



March 2008
37th NY
Wine Industry
Workshop

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Oxidation, SO₂ + Process Management

Continuum, Equilibrium

Oxidation Reduction

RedOx potential changes throughout production process.

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NY Wine Potential

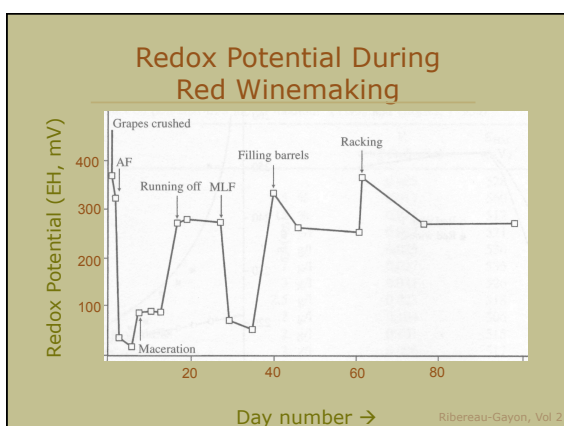
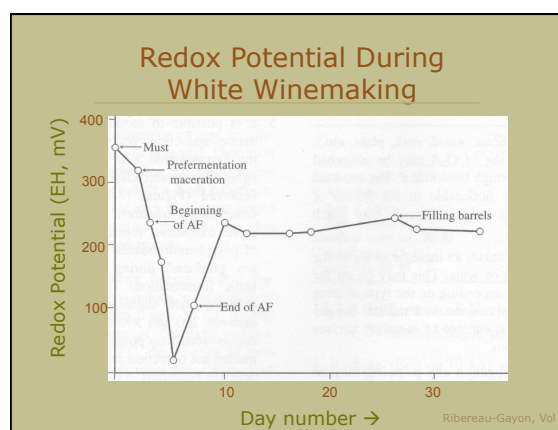
The redox potential is the measure of the ability of a system (e.g. wine) to act as an oxidizing or reducing agent

High redox potential =
More oxidizing, take electrons

Low redox potential =
More reducing, give up electrons



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The Winemaking Process

- Stages of production have different chemical processes, and different risks
- Critical Control Points could be helpful
- Everything is relative



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Must Oxidation



above: must oxidation and re-reduction during fermentation

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Pre-fermentation

- SO₂ is tricky here
- Use the tools at your command (temperature, sorting, quick yeast additions, etc.)
- Oxidation is a relatively low risk, but beware of microbes.



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Fermentation

- Acetaldehyde is formed by ethanol oxidation
- SO₂ will be bound and additions will likely cause more ACHO formation
- Additions at this point are probably big trouble-also stopping fermentations with SO₂



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Post-fermentation

- Yeast, and then lees, are able to remove oxygen...until you rack.
- Now the training wheels are off, and the need for SO₂ management is essential.
- All cellar actions provide a chance to pick up oxygen.



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SO₂ Benefits

- Antimicrobial
- Antioxidant
- Prevents Browning



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SO₂ Reminders

- Only molecular SO₂ is antimicrobial, only free SO₂ is antioxidant
- Infrequent large additions are more effective than frequent (or infrequent small ones)
- SO₂ is a gatekeeper



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Tanks

- Shape
- Material
- Top it Up



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Transfer

- Temperature
- Secure Fittings
(Involuntary Venturi Effect)
- Gas Blanketing



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Filtration

- Fill the system
- Get the air out
- Avoid redundancy



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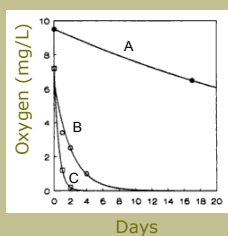
Ascorbic Acid

- Powerful antioxidant
- Protects against ATA
(band-aid – not the brett kind)
- Must have stable (free) SO₂
- Timing is an issue we need to look at
(and are looking)....



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Redox Rate of consumption of O₂ by white wine vs. ascorbic vs. SO₂



$$[O_2]' = [O_2]_0 \cdot e^{-kt}$$

A = 30 ppm SO₂ in model wine
($k=2.7 \times 10^{-7} \text{ s}^{-1}$, half life = 30 days)

B = white wine
($k=6.5 \times 10^{-6} \text{ s}^{-1}$, half life = 1.2 days)

C = white wine + 100 ppm ascorbic acid
($k=3.3 \times 10^{-4} \text{ s}^{-1}$, half life = 35 min)

Poulton (1970)

Heavy Metals

- Danilewicz (2007)- Importance of iron and copper in oxidation
(interaction of metals, polyphenols and SO₂)
- Iron and copper seem to act synergistically
- Iron is tough to avoid, but copper...



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Bottling & Closures

- Yikes.
- Bottling is a significant and important source of O_2 pick-up, but...
- Closures should be considered



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What the heck do we do?

- Critical control points
- Manage the things you can control
- Try to keep Red/Ox potential away from the continuum edges
- Try to keep the big hammer in the drawer



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Where the trouble starts...



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Further Work

- DO meter
- Acetaldehyde monitoring
- Ideas you might have



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