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In situ measurements of dissolved oxygen during low-level oxygenation in red wines

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• The goal of this work was to describe the levels of dissolved oxygen found in commercial wines undergoing microoxygenation. The authors also make recommendations on sampling procedures and the effectiveness of dissolved oxygen measurement techniques.

• Oxygen solubility in wine is highly dependent on its partial *pressure* and the *temperature* of the wine. For instance, at atmospheric pressure and room temperature, oxygen saturation with air is reached at approximately 6 ml/liter. (This solubility increases by 10% if the temperature is lowered to 5°C (41°F)). But with the oxygen flow rates used during microoxygenation, final oxygen concentrations are normally far lower than that.

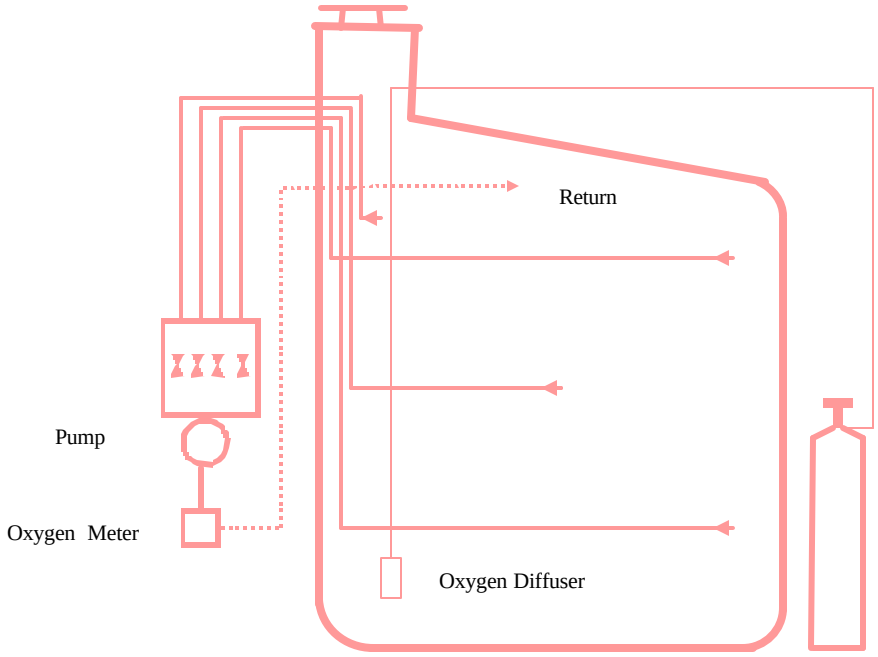

Diagram by authors, modified

• There were 2 different experiments over three consecutive years, conducted at Wente Vineyards (Livermore, CA) on Cabernet Sauvignon. In **Experiment I** (2002-2003) there were 4 treatments in tanks: 1) no-oxygen-no oak staves, 2) oxygen-no oak (5 ml O_2/liter/month), 3) no oxygen-oak, and 4) oxygen-oak. The main differences of **Experiment II** (2003–2004) were that no oak staves were included, and that, unlike in Experiment I where microoxygenation started after MLF, oxygen

treatment in Experiment II started before MLF, ceased during the process, and resumed after. The oxygen rates in Experiment II were variable, starting high (~60 mL/liter/month) and ending low (~0.5 mL/liter/month) (*See Table 1 of original text for details*).

• **Sampling technique**. The authors came up with a sample circulation system that allowed them to sample the tank from 4 points: top of the tank above the sparger, top rear, bottom rear, and center.

• **Oxygen measurement.** Dissolved oxygen was measured using an Orbisphere 2713®. This instrument consists of several electrodes submerged in an electrolyte solution and separated from the exterior by an oxygen-permeable membrane. When an electrical potential is applied between the two electrodes, the oxygen is reduced, thus generating an electrical current that is proportional to the amount of oxygen present. Since the presence of microbes would consume part of the oxygen, microbe populations were also monitored using counting chambers. Finally, the authors performed basic wine analyses, including total phenols (Folin-Ciocalteu).

• **Results: Experiment I.** 1) After 1 month of treatment, the microoxygenated tanks, with or without oak, had oxygen concentrations ranging from 50 to 270 µg/L, whereas the control tank stayed at 25-30 µg/L. Oxygen concentration measurements in the vented gas from these tanks suggested that more than 80% of the oxygen added was being consumed. 2) Between May and June, there was a considerable decrease in dissolved oxygen. Even though this is consistent with the increase in temperature observed during these months, temperature was insufficient, according to the authors, to explain the large oxygen drop observed (from 200 to 50 µg/L). 3) Oxygen measurements at the 4 sampling points showed little variation, indicating a good oxygen distribution in the tank.

· **Results: Experiment II.** 1) Dissolved oxygen in the control tank was between 4 and 14 µg/L, whereas the microoxygenated tanks showed values between 220 and 2400 µg/L. However, when oxygen rates were decreased to 0.5 ml/liter/month after MLF, the differences between the microoxygenated and the control tanks were much smaller. 2) All the microoxygenated treatments showed lower total phenol levels than the control. According to the authors, this could have been caused by the precipitation of phenolics due to higher polymerization in the microoxygenated tanks.

At the end, the authors make the following recommendations:
_ discrimination between oxygen levels when using low rates of oxygen demands very sensitive equipment and appropriate sampling procedures;
_ "it is paramount that winemakers pay special attention to practices in which low temperatures are used, as higher dissolved oxygen rates will be expected".

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