

## Cork winning the war against TCA

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When I took up my post in 2000 as head of R&D at Amorim, the fight against the 2,4,6-trichloroanisole (TCA) was the company's highest priority. And on my first visit to Australia in that same year, winemakers mainly wanted to speak about one issue: TCA and what we were doing to fix it.

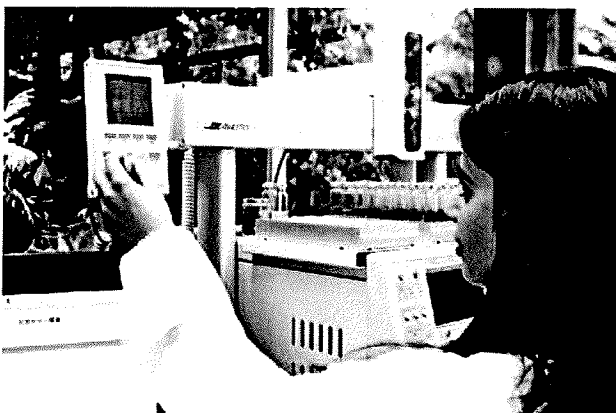
On my most recent trip to Australia and New Zealand in August this year, I found the 'closure debate', as we now call it, had shifted somewhat. Winemakers and wine industry figures were still interested in TCA but also in many other issues, including the gas permeability of corks, random oxidation, the role of the closure in wine development and even the emergence of reductive characters under screw cap.

The closure debate has never been as vigorous as it is today. Many research questions are under discussion or investigation and, for the first time in any practical sense, winemakers have a wide range of closures to choose from.

Given the long and successful association between cork and wine, our company is confident that further research, a strong commitment to quality control and continual product improvement will demonstrate that natural cork, although steeped in centuries-old tradition, is adaptable and more than able to meet the technical demands of a modern wine industry.

For evidence of this, one must point to what Amorim has achieved in the last five years in the fight against TCA and what the cork industry as a whole has achieved in producing cleaner, more reliable corks over the same period.

In 2000, Amorim's objective was to develop an anti-TCA strategy that comprehensively attacked TCA throughout the production chain. Because we were dealing with a ubiquitous environmental contaminant, we felt we could not rely on a single technique, as others had done previously. Our strategy in production combines prevention and cure, plus a little post-production advice on cork handling and bottling, as it was clear that some contamination cases are not due to the cork.



At Amorim, nine gas chromatography machines analyse 12,000 corks soaks a month.

On the preventative side, Amorim introduced tighter controls over the sourcing and storage of raw corkwood, including procedures for tracing 'problem batches' back to the forest. In preparing the corkwood for punching, we invested heavily in new washing technologies, including a completely revamped cork boiling process that removes volatile compounds such as TCA and minimises the risk of mould growth that could lead to the formation of TCA.

Fundamental amongst the preventative measures was the introduction of large-scale sampling for chemical analysis. With nine state-of-the-art gas chromatographs now operating in our laboratories, Amorim today routinely tests 12,000 cork soak samples a month for TCA in the low parts per trillion range.

The significance of this testing cannot be overstated. Thorough chemical analysis as the mainstay of a quality control regime is a revolutionary advance for a traditional industry such as cork.

On the curative side, Amorim developed ROSA, a proprietary steam-treatment process for the decontamination of cork granules, discs and natural cork stoppers – and, more recently, ROSA Evolution, a refinement of ROSA specifically designed for the decontamination of natural whole cork stoppers.

Amorim's internal research established that ROSA is highly effective against TCA in the cork granules used to make technical corks such as Twin Top® and Neutrocork®. Our tests found that a sample of granules contaminated with TCA to an average concentration of 15 parts per trillion (ppt) would emerge from ROSA treatment with an average TCA concentration of 3 ppt, a reduction of 80% in the releasable fraction of the contaminant. These results were later confirmed by independent and respected wine laboratories in Germany, UK and Australia, with all test results showing average reductions of between 69–80%.

Further independent testing by Chatonnet (2004) confirmed similar reductions for cork discs (also used in technical corks) and natural cork stoppers.

There is some debate about the sensory impact of TCA concentrations in the low parts per trillion range but the salient point is not so much the average concentration following ROSA treatment (although the results are commercially very acceptable) but the magnitude of the reduction arising from treatment.

Amorim needed to know if TCA reductions of up to 80% in the cork were effective against TCA in the wine, so we conducted bottling experiments using natural cork stoppers, some treated with ROSA and some untreated. Bottles were opened progressively over a four-year period and the wine tested for TCA. Among the bottles with untreated corks, 19% of bottles had TCA levels higher than 3ppt and 4% were higher than 9ppt. Among the bottles with the ROSA-treated corks, none had a TCA concentration higher than 3ppt and most were at or below the existing limit of detection of 0.5ppt.

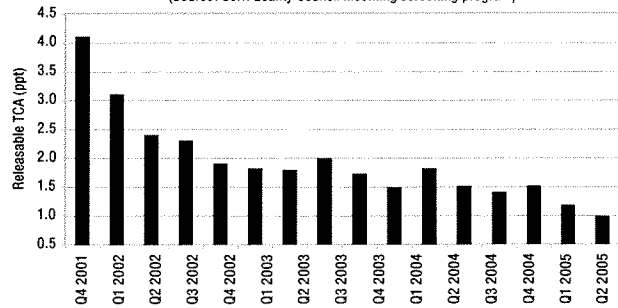
Today, all Amorim granules, discs and natural cork stoppers are screened for TCA using gas chromatographs and all granules are ROSA-treated. Cork lots (containing either discs or stoppers) that test positive for TCA are ROSA-treated. ROSA Evolution is at an industrial prototype stage and, in the near future, we will be using this process to treat all natural corks.

As the largest producer of wine corks, Amorim has taken great strides in its fight against TCA. But we will not promise perfection, because it is unlikely that any producer could ever completely eliminate a contaminant as common in food, wine and packaging as TCA. What we can promise is that musty taints arising from TCA contamination in our corks are diminishing rapidly in frequency and intensity to the point where the risk to wine is minimal.

Amorim is not alone and it appears that other cork manufacturers are also improving their quality control procedures. The result is that the corks produced today are far less likely to be affected by TCA than those produced as recently as 2001.

The US-based Cork Quality Council, of which Amorim is a member, collates TCA analyses in shipments of natural corks produced by CQC members. In the period spanning late 2001 to late 2005, more than 400 million corks were screened by gas chromatography for TCA concentration. Over that period (see chart below and Hervé 2006), the average TCA concentration in these shipments has dropped from over 4ppt to about 1ppt, a better than 75% decline in TCA levels.

TCA Average Scores – Group Cork Soaks  
(Source: Cork Quality Council incoming screening program)



Average levels of releasable TCA have fallen by over 75% in the past five years.

Little public attention has been paid to what is a tremendous success story for cork. The achievements of the last few years have been remarkable and it is a strong message to winemakers that natural cork is a better choice today than ever.

As to the cork-related incidence of TCA contamination in wine, the estimates vary widely, as they have always done. Proponents of alternative closures tend to quote anecdotal evidence suggesting incidences as high as 5% but these estimates are largely unsupported by objective analysis. The following observation should be noted: each year, the Australian Wine and Brandy Corporation's (AWBC) export appraisal panel evaluates sensorily more than 10,000 Australian wines and rejects wines with a detectable wine fault, including mustiness.

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For some years, this eminent panel's rejection rate for all wine faults, not just TCA, has remained between 1 and 2%. While individual wines or wineries may be more susceptible than others to TCA contamination, it is hard to imagine how an industry-wide TCA incidence as high as 5% could go unnoticed by the AWBC.

Perhaps one reason for the lack of commentary on the decline in cork-related TCA is that other issues have claimed industry attention. Of these, one of the most interesting from a research viewpoint is the role of the closure in the development of wine during cellaring.

Research in this field is progressing quickly but it is already known that different closures are differently permeable to oxygen and that these small amounts of oxygen can have a significant effect on the development of the wine over time. A five-year study by Skouroumounis *et al.* 2005 found that white wines under screw-cap had a tendency to develop a rubbery or reduced aroma while those under synthetic stoppers tended to brown and oxidise excessively. The wines sealed under cork displayed "relatively high fruit intensity" and "negligible reduced characters". The strong indication is that screw-caps allow too little oxygen into the wine, while synthetic stoppers allow too much oxygen.

Recent research by the University of Bordeaux supported by Amorim (Lopes *et al.* 2006) confirmed that screw-caps in general had relatively low oxygen ingress rates, compared with natural cork stoppers, while synthetic stoppers had relatively high rates of oxygen ingress.

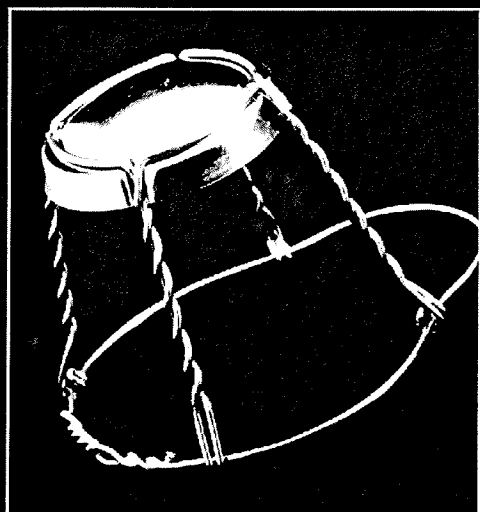
This is an area of research that Amorim is actively pursuing today and we hope to understand more about the mechanisms of oxygen ingress in the near future. We have also asked the University of Bordeaux to investigate the nature, extent and impact of any chemical reactions between cork stoppers and wine that may modify wine flavour during development.

Our company accepts that research into these and other closure-related issues that might lead to improved technology is a standing challenge for the cork industry. We are happy to accept the challenge.

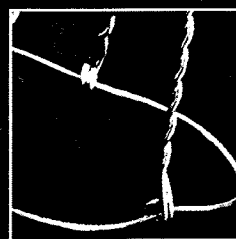
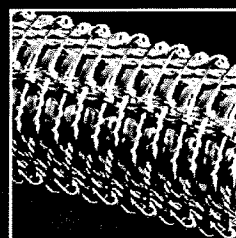
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