about closures simply because there was no other practical way to seal wine bottles. The wine trade certainly knew about the issue of musty taint (referred to as "corked" wine), but seemed to tolerate it. The cork industry was under no pressure to do a better job because it had no competitors.

From this near-monopoly position, cork has seen its market share shrink in the face of alternative closures. Estimates are that of a global closures market of some 20 billion units (sealing 75 cl or 37.5 cl [25 or 12.5 fl oz] wine bottles, but excluding smaller single-pour formats), screw caps are now around 2.5 billion, alongside synthetic corks, which are around 2 billion. This still leaves natural cork (including technological cork-based closures) with a healthy share of the market. However, the march of alternative closures continues. As yet, fine wines have remained largely sealed by corks but the notable exception here is Australia and New Zealand, where screw caps are by far the dominant closure type for all levels of wine.

CORK: A REMARKABLE NATURAL SUBSTANCE

In the debate on closures, cork has frequently been cast as the bad guy. What's often forgotten is that it has remarkable natural properties. It may be highly unfashionable to say this, but cork is a gift from nature ideally suited for sealing bottles. It comes from the bark of the cork oak, *Quercus suber*, which is an unusual and useful tree. If you stripped the bark of most trees, they would die, because you'd be removing the cambium, the cylinder of dividing cells just inside the bark that is responsible for new growth in the stems or trunks of woody perennials. The cork tree has such a thick bark that it can be stripped from mature trees without harming them. Unusually, cork trees have two cork cambium layers. The first, which has its origin in the epidermis, is removed when the tree is about 20 years old, and a new cork cambium then forms a short distance below the site of the first. From then on, new cork tissue accumulates rapidly and can be harvested every nine to ten years, until the tree reaches a venerable old age of 150 or so.

The key to cork's mechanical properties is that it is formed of a honeycomb network of densely packed cells, whose walls have been "suberized." The molecular composition of suberin is still a bit of a mystery. The latest view is that it is formed by a hydroxycinnamic acid–monolignon (poly) phenolic domain embedded in the cell wall, which is linked to a glycerol-based (poly)aliphatic domain located between the plasma membrane and the inner face of the cell wall. "Suberin" is therefore a term that should be used carefully, because it doesn't refer to a single molecular entity.

Suberinization also involves the deposition of a number of waxes in this inner wall region. A wine cork consists of hundreds of millions of these suberized cells, rendered inert and impermeable. Because these cells are filled with gas, the whole cork structure is compressible and elastic. Cork can be compressed to about half its width without losing flexibility and has the remarkable property of being able to be compressed in one dimension without increasing in another. It can resist moisture for decades, and will stay compressed, thus maintaining a seal, for equally long periods.

Because of this composition and structure, cork is good at sealing wine bottles. A decent cork will provide a good seal for 30 years, possibly longer, allowing the wine to develop and mature. And, despite the tightness of the seal that corks provide, it is relatively easy to extract them using one of a wide array of different designs of corkscrew. Added to this, taking the cork out has become a valued part of the tradition of wine. It may sound silly, but there's something special about uncorking a bottle.

CORK'S ACHILLES' HEEL

But before you begin to wonder whether this chapter is actually an "advertorial" paid for by the cork industry, let me try to put things into perspective. Cork has an Achilles' heel. As a natural substance it is variable, and is prone to failure. Most significantly, it harbors a contaminant that is able to spoil wine at fantastically low doses. Meet TCA, curse of the wine industry. TCA is the commonly used abbreviation for a chemical called 2,4,6-trichloroanisole. The dirty secret of the wine trade is that around one in 20 bottles of wine is ruined as soon as it is bottled by this cork taint, which is the name for when a wine takes on a musty odor. The main culprit is TCA present in some corks, although recently other related anisoles have also been implicated in cases of musty taints. In extreme cases it's hard to miss a corked wine because the mustiness can sometimes be overpowering. In other situations the taint is subtler, reducing the fruitiness of the wine, giving it a subdued aroma, usually with a faint whiff of damp cardboard or old cellars in the background.

The problem with TCA is that it is incredibly potent, and so most people can detect it at concentrations as low as 5 parts per trillion (ppt, the same unit as nanograms per liter), and some are even more sensitive. This makes it hard to eradicate. To give you a better idea of this figure, it's equivalent to one second in 64 centuries. Where good data has been collected, the frequency of cork taint hovers around 2–5% of bottles sealed this way, a rather contested figure that we will address later.

TCA: ITS ORIGINS

Where does TCA come from? It's a compound produced primarily by interaction between microbial metabolites and chlorine in the environment. The use of chlorine in washing steps in cork production was thought to contribute to this, but now that chlorine-based products have been replaced by alternatives, such as hydrogen peroxide, cork taint is still with us, suggesting that an exogenous chlorine source may not be needed. In fact, in a study published in the *Wine Industry Journal* in 1987, some researchers from Australian wine company Southcorp analyzed cork trees *in situ* from four regions of Portugal. They detected TCA in 58 out of 120 trees analyzed. Microbes such as mold-forming fungi live in the small pores (called lenticels), which run throughout cork bark. The lenticels are areas of the cork where cells have divided faster than elsewhere, forming a looser structure that allows air through this otherwise impermeable barrier. They can be seen in corks as darker, colored lines or imperfections. In addition, the processing steps used in making corks from sheets of barks may encourage fungal growth and thus TCA production. Chloroanisoles can also be produced in the absence of microbes. All that is needed are the phenolic precursors and a chlorine source. It is a complicated subject, but the message here is that TCA is endemic to cork.

It needs to be emphasized that TCA isn't confined to corks, nor is it the only compound responsible for musty aromas. Musty off-odors are a major problem in the food industry. Chloroanisoles other than TCA are also potential contaminants, especially TeCA (2,3,4,6-tetrachoroanisole), which is detectable in wine at concentrations of 10 ng/liter. A 2004 study by Pascal Chatonnet and colleagues identified a further potential musty contaminant, 2,4,6-tribromoanisole (TBA). This causes musty off-odors in wine at concentrations of 4 ng/liter, and is formed from its precursor TBP (tribromophenol). TBP is used as a pesticide inside buildings, and barrels, corks, and plastics are all susceptible to TBA contamination from the environment in situations where TBP has been used. Old wooden structures are especially prone. In support of this hypothesis, Chatonnet cites the results from the analysis of wines carried out in Canada by the Liquor Control Board of Ontario (a monopoly supplier owned by the provincial government) on wines it intends to list. In 2002, 2,400 wines were tested. Of those that were considered to have musty taint, only 49% had significant levels of TCA (>2 ng/liter). Other chloroanisoles or TBA may have affected the other 51% of tainted bottles. Because these weren't tested for, we don't know how much influence they had. Barrels can also be a source of musty taint, although there is some heated debate about just how much contamination of barrels occurs. Cooperages claim it is a much lower rate than those offering barrel-screening services.

Several wineries have had problems with TCA or TBA contamination of their premises, resulting


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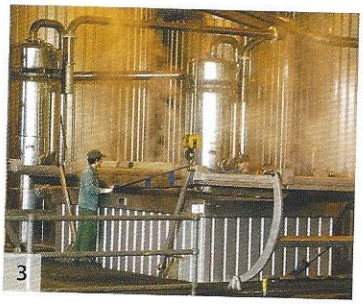
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1 A freshly harvested cork oak. This is one of the few trees you can strip the bark from without killing it.

2 Planks of harvested cork bark are bundled together, ready for processing.

3 The cork planks are then boiled to soften them and wash away impurities.

4 A strip of bark with corks punched out of it.

5 High-grade corks, hand-selected. These will be very expensive, in excess of €1 a piece.

6 A soak test of corks being conducted by a winery, in a bid to identify any tainted batches before they are used.

7 Corks from some high-end Bordeaux wines. While Australia and New Zealand have almost entirely shifted to screw cap for their wines, leading European bottles are still cork-sealed, with very few exceptions.

8 Diam closures, made from cork particles, which are now being used even on high-end wines.

9 At Nomacorc's head office in Zebulon, North Carolina, a range of prototypes are on show. The current Select Series Nomacorcs are quite different to the early incarnations of this successful wine closure.

10 This screw-capped wine is actually from 1977, and it's a Clare Valley Riesling made by Riverina College students. The wine had survived beautifully.

in large volumes of wines suffering from low-level musty taint. Musty taint has also been identified in wine with barrels as the source. But all the indicators are that the vast majority of TCA taint is down to the cork, because in large competitions, such as the International Wine Challenge where in excess of 20,000 bottles are opened and tasted, with very few exceptions all the bottles displaying musty taint are sealed with natural cork.

THE PREVALENCE OF CORK TAINT

How common is cork taint? Each year, the International Wine Challenge is held in London. An enormous number of bottles are opened and tasted systematically by panels made up largely of experienced tasters. Although a tally of cork-tainted bottles has been kept in previous years—in 2001 it was 6% and in 2002 it was 4.6%—in 2003 a "super juror" verified all cases of suspected mustiness as cork taint. The results were that of 11,033 bottles sealed with natural corks, 4.9% were considered to be corked. A further 2.79% were faulty for other reasons. This figure tallies well with results from other surveys. Starting from 2005 onward there was a dedicated faults clinic overseen by Sam Harrop, an expert on wine faults. Over the five years from 2006–10 the average rate of cork taint was 2.8% (individual years: 2.8%, 3.3%, 3%, 3.2%, 1.9%). The weakness of this sort of sampling is that it is likely either to produce false positives, or that low-level TCA contamination will be missed in some cases. Although there is no chemical analysis of bottles judged to be affected, the scale of the sampling is impressive enough to mean that these are useful results, and most wine-trade tasters are pretty good at spotting cork taint. Influential U.S. publication *The Wine Spectator* keeps a tally of corked wines. *Spectator* taster James Laube reported that of the 3,269 Californian wines tasted in *The Wine Spectator* office in 2012, 3.7% were corked. He adds that this is the lowest percentage seen yet, down from 3.8% in 2011 and a high of 9.5% in 2007. According to judge Andrew Jefford, in the 2012 *Decanter* World Wine Awards, some 3.3% of the 14,120 entries were dismissed as being spoiled by TCA. However, 10% of those wines turned out to be either screw-capped or not stoppered with cork, so there may have been some false positives. Judges can sometimes detect cork taint where there is none, or confuse other faults with cork taint.

OTHER ISSUES RELATING TO CORK PERFORMANCE

IS CORK A NEUTRAL CLOSURE?

Are corks neutral in contact with wine? During the cork-manufacture process there are steps such as seasoning, boiling, and stabilizing the cork planks, which are designed to remove various tannic and phenolic compounds, rendering the cork as neutral as possible. The cork cells are relatively inert, but it is likely that the cork is not completely neutral and will interact with the wine chemically, albeit to a rather limited extent, for example, by releasing phenolics into the wine. The process of "flavor scalping," where packaging absorbs aroma components, is a problem in the food industry. Aware from studies that TCA could be absorbed from the wine by the cork, scientists at AWRI investigated potential flavor scalping of aromatic wine components by a range of closure types. The wine used was the same as in the AWRI closure trial, a 1999 Semillon, spiked with the flavor compounds they wanted to study. Closure performance was compared with that of the same wine in a sealed glass ampoule. After two years, the concentrations of many of the flavor compounds had changed significantly, partly through absorption by the closures but also through chemical modification independent of closure. Screw caps didn't absorb any flavor compounds, performing similarly to the sealed glass ampoules. The corks, technical corks, and synthetic closures absorbed relatively non-polar volatile compounds, while the more polar compounds weren't absorbed by any closures. Of these closures, technical corks absorbed a little more than the natural corks, and synthetics absorbed a lot more than either. The conclusion was that synthetic corks are responsible for considerable flavor scalping, and even natural corks are capable of absorbing certain wine aroma components in limited amounts.

SOLVING THE PROBLEM OF CORK TAINT

There are three strategies for combating cork taint. First, eradicate TCA from natural corks, curing the cause of the taint, and rescuing the cork from an otherwise gloomy future. The

second is to manufacture synthetic, taint-free corks from alternative materials such as plastic, thus allowing wineries to keep their current bottling lines and consumers their corkscrews. The third, which is a little more radical, is to ditch the concept of corks altogether and turn to different forms of closure, such as screw caps.

THE KEY PROPERTY OF CLOSURES: OXYGEN TRANSMISSION

It was only when wine producers began exploring alternatives to cork that discussion began about the technical requirements of wine-bottle closures. Beginning with the crucial question, one for which we don't yet have a clear answer: what would an ideal closure look like in terms of performance? Results from comparative closure studies show that perhaps the most important property of closures is their level of oxygen transmission. Do we want our closure to give a completely hermetic (airtight) seal that doesn't allow any oxygen transmission at all? That is, would a sealed glass ampoule be the perfect closure? Or do we want some oxygen transmission? If the answer is yes, then how much?

Over the last few years there has been a change in thinking in the closures field. It concerns the old notion of the closure "sealing" the bottle. It used to be thought that the better the seal, the better the closure. To a degree that is true. We want to keep wine in the bottle, and we want to keep air out, hence "closure." The idea that the cork allows the wine to "breathe" is patently false. If oxygen were able to permeate the cork freely, the wine would oxidize rapidly. But if we are to extrapolate heroically the notion that the better the seal, the better the closure, we'd end up at the position that maintains that a perfect closure would be one which seals hermetically, with no gas transmission at all. In fact, advocates of screw caps frequently cite the writings of the late Émile Peynaud, who stated in *Knowing and Making Wine* that, "It is the opposite of oxidation, a process of reduction, or asphyxia by which wine develops in the bottle," or Pascal Ribéreau-Gayon, who in the *Handbook of Enology* asserts that, "Reactions that take place in bottled wine do not require oxygen." But another celebrated French wine scientist, the late Jules Chauvet, had this to say on the subject of closures:

"I believe that no one can ever replace natural cork, at least not currently. Cork is porous, enabling the realization of equilibrium of oxidation-reduction in the bottle. If you want to bottle a wine and drink it 15 days later, the closure has no importance at all. But for wines that are kept for a few months or a few years, you must use a cork, and a good cork ... We did an experiment in which we sealed some wine bottles with cork and some with ground-glass stoppers. We noticed that three months later the wine sealed by glass had a better appearance but it was already reduced. The cork-sealed wine was still ailing from its 'bottling sickness,' and was still a little oxidized. Later on we saw the cork-sealed wine improve and the glass-sealed one get worse. The latter became undrinkable. We are sure that a micro-exchange of oxygen is needed to induce an equilibrium that allows a light and pleasant aging."
Jules Chauvet, interviewed by Hans-Ulrich Kesselring in *Le Vin en Question*.

Most people would now agree that a degree of oxygen transmission is needed for the successful development of wines in bottle. "The point we've been making for a few years now is that it is possible to use different levels of oxygen—introduced into the wine either at bottling or post-bottling—in a creative way, to manage the development of the wine so it is at its optimum when it is consumed," says the Australian Wine Research Institute's Peter Godden. "I don't think zero permeation is ideal for many, if any, wines. I wouldn't use such a closure to seal my wines. But this is perhaps missing the point. Variable levels of oxygen ingress will create different wines. This is the key point from our closure trial. We took one wine and bottled it with 14 closures. Since then we have taken one wine and bottled it with various numbers of closures. You get different wines, and they look different after as little as three to six months. They are not all heading toward the same endpoint. They are going off in different tangents. We are past the question of whether or not the wine needs oxygen."

So why is some oxygen transmission by the closure necessary? There are two possible scenarios to explain the process of wine aging and the influence of the closure on this development.

First, it may well be that oxygen transmission isn't needed for a wine to develop, and that a wine will evolve in a pleasing way sealed hermetically. In this scenario, oxygen transmission is needed solely to avoid problems with reduction (caused by volatile sulfur compounds, see Chapter 15).

In the second scenario, wines will age in the total absence of oxygen, but in a way that we don't really like. In this scenario, for *successful* aging, some oxygen transmission is needed, not just to avoid reduction, but also to facilitate the complex chemical transitions needed to result in a wine aging to an optimal outcome.

But, as Godden points out, it is clear that the level of oxygen transmission will adjust the rate of aging, and it likely will also adjust the trajectory of aging. Therefore, a wine sealed with a very low oxygen-transmission closure might end up in a different place—never reaching the same destination—as one aged under cork in such a way that we know and appreciate. In discussions of desired closure performance, we need to distinguish between two types of wine. On the one hand there are wines destined for early consumption, which make up the vast majority of wines produced these days. They need to drink well on release, and hold their quality for as long as it takes them to get through the supply chain. On the other hand are fine wines that are destined for aging. In some cases, the expectation is that these wines will improve in bottle for many years, and then hold this quality for perhaps as long again. In other cases, the wines aren't expected to improve dramatically, but they are supposed to retain drinkability for several years as they loiter on restaurant wine lists or in consumers' cellars. The closure requirements will differ for these different types of wines.

Thus we arrive at a slightly more nuanced pair of questions. What do we want from an alternative closure to ensure successful wine aging for fine-wine styles, and what is the ideal closure for a short-rotation wine? Then, if we dig a bit deeper, it emerges that red and white wines respond differently to oxygen. With their high phenolic content, red wines can absorb a lot more oxygen than white wines without showing an oxidized character. Indeed, red wines appear to need some limited oxygen exposure during the winemaking process in order to develop optimally. And white wines that are differently treated in their early stages will show different levels of resistance to oxidation. Those that are protected from oxygen exposure all the way from the crusher to the bottle will be more fragile than those that have been exposed to more oxygen during the winemaking process, for example, through deliberate pre-fermentation juice oxidation or barrel fermentation. Add to this the effects of different levels of free sulfur dioxide at bottling and wine pH, and the picture that emerges is that different wines are likely to have different requirements from closures. It seems remarkable that cork has done so well as a one-size-fits-all closure.

To date, the most important closure study has been that of the AWRI whose important closure trial began in 1999. This trial uses a battery of measurements to test oxygen transmission, including detailed sensory analysis and measurement of free and total sulfur-dioxide levels. The study included 14 different closures, including a number of synthetic corks, two different screw caps, two natural corks, and a range of technological corks (such as Amorim's Twin Top® and Sabaté's Altec). Of these, the synthetic corks allowed the most oxygen ingress, with the results that all the wines had oxidized within the first few years. The two corks used in the study showed varying degrees of oxygen transmission, but on average performed better than the synthetics. The Twin Tops® and Altecs provided fairly consistent tight seals, but there were problems with all the cork-based closures in that many of them showed TCA taint. The screw caps provided the tightest seals, but there were reduction problems.

Perhaps the most significant observation at the 63-month time point is that wines sealed with different closures look quite different, and these differences track fairly closely the degree of oxygen ingress, as deduced from the remaining levels of free sulfur dioxide.

Other trials have looked at closure performance. Paulo Lopes and colleagues have studied a range of closures using nondestructive colorimetry, involving an indigo-carmine dye. This dye changes color in contact with oxygen. Currently, synthetic closure manufacturer Nomacorc are partnering with several academic

institutions and other industrial partners to undertake significant oxygen in wine study, based on the use of a luminescence probe. At conferences, Jim Peck of G3 Enterprises has reported other, as yet unpublished data on closure-oxygen transmission based on the use of MOCON measurements. The hope is that soon winemakers will have a better idea of the requirements of various wines in terms of closure-oxygen transmission, and also the actual physical properties of the various alternative closure types.

There is an extra level of complexity here, in that closure OTR is in many cases quite dynamic. When a wine is bottled with a cork there are a number of different phases of oxygen influence. First of all, there is oxygen that is present in the headspace, introduced during the bottling process. Then there is the diffusion of oxygen present actually dissolved in the closure. And then there is the steady state OTR level through the closure. This dynamic exposure to oxygen might be quite important, but it makes discussion of closure OTR very complicated. (This issue of post-bottling oxygen exposure is discussed in detail in Chapter 10.)

Recent (2012) estimates are that screw caps now have more than 10% of the bottled wine market. This total market is estimated to be some 20 billion annually worldwide. Of this, screw caps are now around 2.5 billion, with synthetic corks around 2 billion and natural cork accounting for most of the remainder. This is a dramatic rise from the situation five years ago, when screw caps were estimated to be around 200 million worldwide.

Technical corks are proving to be increasingly important closures for wine bottles, but compared with synthetics, screw caps, and natural cork, they get relatively little coverage, to the point that many people in the trade aren't even familiar with the term "technical cork." It refers to a natural cork-based closure made by combining disks or granules of natural cork to produce an inexpensive closure solution. Their significance is shown by the fact that they now represent around half of the business of Amorim, which is by some distance the world's largest cork company.

The most significant technical cork is the Twin Top®, developed by Amorim (whose products are distributed in the US by its wholly owned subsidiary Portocork) in the mid-1990s. It's a closure that adapts the technology used in Champagne cork production. "Champagne corks are not only an important product for cork companies," says Carlos de Jesus of Amorim, "but also led to the development of the Twin Top®." Cork companies realized that Champagne corks were performing well, with low levels of taint and consistent physical performance. "We asked ourselves how we could transfer this technology to still wine closures and get good results?" reports de Jesus.

The Twin Top® has an agglomerate core sandwiched between two disks of good-quality natural cork. The advantage of having natural cork at both ends of the closure is dual. First, no orientation machine is needed before the cork is applied on the bottling line, and second, the consumer sees nice-looking natural cork when the capsule is removed, and not agglomerate. Launched just in the mid-1990s, the Twin Top® is now the best-selling technical stopper in the world, with sales of 650 million units per year (2012 data). It is usually employed for large volume, price-sensitive wines where the cost of good natural cork would be prohibitive.

While the one-plus-one is the most popular technical cork, it is rapidly being caught up by a new generation of closures known as micro-agglomerates. While the agglomerate portion of the one-plus-one is made up of relatively large particles of cork, giving quite an ugly appearance, micro-agglomerates are made up of much smaller granules and have an altogether more attractive, uniform look. Because the agglomerate portion of the micro-agglos (as they are commonly referred to) is much more attractive, it is not sandwiched between cork disks.

The first micro-agglomerate was the Altec, which, though revolutionary at the time, turned out to be fatally flawed. Introduced in 1995 by French cork company Sabaté, Altec was made of finely ground cork flour glued together with synthetic microspheres to produce a cork-based closure that looked pretty classy and had uniform properties. The synthetic microspheres were needed to provide a degree of elasticity to the Altec. Without them, the closures

would have been too rigid, because of the very small size of the cork granules employed.

The market, dissatisfied at the time with the quality of cheap natural cork and not convinced by the first generation of synthetic corks, endorsed Altec by buying two billion units over the following years. (This is before the screw-cap revolution, which started in Australia in 2000.) But grumbling about the organoleptic impact of Altec soon started. Some people complained of a glue taint. In fact, the problems were caused by a consistent low level of cork taint, caused by the presence of 2,4,6-trichloroanisole at very low levels. What had happened is that the manufacturing process using small granules of cork had averaged out the TCA naturally present in the cork, so that instead of having a few contaminated closures in a batch, every closure was contaminated to a low degree. And unfortunately for Sabaté, this level of TCA was above detection threshold for some tasters. It was a major disaster, and by 2002 sales plummeted.

Sabaté, to its credit, responded well. It looked at ways of cleaning the cork component from any contamination and with the help of the French atomic energy commission it came across a process that actually worked. It involved the use of carbon dioxide in a state known as its critical point. At a particular combination of pressure and temperature, the liquid/gas interface disappears, and you then have a substance that can penetrate like a gas, but clean like a liquid. For carbon dioxide, the critical point is not too hard to achieve: it's 88°F and 73 bars of pressure—a conveniently low temperature, even if the pressure is on the high side. This technique has been used to remove caffeine from coffee and by the perfume industry to extract fragrances.

After trials, the new version of Altec, called Diam, was released commercially in 2005, and Sabaté has since changed its name to Oeneo-Bouchage, after some restructuring. The Diam range has expanded and currently consists of Diam versions 2, 3, 5, 10, and Grand Cru in ascending order of cost and impermeability to oxygen, as well as the Mytik sparkling-wine closure. Oeneo has improved the appearance of the closure by adding a grain effect, to make it look more like natural cork. Diam's great benefit is that it is taint-free, because of the effectiveness of the production process. However, because of the added cost of the supercritical carbon dioxide treatment, Diam costs a little more than some of the other technical corks on the market, and is really aiming to compete not with synthetic corks and screw caps (which is the target market for most technical corks), but with natural cork.

"The price of Diam is €50–300 [$65–400] per 1,000," says Bruno de Saizieu, marketing director with Diam (2012 figures). "Clearly, where we play is against natural cork. Our market is more and more for high-quality wines. We now have the Diam Grand Cru, for wines of €15 [$20] plus. In Burgundy we already have some *grand cru* wines, as well as 50% of the Chablis market." Diam is doing well. "Our increase in sales last year was 20%," says de Saizieu. "I expect the same increase this year." In the U.S., Diam made an agreement for G3 Enterprises to take over all distribution in April 2010.

Following the initial market success of Altec, other cork producers began work on micro-agglomerates, and most now offer them as part of their portfolio. For leading cork manufacturer Amorim, its micro-agglo, called Neutrocork®, has been experiencing rapid growth in sales. "It is now the fastest-growing technical stopper," reports Amorim's de Jesus. He says that sales have grown over the last four years at 20% per year, with a current figure of 410 million units. For the micro-agglo category as a whole, corresponding growth has been 12%. "It's a workhorse in getting wines back to cork from plastic closures," says de Jesus. "It can undercut the synthetic corks by as much as 50%, depending on the market and the quantity." MA Silva's micro-agglomerate is Pearl®, while Corksupply offers the Vapex microextra®.

In conclusion, there now exist several alternative ways of sealing a bottle of wine. Oxygen transmission by these closures seems to be very important in determing the way the wine develops in bottle, but there is still few solid data on what is taking place here, and what sort of levels of oxygen transmission are appropriate for different wine styles. This makes it tricky for winemakers to choose the right closure, from a purely scientific point of view.

WSET Wine Australia Scholarship Trip – "Diverse Australia" March 2013

Closure Debate: Amanda Parker

INTRODUCTION

The debate surrounding closures is one of the most hotly contested wine subjects around the world. Stemming from the widespread issue of cork taint and sporadic oxidation a number of alternatives abound – agglomerate, screwcap, vinolock (glass) and plastic.

Of the 18 billion units, screwcaps are now around 2 billion, with synthetic corks accounting for around 4 billion.[1] While cork still maintains its hold in many markets, countries such as Australia and New Zealand lead the way in adopting srewcap as the preferred type of closure for all quality levels of wine.

Throughout this Wine Australia Study Tour our group had an amazing opportunity to experience the divergent styles of regional Australia. It challenged perceptions that there are generic terms you can use to describe climate and styles associated with Australian wines. Though what was also of great interest, and what stood out, was the passion that many of the winemakers were on sharing their views on closures. So rather than writing on cool climate regions this report researches the debate and looks at the issues surrounding the type of closure selected.

THE AWRI CLOSURE STUDY

The background to this paper begins with our group's first-hand experience of the 1999 scientific study on closures run by the Australian Wine Research Institute (AWRI). A Clare Valley Semillon, fermented and stored in stainless steel tanks, was divided into two batches of 300 and then bottled under 14 different closures. There was an additional 800 bottles closed under screwcap. The wines were then monitored and tested over the course of the 24-month study. There was enough wine to continue the study for up to 10 years.

1999 Semillon Closure Study after 14 years

Peter Godden of the AWRI, who was originally tasked with establishing the study, presented a concise overview of the methodology and the technical results. He also led us on a tasting of wines stored under different closures.

He presented us with five wines to taste blind. The first wine was the freshest, displaying typical lemongrass, hay and citrus characters, though there was a slight reductive note. The second wine had riper fruit character, indicating more development, while the 3rd and 4th wines respectively showed oxidative notes and cork taint.

The 5th wine was outstanding, though very clearly the most developed of the line up. The wine had lovely citrus, ripe stone and tropical fruit. Stony, mineral notes added to the complexity of the wine, which also had a fresh sage oil character. There was great intensity on the nose and palate with extra-ordinarily long length.

When the wines were revealed, we discovered that wines 1 through to 4 were all 2007 Semillon's bottled under different closures and formed part of a continuing closure trial. Wine 1, which was identified as the freshest and most youthful, had been closed under screwcap, while the second wine displaying riper fruit

[1] "Getting Closure", Dr Jamie Goode The World of Fine Wine Issue 28 2010 pg: 62

character was under a technical cork (also known as one-plus-ones: a cylinder of agglomerate cork with a disc of natural cork at each end).

Wines 3 & 4 both demonstrated noticeable oxidation and cork taint and been bottled under cork. The final wine, which had wow'd many within the group, and noted as outstanding, was in fact from the original 1999 study, a Semillon bottled under screwcap.

The Pitfalls of Screwcaps

One of the key issues the AWRI study was able to examine was the reductive nature of some wines. Ensuing research looked into the impact of different oxygen levels to determine why these characters occur after bottling.

Reductive characters are often associated with wine bottled under screwcap. The study found that it was not the closure that was the cause of the reductive characters, but a number of factors including:

- wine composition
- levels of oxygen at bottling (including the oxygen contained in the closure itself)
- storage conditions
- nature of the closure and the level of oxygen ingress

Wines made in highly anaerobic conditions bottled with low Oxygen Transfer Rate (OTR) closures have a greater propensity to develop reductive characters ***IF*** the factors that contribute to reductivity, as outlined above, are present.

When the AWRI team looked at a case study for oxygen picked up during the winemaking process, 69% of total oxygen contained in wine was found in the headspace and hence the key contributing factor to reduction.

While this can be an issue, there is a solution. With the increased understanding of volatile sulphur compounds, the winemaker has the ability to adjust and prepare the wine differently prior to bottling to avoid reduction occurring in the wine post bottling.

Sporadic Oxidation

The move to screwcaps is often justified in the press by the high incidence TCA (2-4-6-trichloranisole). However, having researched the issue further, one of the major concerns wine makers have is not just the high incidence of cork taint, but sporadic oxidation.

Sporadic oxidation is often also, but incorrectly termed, random oxidation. As the definition in James Halliday's Wine Companion points out, if random oxidation was in fact random, you would not be able to point to a cause. Sporadic is more appropriate as the cause can be identified, however there is no particular pattern in occurrence.[2]

What the AWRI study clearly demonstrated was that 14 different closures resulted in 14 different wines – the differences were purely down to varying development rates. Our tasting of the five Sémillon wines certainly demonstrated that even in a controlled study, sporadic oxidation was evident particularly under a cork closure.

FROM THEORY TO REALITY

Winemaker Wayne Stehbens has been the driving force behind one of Australia's leading Coonawarra Estates for 35 years, Katnook Estate. The estate's entry and mid-level wines are bottled under screwcap, their iconic wines, Odyssey Coonawarra Cabernet Sauvignon and Prodigy Shiraz are both bottled under cork. Speaking with Stehbens, after a fabulous dinner at Pipers of Penola in the Coonawarra, his view on the closure debate was simple: left up to him all wines would be bottled under screwcap.

His argument, a winemaker and his team make decisions at every point in the grapes development, and its transformation from juice to wine – to ensure the best quality of wine is produced. Consciously choosing to put a cork in the bottle, then introduces risk, bringing with it unknown variability that can impact negatively on the final product being enjoyed by consumers.

[2] James Halliday, Australian Wine Companion Website: http://www.winecompanion.com.au/wine-essentials/wine-education/wine-encyclopedia/encyclopedia-a-to-z/rack-and-return-to-rutherglen/random-oxidation

Bottling Katnook Estate's premium brands under cork is a direction set out by the parent company, the Freixenet Group, based in Spain. One of the key export markets also happens to be the US, where consumers don't associate screwcaps with quality wines. John Ritchie Rymill, of Rymill another leading Coonawarra producer agreed. Similarly Rymill's premium wines are bottled under cork, while entry-level use screwcap. "It's all about market appeal and positioning" he noted.

Dr Jamie Goode's "Getting Closure" article which was published in The World of Fine Wine Issue 28, was an excellent read for those interested in the debate. However, understandably for Australian winemakers it goes beyond an interesting read, and raises issues for the marketing of Australian wines overseas.

Iain Riggs, Managing Director and Chief Wine Maker of Brokenwood, a Hunter Valley estate, wrote a response to Goode's article, raising a point particularly pertinent for Australian wine producers. Many participants want to shift and reposition the perception of Australian wine, away from $10 "critter creatures" and increase awareness of to quality, small production, terroir driven styles. However, his argument is that it is impossible to convincingly convey the regional diversity story when wines older than 10 years (under cork) are out of condition.[3]

Riggs' second point questions whether it is "arrogance" to knowingly sell a product that has an inherent degree of failure. He quotes that sporadic oxidation due to cork robbed Brokenwood of up to 50% production when they released their 1999 Reserve Semillon at 5 years of age.[4]

General responses from consumers when researching this paper, found that when faced with a corked wine, the fault is usually seen independently to the wine. The failure rates are spread over numerous customers so often the incident is passed over or unreported – it's often considered merely disappointing. It's rare that the estate's reputation is tarnished as a result of the fault. However, sub-consciously the negative experience may well influence buying behavior in the future, particularly amongst less educated wine buyers. In circumstances where one customer experiences a larger batch of tainted wine, for example an 'on-trade client, significant reputational impact and brand aversion are possible outcomes.

At the commencement of our Regional Chardonnay Masterclass, led by David Bicknell of Oakridge Wines, Yarra Valley said, "There is no other industry that would tolerate a failure of up to 7% for any of its products. They would simply go out of business".

BLANKET OR TAILORED APPROACH

It's such a diverse topic, every winemaker you speak to has a different point of view and a very convincing argument to support their position. For some, the closure decision should be driven not only by drinking window, but by variety. For whites such as Semillon and Riesling, where the oxygen contained within the bottle is enough to help it develop, screwcap is the best choice. While wines based on red grapes such as Shiraz or Cabernet, where tannins naturally provide higher protection against oxidation, many believe that cork offers a better solution to evolution.

EXPORT MARKETS

With countries like China representing a huge opportunity for producers that can carry wines across every quality spectrum, there are very lucrative opportunities for exports. Currently second behind France, Australia achieves the highest value with the group of top 10 importing countries.[5]

However, despite the knowledge behind cork's variability, preferences for cork still dominate. Australia's radio network, ABC, declared, "In China, though no research exists, experts reckon that close to 100 percent of consumers want a cork in their bottle."[6]

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[3] "What Closure" Iain Riggs, Managing Director / Chief Winemaker, Brokenwood Wines, The World of Fine Wine, Issue 30 pg 29

[4] "What Closure" Iain Riggs, Managing Director / Chief Winemaker, Brokenwood Wines, The World of Fine Wine, Issue 30 pg 29

[5] Wine Australia Website: http://www.wineaustralia.com/en/Market%20Development/Market%20Programs/China.aspx

[6] http://www.foodnews.co.nz/29135/winemakers-warned-chinese-consider-screwcaps-cheapen-wine-value/

For those brands wishing to secure a share of these markets, along with Europe and the US, cork remains king, particularly for premium brands.

CONCLUSIONS

Despite the passion that many of the winemakers we met over the course of the study tour have for the use of screwcaps what seems evident is that there are a range of solutions for a range of wines based on quality and export markets. These decisions need to be commercial, but commercial decisions are usually market-led decisions, responding to consumer wants and expectations.

In essence, many believe that the more money you spend, the more ritual you want for your buck. Spending $50 or more on a nice bottle of Australian, French or Spanish wine, many people feel slightly cheated if they open the wine the same way they open a bottle of Coke. The crack of a screw top is not the same as the pop of a wine cork."[7]

The Australian consumer in many respects has been well trained to appreciate the ease of the screwcap. However the debate between the emotional attachments associated with a popping cork and the potential inconsistency in a product, that is a deeply personal one for the wine maker, is expected to continue

This research paper was an interesting start to what could provide hours of more study. It has instilled a drive to ensure that at every opportunity, every winemaker that is met, a mandatory question will be posed on this topic. It will be more than just an information gathering exercise, but a window into a winemaker's passion and reasoning behind their choices. It will also be a great opportunity for a student of wine to challenge information already garnered and continue to compare and contrast, what often can be a polarizing debate.

[7] http://www.bbc.com/news/magazine-22909428 16th June 2013

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