OXYGEN AND OXIDATION

Oxygen in winemaking is a double-edged sword. It can make or break a wine, depending on the way it is managed, both during winemaking and at bottling.

In many instances oxygen is beneficial, and even required e.g. during fermentation and for macro- and micro-oxygenation techniques. The slow addition of oxygen through the closure after bottling may also prevent the formation of 'reductive' volatile sulphur compounds.

If too much is allowed to dissolve in wine, however, oxygen can have severe negative effects on colour, aroma and flavour. Not only can it modify key aroma compounds, such as the thiols, but it can also oxidise wine, reacting with phenols and resulting in browning, the loss of primary flavours, and the development of oxidation aroma characters.

Oxidation in bottled wines has, historically, represented up to 25% of total faults at competitions (Atkin, 2012).

Oxygen and SO2:

Oxygen contact during processing, at bottling, and even after bottling, is nearly always unavoidable. SO2 is added to wine to react with dissolved oxygen and protect it from oxidation. 1mg/L oxygen reacts with 4mg/L free SO2 (Zoecklein, 2006).

Oxygen during processing:

Processing operations like racking, transfers and filtration can add between 2-8mg/L oxygen to wine, while barrel ageing can add a further 20-45mg/L/year (du Toit, 2006). This oxygen pickup can result in wines losing between 5-20mg/L free SO2/month (Rotter, 2001). The amount of oxygen pickup during processing is almost exclusively due to the way wine is handled and equipment used in the cellar (Moutounet, 2007). Using inert gases and maintaining adequate free SO2 levels will ensure a wine remains protected.

VinLAB (Pty) Ltd
Tel +27 21 882 8866/7 – Fax +27 21 882 8868 – email lab@vinlab.com – www.vinlab.com
P.O.Box 532, Stellenbosch, 7599, South Africa

Oxygen at bottling:

But even the most carefully protected wine may be vulnerable to damage caused by excessive oxygen pickup at bottling.

Before bottling, oxygen levels should preferably be less than 0.5mg/L (Zoecklein, 1995). Levels much higher than this indicate poor oxygen management during processing (Moutounet, 2007). Sparging with nitrogen may help reduce high oxygen levels before bottling.

Oxygen pickup at bottling should not exceed 0.8mg/L, and should preferably be less than 0.2mg/L in white wines and less than 0.5mg/L in red wines (Zoecklein 2006). To achieve this, bottling equipment – hoses, tanks, pumps, fillers, bottles – should have as much oxygen excluded as possible through the use of inert gases.

After bottling, Total O2 in the wine should be measured. Total O2, or Total Package Oxygen (TPO) includes both dissolved oxygen and oxygen in the headspace.

Most headspaces will contain some oxygen. In the absence of a vacuum filler, O' Brien et al. (2009) found headspace oxygen levels of up to 3.9mg/L, equivalent to the loss of 16mg/L free SO2 after bottling.

Total oxygen levels after bottling should preferably be less than 0.6mg/L for white wines and 1.25mg/L for red wines (Steiner, 2013).

OTR (oxygen transfer rate) through the closure post bottling will also impact the oxidation potential of the wine after bottling. Different closure types have different OTR's and range from 20mg/L/year for synthetic closures to less than 0.37mg/L/year for screwcaps (Firstenfeld, 2014). Free SO2 and total O2 levels at bottling need to compensate for this.

Knowing the impact and effect of oxygen on wine at all stages during the winemaking process, winemakers should be better able to manage and control oxygen contact, reducing the incidence of oxidation issues in their wines.

VinLAB (Pty) Ltd
Tel +27 21 882 8866/7 – Fax +27 21 882 8868 – email lab@vinlab.com – www.vinlab.com
P.O.Box 532, Stellenbosch, 7599, South Africa

REFERENCES:

Atkin T. 'Creating a Stink about Screwcaps', www.timatkin.com, 2012

Du Toit W.J., Marais J. Pretorius I.S., du Toit M. 'Oxygen in Must and Wine: A Review' SAJEV, vol. 27, 2006, p.76-94

Firstenfeld, J. 'Using Closures to Customise Oxygen Transmission', Wines and Vines, August 2014

Moutounet and Vidal, 'Dissolved Oxygen Measurement and Quality', Internet Journal of Viticulture and Oenology, 2007, #6

O'Brien V., Colby, C., Nygaard, M., 'Managing Oxygen Ingress at Bottling', Wine Industry Journal, January/February 2009

Rotter, B. 'Sulphur Dioxide', www.brsquared.org, 2001

Steiner T.E. 'Strategies to Manage Dissolved Oxygen', Wines and Vines, August 2013

Zoecklein B.W., K.C. Fugelsang, B.H. Gump, and F.S. Nury. 1995. Wine Analysis and Production. New York: Chapman & Hall.

Zoecklein B.W. Enology Notes #122, December 2006

VinLAB (Pty) Ltd
Tel +27 21 882 8866/7 – Fax +27 21 882 8868 – email lab@vinlab.com – www.vinlab.com
P.O.Box 532, Stellenbosch, 7599, South Africa