Wine racking in the winery and the use of inerting gases

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INTRODUCTION

The O_2 uptake in the different winemaking processes is generally considered to be negative for the sensory characteristics of white and rosé wines. Wine racking is a critical point of O_2 uptake, as the large surface area of the wine exposed during this operation and the inability to maintain an effective inert gas blanket over it. All this causes more O_2 to be dissolved in the wine, which can gain between 2.5 and 5 mg/L of dissolved O_2, depending on the technique and the technology used [1,2]. During racking, there are three main areas for consideration in preventing wine oxidation: the tank being emptied, the tank being filled, and the hoses, lines, and pumps [3]. This uptake of O_2 affects the protection of the wine, due to the consumption of the sulfur dioxide present in it. It is known that 1.7 moles of SO_2 react with one mole of oxygen [4].

OBJETIVES

- Study O2 uptake during the racking of a model wine without using inerting gases and to compare it with the purging of the destination tank with different inerting gases (experimental winery at university in Palencia).
- Inerting gases were also used to protect the wine in the racking tank by blanketing the wine.
- A full-scale inerting study was carried out in Bodega Emina Rueda (Bodega Matarromera, S.L) during the racking of a Emina Verdejo white wine to evaluate the effectiveness of the use of different inerting gases.

MATERIALS AND METHODS

- Model wine: 12.5% v/v hydroalcoholic solution with characteristics similar to those of real wine was used (pH = 3.5).
- Real wine: Emina Verdejo white wine (D. O. Rueda)
- Racking: 2 stainless steel tanks (1800L) at experimental winery in Palencia. 2 DN32 butyl rubber hoses were used for the connections (one 7 m long and the other 3 m long). Connections were all DIN 11851 with Viton seals. A flexible impeller pump was used with a flow rate of 6000 L/h.
- Dissolved Oxygen Measurement Equipment: Tank head space oxygen (HSO) and wine dissolved oxygen (DO) were monitored in different points during the wine racking. 10-m-long Oxygen Dipping Probes DP-PSt6 were used connected to two OXY-4 trace measuring devices (PreSens GmbH, Regensburg, Germany).
- Inerting gases
  - N_2, CO_2, Ar, N_2:CO_2 (80:20) and Ar:CO_2 (80:20)
- Purging of tanks and hoses:
  - 4 probes were placed into the inerted tank at different heights to monitor the inertization.
  - Each inerting gases were injected through a valve at the bottom of the tank until the partial pressure of oxygen (pO_2) reached a value of pO_2 < 1 hPa.
  - Hoses were also inerted until pO_2 < 1 hPa values were reached.
- Blanketing:
  - 1, 0.5 and 0.25 vessel volume of inerting gas blanket of the headspace in the racking tank.

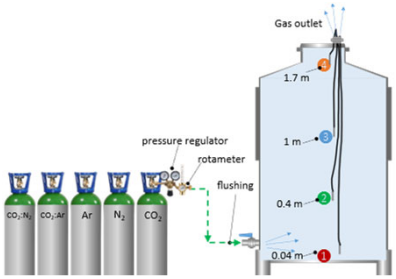

Figure 1. Schematic diagram of the monitoring system for total and sequential inerting in an empty tank to compare the different inerting gases (Purging), as well as the different probes placed at different heights in tanks at the experimental winery in Palencia.

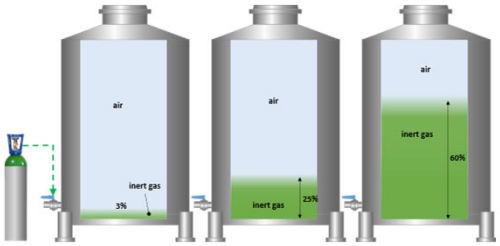

Figure 2. Diagram of the purging process with different inert gases and different thicknesses of the applied gas cover. A total of 3% corresponds to a thickness of 0.04 m of each gas; 25% to a thickness of 0.4 m; and 60% to 1 m.

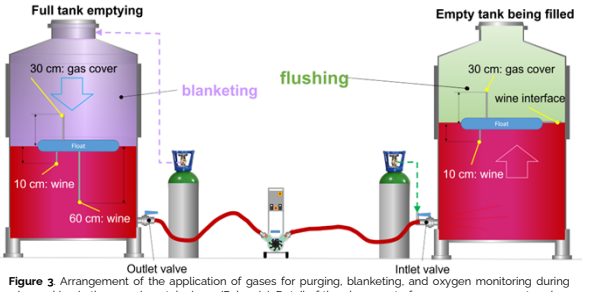

Figure 3. Arrangement of the application of gases for purging, blanketing, and oxygen monitoring during wine racking in the experimental winery (Palencia). Detail of the placement of oxygen measurement probes fixed on the float.

RESULTS

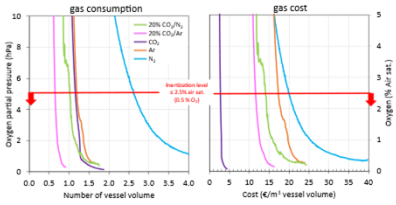

Figure 4. Monitoring the oxygen content during purging of the empty destination tank in experimental winery with different gases. Number of vessel volumes of gas required to achieve total inerting and their economic cost.

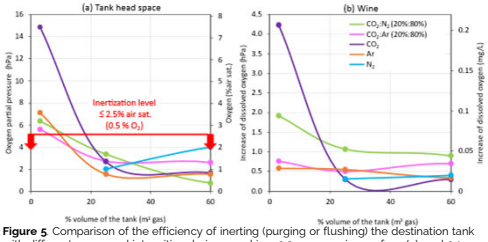

Figure 5. Comparison of the efficiency of inerting (purging or flushing) the destination tank with different gases and intensities during a racking. 0.3 m over wine surface (a), and 0.1 m under racked wine surface (b). Triuals placed at the experimental winery (Palencia)

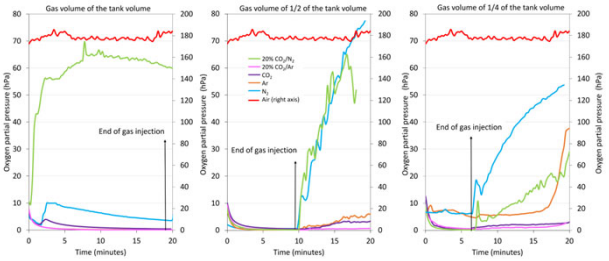

Figure 6. Monitoring of the oxygen content in the HSO of the racked tank at the experimental winery (Palencia) by inerting the wine with different gases and different volumes of each gas added: one vessel volume (a); 0.5 vessel volume (b); and 0.25 vessel volume of (c) inert gas .

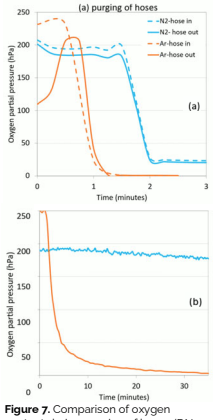

Figure 7. Comparison of oxygen content during purging of hoses (DN50 and L = 20 m) (a) and of an empty 25,000 L tank with N_2 and Ar in Emina Verdejo white wine cellar (b).

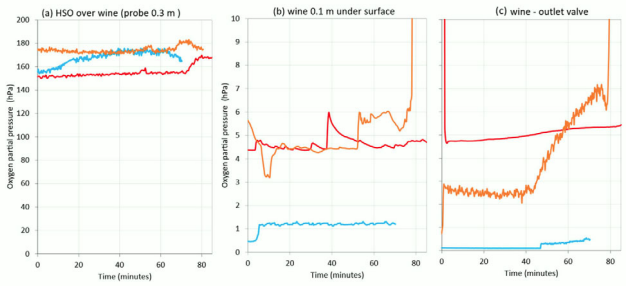

Figure 8. Comparison of oxygen content in the racked tank during wine racking in in Bodega Emina Rueda (Bodega Matarromera, S.L). Without inerting (red), using N_2 as inerting gas (blue) or argon (orange). Measures made in the atmosphere at 0.3 m above the surface of the wine (a); 0.1 m depth inside the wine (b) and wine at the outlet (c).

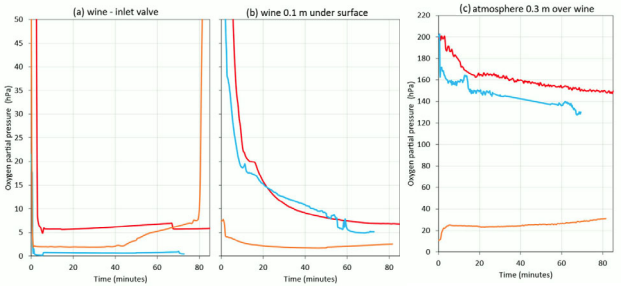

Figure 9. Oxygen content in the 25,000L destination tank during a Emina Verdejo white wine racking in Bodega Emina Rueda (Bodega Matarromera, S.L). Without inerting (red), using nitrogen as inerting gas (blue) or argon (orange). Measures made in the atmosphere at 0.3 m above the surface of the wine (a); 0.1 m depth inside the wine (b) and wine at the outlet (c).

CONCLUSIONS

- Purging an empty tank with different inerting gases was effective being the CO_2:Ar (20:80) mixture clearly the most effective, requiring less gas volume to displace O_2. The opposite result was found with N_2 because it worked in dilution mode. Although from an economic viewpoint, the most recommendable gas was CO_2.
- The level of protection of the racked wine and the HSO over the racked wine in the empty destination tank differed depending on the gas used and the thickness (% of the tank volume) of the blanket formed with each gas. Purging with 25% of the empty tank volume of each inert gas is recommended to protect racked wine in a good cost-benefit way.
- To keep the headspace of the racking tank inert, blanketing with 50% of tank volume of Ar, CO_2 or the mixture of both were sufficient. Applying different volumes of gas had little effect on the DO of the wine at the tank outlet.
- The study of a Emina Verdejo white wine racking in Bodega Emina Rueda (Bodega Matarromera, S.L.) demonstrated the greater efficacy of Ar versus N_2 in the purging of the destination tank. For the inerting of the hoses, the differences between both gases were minor. Ar was able to maintain the wine at lower DO levels, as well as to provide a higher level of HSO protection in the destination tank during the racking process.

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