Cork Closures and Quality Control at Yalumba Wines

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Introduction
Closures for wine bottles, and in particular corks, represent a significant cost to any winery. This cost arises not only through the cost of the individual closure, but also the procedures employed to scrutinise their quality, and the potential costs of product loss in the event of their failure. Closure problems such as wine taint or leakage are widespread.

A wine bottle closure must fulfil the following basic functions:
1. Seal the bottle: to stop the wine leaking out and stop air getting in.
2. Be flavour neutral: neither taint the wine with flavours originating from the treatment or the cork (whether they be of fungal origin such as 2,4,6-trichloroanisole (TCA), or derived from the wood), nor absorb wine flavours.
3. Perform well in the hands of the consumer: it must be long-lasting and, in the case of a cork closure, have the appropriate appearance and extraction characteristics, and not contribute detritus to the product.

The staff at Yalumba believe the crux of the problem is that corks are purchased by grade, which is based largely on physical appearance. The relationship between the grade and the physical characteristics of a cork is tenuous, and the relationship between these physical characteristics and its performance (the capability to seal, to be flavour neutral and to perform in the customer’s hands) is similarly tenuous.

The aim, therefore, is to ensure that the closure meets the required performance characteristics at a reasonable cost. This is difficult to achieve at times. This paper details the company’s current strategies in pursuing this aim.

Qualification of suppliers
Knowledge of the business capabilities and quality of product of suppliers is pursued through extensive trialling and usage.

It is in the best interests of the company group to ‘qualify’ as many potential suppliers as possible. They receive a preliminary qualification based on estimates of their ability to supply and the professionalism of their overseas suppliers, an impression of their quality aspirations, and various supply considerations such as their proximity to the winery, their supply history, and their ability to form team links with the Quality Assurance (QA) and Purchasing Groups.

Historically, the path to becoming an established supplier has been through the successful submission of trial samples which were subject to long-term performance examination. This method was, however, subject to failure. It caused a massive load on the QA Group, as attempts were made to analyse the data obtained for these long-term evaluations. Often, the length of time required for the analysis meant that the corks were seen as either of marginal or particularly good quality. This is to ensure that a sample of the corks during treatment would not preclude a change of usage, which may be made as a result of the delivery assessment.

Each delivery of a particular lot of corks is regarded as a single batch, which is then subject to the same sampling and assessment regime. The fact that several batches of corks may come from the same shipment of corks is not lost, however, as information is collected detailing the delivery (ex primary supplier), the assessed grading, and the treatment and processing date. The following sampling strategy does not have statistical significance, especially in light of AS 1199 (Standards Australia 1988), however it is considered to give the opportunity to assess the variability of the sample and to detect any defects present at a high level. If any problems are detected in the batch following this non-statistical sampling strategy, further samples are taken according to the protocol outlined in AS 1199 (Standards Australia 1988).

Typically, a sample of 75 corks is drawn from a single lot, which is in turn drawn at random from a batch. From these 75 corks, 10 corks are randomly selected and assessed for the moisture content, physical dimensions, weight and number of growth rings. A II 75 corks are then graded, according to the following 5 categories:

- top – a blemish-free cork;
- reference 1 – a good cork;
- reference 2 – a cork showing minor flaws;
- non-critical – a cork showing flaws which are not expected to cause a failure; and
- critical – a cork which is expected to fail.

A definition of all cork defects and how the degree of defect affects the grading category is included in cork specifications, which are provided to each cork supplier. A non-overall grade for the batch is derived from the grades given to individual corks.

A further 12 corks are drawn from the 75 corks. These 12 corks are soaked in approximately 250 mL Riesling wine for 8 hours. Paired samples of this extract (both neat and diluted 3% in the original base wine) are then tasted blind against the control sample. Taints considered to be grounds for rejection...
include those derived from treatment materials, TCA-type characters, those derived from shipping conditions, and aroma and flavour modification caused by woody or corky flavours. The neat solution is also examined for excessive colour pick-up and cloudiness, and is used to indicate problems with the adhesion of treatment materials. Finally, the moisture, weight and dimensions are used to calculate an apparent density and a dry cork-wood density for each of the measured 10 corks. These calculated parameters, together with the measured parameters, are stored on the company's cork information database.

Monitoring of the performance of products after use

Each batch of wine which has been sealed with the same batch of corks in a 24 hour period is considered unique. Within each batch, 24 samples are drawn as unsealed bottles from the bottling line for post-usage monitoring. Of the 24 samples, 20 are sealed with the cork and 4 are closed with a Stelvin closure, to act as reference samples against which the cork-sealed samples may be assessed.

Of the 20 cork-closed samples, 3 are opened 5 minutes after the insertion of the cork. The force required to extract the corks is noted, as is any tearing in the bottle. Physical deformations such as cuts, creases or turn-ups caused by the corking process are noted.

A further 9 bottles are stored upright at ambient temperature for at least 18 hours to allow expansion of the cork. Three of these 9 are then stored lying down at 3–5°C for 8 hours, a further 3 stored upright at 37°C for 8 hours, and the final 3 stored lying down at 37°C for 8 hours. At the end of the test, each of these samples is examined for wine travel past the cork, extraction force, turning in the bottle, and cuts or creases of the cork caused during insertion.

Of the remaining 12 bottles (4 Stelvin, 8 cork), 4 of the latter are tasted against 2 of the Stelvin samples 2 weeks after bottling. The remaining samples are stored for long-term evaluation, the length of which depends on the style of the wine being assessed.

The data from this post-usage monitoring are collated with the goods inwards testing data, in the cork database.

Where to from here?

The company continually monitors those cork application parameters regarded as important, and to improve those bottling line set-up conditions which are not yet optimal. It is important to achieve vacuum under the cork and this is measured throughout the bottling run. However, the currently-available tools for its measurement are not reliable. Similarly, the vacuum or headspace volume under the cork is critical, and the existing standards are currently under review, with the aim of defining a minimum vacuum for each bottle shape over a range of wine temperatures at filling.

It is also important to allow adequate time for cork recovery before bottles are laid down. One table wine bottling line permits more than 8 minutes before lay-down packing, while the other permits barely 3 minutes. Although most of Yalumba's products are packed in stand-up cartons, premium reds and some commercial table wines are binned in a lay-down configuration. The commercial wines are binned to accommodate possible alternative label usage, and the premium reds for bottle maturation. Thus, wines with the highest and others with the lowest quality corks, some of which have been given 8 minutes for recovery, others less than 3 minutes, are laid down.

The optimum relationship between bottle bore size, compression diameter and cork diameter still remains unknown. Previously, 24 mm corks were used in the Stein bore and 25 mm on imported metric bores, based on published recommendations that the cork diameter should be 6–6.5 mm larger than the bottle neck bore. The apparently successful conversion to the CETIE bore and the retention of 24 mm corks poses the question 'was the wrong size cork used in the metric bore all along'? Further, why has there been so little technical work published on this relationship either here in Australia or in Europe?

There are two areas where the industry is believed to be particularly vulnerable. The first, which is a minefield of conflicting reports, is flavour modification. Given that modification of the flavour of wines by cork-derived taint is perceived to be caused by corkwood flavours (believed to a function of the forest), by cork treatments, and by the residual effects of a plethora of cork washes, the lack of published technical work in this area is considered unacceptable.

The other area in which too many unknowns remain is the relationship between cork quality (visual defects) and the effectiveness of the cork in sealing the bottle. Although Portuguese work and ISO Standard 9727 (International Organisation for Standardisation 1991) detail a series of physical test methods which can characterise an individual cork, the company is unaware of any published information that reports the relationship between the grade of a batch of corks, their measured physical characteristics, and their ultimate performance in the bottle. This is an area of vital interest, particularly as the Australian dollar moves against the currencies of the cork-producing countries and the financial incentive to use lower grade corks becomes stronger.

The issue of physical quality is of particular importance to the closures used in sparkling wines. In this instance the equation is further complicated by the use of a two-part cork with a component of natural cork wood and a component of agglomerate cork. The mechanisms by which the seal is provided, and the effect of the various grades of cork on this sealing process, are largely unknown. If the agglomerate body of the cork provides the sealing mechanism, the insertion depth must have a significant effect on the effectiveness of the seal. Conversely, if the natural cork discs provide the seal, insertion depth is not critical for sealing, but it remains important to the extraction torque.

Simply, more needs to be known of the science of how corks work.

What should we as an industry do?

Given that more knowledge of the science of the cork closure is required, these problems should be tackled on several fronts. A wineries are the end user of the corks, they are best placed to pass critical comment regarding the commercial performance of the corks. Therefore, individual users need to put in place systems that quantify flavour modification and the performance of cork products.

There is no advantage afforded to any company if another company has problems, and so an opportunity exists to use this individually-gained information to establish a collective database of cork performance history for the Australian industry. The Winegrowers' Federation of Australia (WFA) or The Australian Wine Research Institute could play a role in the maintenance of this database.

Additionally, more research into both flavour modification and of sealing performance of corks must be encouraged.

The following list details some of the questions that need answering regarding flavour modification:

1. What are the compounds that produce wood-like flavours?
in corks, and can they be sealed within the cork by polymeric coatings?
2. Where is the site of the origin of taint compounds on a cork, and what mechanisms transport them through or around the cork?
3. What are the flavour effects of the various surface treatments used to coat corks?
4. What are the flavour effects of the various washes used to bleach and/or wash corks?
and lastly and most significantly:
5. What causes taint? Is it an artefact of the cork preparation process, a modification of an artificially synthesised chemical that is ubiquitous in the cork forests of the world, or is it a natural chemical produced by the cork tree?

The aspect of performance most in need of research is the relationship between the physical characteristics of a cork (such as density and elasticity) and the various defects which

are used as grading criteria, and its sealing properties.

While there is no doubt that such research should be locally supported through bodies such as the Cooperative Research Centre for Viticulture, it is believed that the Australian industry must gain access to the substantial store of relevant information that is generated in Europe. Our track record in this area is not good, and so determined steps must be taken at the peak industry level to improve. At a starting step, it is proposed that the WFA becomes a member of CTCOR.

References