OREGON WINE

PORTLAND

SYMPOSIUM

Winery Oxygen Management from Barrel to Bottle

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Overview

- Oxygen and Winemaking
- Types of Oxidation
- Where Why and How to Measure Dissolved Oxygen
- Bottling and Closures

Dissolved Oxygen

- Definition: Concentration of oxygen molecules in a liquid
- Wine is saturated with oxygen at ~6-8ppm
- How much oxygen can a wine take?
  - Complicated topic
  - Dependent on grape variety, winemaking practices, and expected aging potential
  - New technology for measuring antioxidant capacity has potential to give winemakers better understanding

Oxygen and Wine:
The good the bad and the ugly

- The Good
  - Before and During Fermentation
  - Treating wine faults
  - Reducing perception of vegetal flavors
  - Softening astringency and stabilizing color
  - Wine sensory evolution

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Oxygen and Wine: The Bad and the Ugly

- Chemical Oxidation (post fermentation)
  - Primarily oxidation of phenolic compounds
  - Browning
  - Forming undesirable sensory compounds
  - Premature aging
  - Aroma degradation

Oxygen and Wine: The Bad and the Ugly

- Microbial Spoilage
  - Acetic Acid Bacteria and Film Yeasts
  - Ubiquitous organisms, production of compounds activated by presence of oxygen
  - Metabolism produces spoilage compounds: acetic acid, acetaldehyde, and ethyl acetate

Winery Activities and Oxygen Pickup

- Racking Barrels
- Tank Movements
- Barrel Aging
- Fining/Additions
- Tanks with Headspace
- Cold Stabilization
- Bottling

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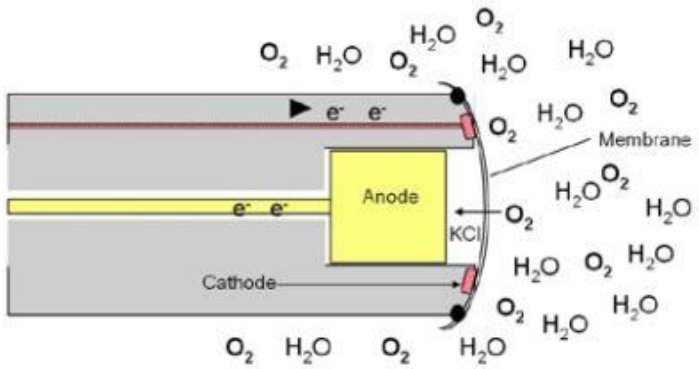
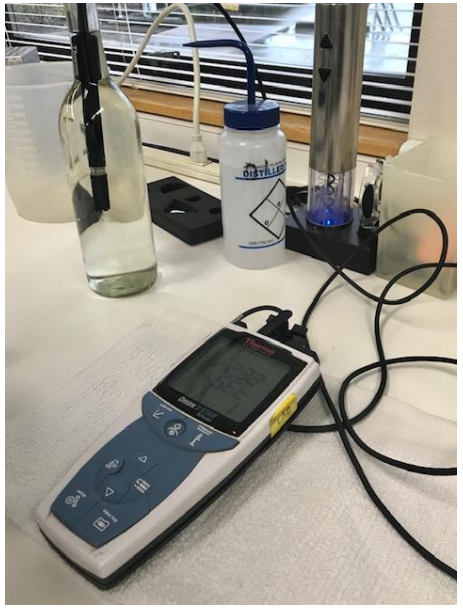
Instruments for Measuring Dissolved Oxygen

- Electrochemical Membrane Sensor
- Luminescent/Optical Based Sensor
- Non-Invasive Luminescence

Electrochemical Membrane Sensor

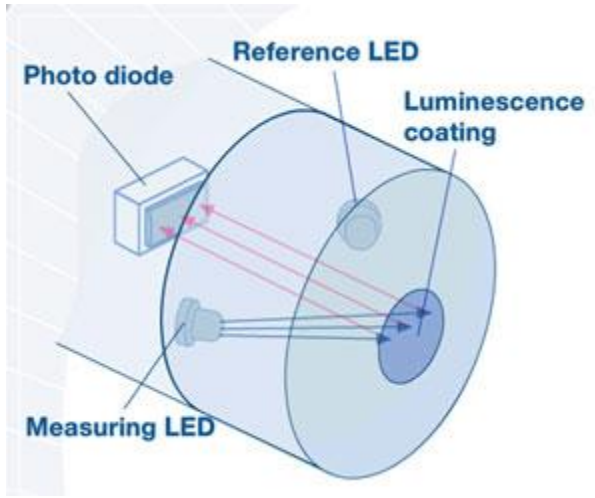
- Method
  - O2 diffuses across permeable membrane to sensor, produces electrical signal related to concentration
- Pros
  - Portable
  - Accurate
  - Inexpensive ($700-$900)
- Cons
  - Invasive
  - Consumes O2 during Measurement
  - Frequent Calibration and Maintenance
  - Can be prone to drift, longer response time
  - Requires stirring





Luminescent/Optical Sensor Probe

- Method
  - Measures interaction between oxygen and intensity of luminescence
- Pros
  - Less maintenance: no membrane, no electrolyte solution
  - Minimal Calibration
  - Portable
  - Accurate
  - Moderately priced (~$1500)
  - Faster response times
- Cons
  - Invasive
  - Probe diameter too large for wine bottle



Luminescence With Sensor Spots

- Method
  - Measures interaction between oxygen and luminescent intensity
- Pros
  - Non-Destructive, Non-consumptive
  - Potential for bottling line audits
    - Checking each filler head
    - Measure headspace of bottle and calculating TPO
  - Can measure evolution of QC bottles longitudinally
- Cons
  - Sensor life expectancy?
  - Expensive (~$5K)

Typical oxygen pick up during cellar activities

- Tank to tank transfer: 0.1-3.0ppm
- Racking barrels to tank: 0.3ppm
- Filtration: 0.6-2.0ppm
- Cold Stability: 0.1-2.6ppm

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Preventing Oxygen Pickup in Cellar

- General Cellar Practices
  - Gassing lines and tanks well
  - Tightening clamps, inspecting pump seals
  - Using gravity to move wine when possible
  - Begin filling tank from bottom valve
  - Maintain adequate SO2 levels
  - Minimize Head space

Cellar DO Protocols and Targets

- DO Target for wine movements
  - No more than 0.5ppm pick up
  - Not to exceed 1.0ppm in receiving tank
- Take initial DO and during wine movement
  - Catch any DO increase early
- Cold Stability
  - Hard to get accurate reading at low temp
  - More DO concentration in wine at lower temperatures
- Filtration
  - Velo:
    - Gassing bell
    - Sparging at outlet
  - Pad/Cross Flow
    - Gentle sparging at outlet

Sparging

- Inline with sparging stone (2 micron stone), finer bubbles
- Use N2 gas

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Monitoring

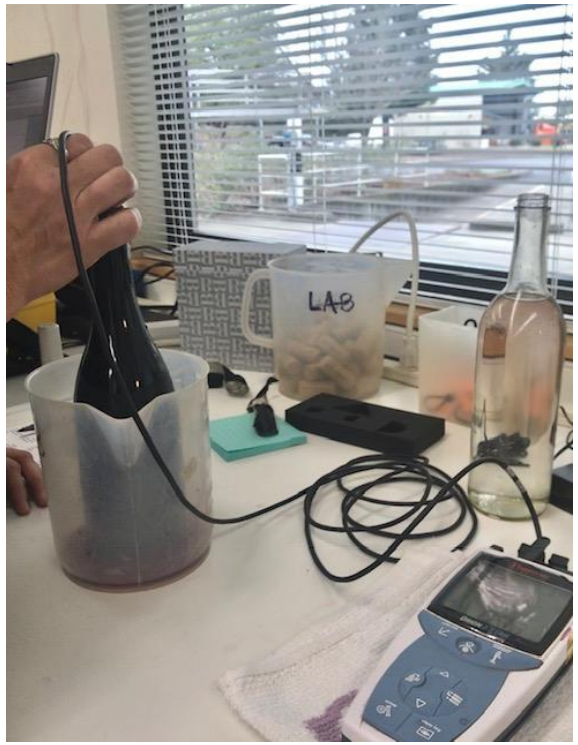
- Monitoring Topped Tanks
  - Check F/TSO2 and VA each month
  - If FSO2 drops or VA increases, then check DO, look for potential issues
- Tanks with Headspace
  - Gas every 3 days with argon
  - Inspect wine visually
  - Check DO when gassing

Bottling Protocols

- Gas lines from tank to filler bowl with N2 (~15 minutes)
- Sparging bottles with N2 or CO2
- Decant rounds at start up, usually 2 or more
- Check 1st bottle DO before start of bottling
- DO <1.0ppm and <0.4ppm pick up from tank
- High DO? Trouble shoot: Filler heads, sparger, clamps, lines etc.
- DO checked every hour (or at least 3 times if a small run)
- DO checked if line is stopped >30min
- DO checked for last bottles off the line (always higher DO)

Bottling with Screwcap:

- Greater head space
- Dose wine with liquid nitrogen
- Displaces O2 in headspace



Closures and OTR

Greatest oxygen ingress occurs from 0-90 days and then levels off (bottle shock?)

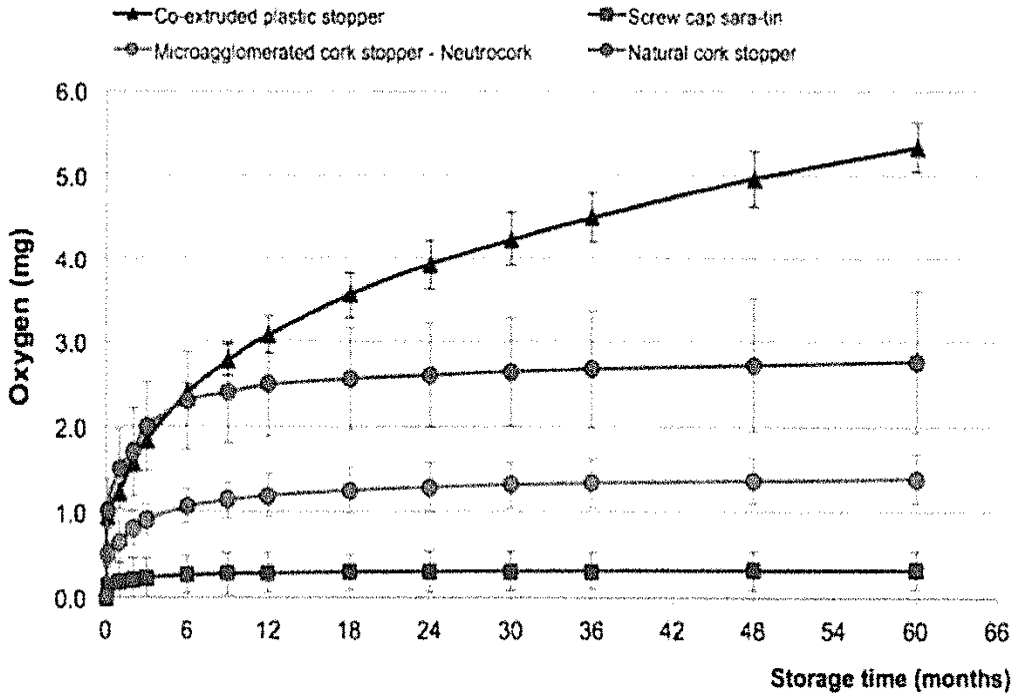
*Lopes et al. (2005)

- Co-extruded Plastic stopper
  - Highest level of oxygen ingress
  - Poor seal??

- Cork
  - Compression releases O2 into wine
  - High initial OTR in first 3 months
  - Variability, especially in lower grade cork

- Technical Cork
  - More homogeneous
  - Controlled OTR
  - Select product based on desired oxygen transfer

- Screwcap
  - Select liners with controlled OTR



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Free SO2 Consumption

- Highest consumption in first week (low OTR closure)
  - SO2 reacts with oxidation products immediately after bottling
  - Decrease of 20-50% of FSO2 in first year of bottling

- 2017 La Crema Chardonnay Trial
  - DO: 0.58ppm vs. 1.50ppm
  - Last off bottles with elevated DO (1.5ppm)
  - Initial FSO2: 28ppm,
  - 4 months: 22ppm and 6 months at 22ppm
  - No decrease in FSO2 compared with Control Wine
  - High DO preferred in blind tasting

Final Thoughts

- Develop an O2 Monitoring Program
- Measure and record DO for various cellar activities
- Identify where DO pickup is likely to occur
- Determine what oxygen pickup is acceptable for your wines
- DO prevention is the best
  - Minimize sparging and other corrective practices
- Select closure that works for your wines

References

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Thank You!

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