Protective gas use in bottling lines

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Introduction
This paper will address the topic of protective gas usage in bottling covering the areas of wine in storage and transfer for bottling operations, and specifically some of Beringer Blass’s activities. The key objectives considered are monitoring and managing dissolved gases, dissolved oxygen primarily, and carbon dioxide in the wine-bottling and handling process leading up to and during the bottling operations.

Oxygen content in wine is monitored to minimise the possibility of wine quality degradation during the transfer or preparation of wine to bottle. To neglect the management of dissolved oxygen (DO) through these processes can cause noticeable and considerable changes in the quality of wine. In a sense these activities are understood, but this paper will specifically cover how we address these activities within the Vinpac and Beringer Blass locations, using examples from both locations involving tanker loading and unloading, wine in tank, pre-bottling and bottling. Additionally, I will discuss some of the tools used in the process of DO management primarily, as well as monitoring CO₂, and give some ideas on future directions.

DO and CO₂ management of wines during transfer and in tank
During wine transfer, for filtration process, a wine can be monitored for DO to ensure that minimal oxygen pick-up is achieved. This can be done with the aid of either fixed or movable snap-lock or turret fittings, allowing a DO meter attachment to provide a flow of liquid through the monitoring device. We have recently introduced and trialed this particular piece of equipment at one of our sites and the results have so far been successful. Our DO monitoring equipment has a turret fitting with a male-female connector allowing it to be moved within the winery and used to check a process at any activity.

The same procedure can be employed for CO₂ monitoring, and although we have tried this in only one instance, it was also successful. Other handling processes that we monitor are wine tanker loading and unloading, not only at Vinpac, but also throughout the Beringer Blass activities where wines are continually being moved from our winemaking sites to our bottling facilities either at M erbein or at Yellaglen. The initial levels of DO are monitored in the holding tank prior to loading, and subject to the DO levels, we sparge with nitrogen and again check the DO level in the tanker when loaded. This ensures that the desired level is achieved, which is generally less than one PPM. The aim is to have the wine adequately covered, without over-sparging, because at times it can be difficult to achieve a very low level of dissolved oxygen.

During tanker unloading at M erbein or at Vinpac, levels of DO are monitored in tanker prior to offloading and, if necessary, sparged from tanker to tank with nitrogen until the wine has again achieved the desired level. At our Vinpac facility, this nitrogen sparging operation is made in consultation with the respective winemaker to achieve their desired DO level. The sparging rate used is between 10 and 15 litres of nitrogen per minute, subject to the specific DO requirements of the winemaker. In some instances we may bring the sparge rate down less than five litres per minute.

The system that we currently have in use at Vinpac is a turret fitting with the gas connected to the turret on the line leading to the tanker. Flow meters which are sited just inside the building are used to monitor the nitrogen sparge rate. A 7 micron sintered stainless steel fitment is used for the dispersion of nitrogen. For wine in store and tank management at Vinpac, an Air Liquide gas management system has been established, which has now been in place for three years. This gas management system has proven to be extremely successful in servicing a site like Vinpac, which being a contract bottling facility, has a considerable number of wines that are moving in and through the facility on a daily and weekly basis.

To monitor and manage wines and maintain them in the condition that the respective winemaker or Vinpac customer requires, is quite a task in itself. We need to ensure that the wines in transfer and in tank storage are at the quality desired by the customer. The computerised gas system monitors the different sizes of tanks that we have at Vinpac, and the system is used on tanks from 4,500L to some as large as 45,000L. The computerised gas system monitors the head space every 30 minutes and provides a history of each tank. Additionally, the system allows selection between one of three gases, and currently we have selected the ratio of 60/40 nitrogen/CO₂. One reason for this ratio is that we have on site, the ability to generate our own nitrogen, so it becomes a cost-effective advantage for us. A number of our customers have asked us to consider the use of argon. It is a rather expensive exercise at this stage, but the costs are coming down and argon is a viable alternative for the future as a mixed gas.

One of the challenges for Vinpac is the great diversity of wine quantities delivered for bottling, and as such, we do not always have the exact tank required for a particular volume of wine. It is therefore in our interest to put the wine to the best, or next fit tank, and then to manage the wine and maintain it in optimal condition. The computerised gas system allows us to adequately gas-cover any wine in tank, whatever volume the tank-fill capacity is.
A further advantage of the computerised gas system is the occupational health and safety aspect. It is no longer necessary to have people carrying buckets of dry ice around catwalks and on the top of tanks. Additionally, the system monitors the tanks 24 hours a day 365 days a year. CO\textsubscript{2} applied as dry ice to provide adequate head-space coverage is lost within a matter of hours, whereas this computerised system is running non-stop and is directed by the winemakers to provide and deliver what is required.

Disadvantages are few and minor. The initial cost of the unit set-up is substantial, but we have at least an arrangement with Air Liquide. The commercial and labour management advantages are also significant for Vinpac.

Each of the wines that continually move through the Vinpac facility require tanks to be managed and monitored on a much more frequent basis than if the wine was maintained in-store all of the time. For tanks with ullage - and occasionally we have a degree of ullage that is quite substantial - the system is continually monitoring and managing those tanks to ensure the head space is oxygen-free, or reduced to a level of below 2 per cent.

### Protective gas management in bottling operations

In the bottling areas both in Vinpac as well as in our Beringer facilities, we monitor tanks of wine for DO, CO\textsubscript{2} and sulfur dioxide; and prior to bottling we analyse all of our tanks. During the bottling process we monitor DO, CO\textsubscript{2} and SO\textsubscript{2} at the first fill, half-hour, hourly and last fill, and also at shift changeovers. We are trialing an in-line apparatus at one of our facilities for monitoring DO during the process of wine delivery to the bottling tank.

The DO standard that is set for bottling operations may vary from company to company, with a preference that the DO should be within 0.3 PPM of the original tank DO concentration, and preferably not exceed 1 PPM. Certain wines are more easily managed with regard to DO levels, and the DO of other wines can only be brought down to a low level with difficulty. Primarily we are aiming for less than 0.8 PPM in tank of DO. Under that can be to advantage, but this is not always the case. The level of CO\textsubscript{2} is winemaker specified, and generally under 0.8 grams per litre.

One of the units that we have found successful for measurement of DO is the Orbisphere. We have arranged an attachment that fits to the tubing system, and a turret fitment so that we can snap-lock the unit onto tanks and other fitments that we have on location. In respect to our bottling measurement we use a package analyser. Samples are taken off the bottling lines routinely (hourly) but we can monitor the oxygen content at any time. A similar arrangement applies the CO\textsubscript{2} unit, which we have put in-line in the laboratory at Vinpac and also at the Merbein facility. We can take samples from the bottling line with a carry gas of nitrogen, push the sample of wine directly from the bottle through the units and get a CO\textsubscript{2} and DO reading on the spot.

With regard to gas analysis we are considering how to improve our wine quality management for dissolved and gaseous oxygen measurement in tanks, CO\textsubscript{2} measurement in tanks, as well as temperature and volume. With some of the new technologies available, these determinations are not too difficult to achieve. Also, with respect to our bottling lines, we are looking at the introduction of DO gas management systems at all of our bottling facilities, DO gas management at loading and off-loading of the wine prior to delivery to tank. Furthermore, in our bottling line systems we are looking at the next stage of development, and of putting in-line/on-line analysis which will carry out determinations of dissolved oxygen, CO\textsubscript{2}, alcohol, turbidity, density and temperature.

These developments will allow more significant quality management to all of our wines in process prior to delivery to the filler. If need be we can divert the process, or stop the actual process of bottling. The rational is to log on a regular basis, so any out-of-specification occurrence will allow the line to be shut down.

In preparing this paper on our wine quality management, from wine receipt to wine in-store, and through our process to bottling, I would like to sincerely thank the following for their participation and support: Mark Jamieson at Vinpac, Colin Goad at Vinpac Merbein, Eric Wilkes at Bilyara, Don Allen and his team with regard to the system that we have at Vinpac, and Lino Ottey from Orbisphere.