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Cellaring is about ageing a fermented young wine until it is mature and, hopefully, drinkable. We cellar the wine in oak barrels for 2-3 years, then bottle it and then store the bottles for another 2-5 years until they can start to be consumed. In other words, we start drinking our wine 4-7 years after the grapes were harvested and we expect it to improve quality for another 5-15 years after that. This means we only find out 10 years after harvest and winemaking whether we did a good job (we find out much faster when we do a lousy job!) – thus the need to keep good records, and the slow learning process. This also translates our annual production of 2 barrels into a required cellaring capacity of 8 barrels and over 5,000 bottles (more than we originally anticipated).

Cellaring comprises 5 interlinked activities:

- **ML**: Initiating and watching for completion of the Malolactic Fermentation

- **Elevage**: Ageing wine in barrels or tanks takes 1-4 years. During this time the barrels need to be topped up every 4-6 weeks to compensate for evaporation, sulfur needs to be replenished to prevent contamination and adjustments are made if required.

- **Adjustments** - there are 4 basic types of adjustments: Filtering, Fining, Cold Stabilization and Racking & Blending.

- **Bottling & Maturation**: Before bottling, the wine in the mixing tank needs final adjustments in SO2 (to prevent spoilage) and
possibly in CO2 (to compensate for too much or too little aeration during winemaking and cellaring). Then the wine is poured into bottles, the bottles are corked, capped and labelled, and finally, the wine is aged in the bottles for another 2-4 years before it is ready for consumption.

- **Barrel/Tank Management** is about selecting and buying barrels and tanks, about cleaning them after use (i.e. following a Racking operation) and about storing unused barrels until they are needed again.

This section is organised into the following 10 pages:

1. **Barrel & Tank Management**: How we select tanks and barrels, how we keep them in good shape and how long we use them.
2. **Malolactic Fermentation**: This page describes how we initiate and monitor the progress and completion of the Malolactic Fermentation in the cellar.
3. **Elevage**: We monitor how the wine ages in the barrels or tanks, how we top up the barrels because water in wine evaporates through the wood and how we replenish the sulfur content to prevent contamination. Every 4-6 weeks when we check, we have the opportunity to make adjustments: Filtering, Fining, Cold Stabilization, Racking & Blending as explained in the following pages. Ageing is complete when the wine is judged ready for bottling.
4. **Fining**: We can remove specific chemical substances in the wine by adding specific fining agents which bind to these substances and aggregate into very large molecules which precipitate into sediment and can then be removed by Racking.
5. **Filtering**: We can filter the wine conventionally to remove large particles, or we can process it through a reverse osmosis filter to remove only the smallest particles.
6. **Cold Stabilization**: We can remove certain chemical substances by cooling down the wine to just above 30 dF. Keeping the wine at that temperature for a few days will make these chemicals crystallise and precipitate. Then we remove the sediment by Racking.
7. **Other Adjustments**: This is a grab bag for dealing with other wine-faults.
8. **Racking & Blending**: Racking is syphoning out the wine from a barrel into a temporary holding tank, leaving the sediments behind. Then the sediments are removed, the barrel is cleaned, and the wine is poured back in. Racking can be followed by Blending. We can blend wine from different barrels or tanks to create more complex wines or to cover up wine faults which are only apparent in higher concentrations. To blend we rack wine from different tanks or barrels into a blending tank, mix and then pour the mixture back into clean barrels or tanks.
9. **Bottling & Labelling**: Before we bottle we give the wine a final dose of SO2 and we check the dissolved CO2 level. For our wine we target a dissolved CO2 level of around 100-150 mg/L. Then we transfer the wine into bottles and cork and cap the bottles. Finally, we design and print bottle labels and affix them to the bottle.

10. **Bottle Storage & Maturation**: We store the bottles under temperature and humidity control for a few years until the wine is ready to drink.

11. **Cellaring Summaries**: a summary of how each vintage was treated in the cellar.

The graphic on the right illustrates the differences in the cellaring process across vintages 2009-2015. The height of each bar reflects the relative size (in lbs) of each harvest. Note, the number of bottles does not correlate well with the size of the harvest because we blended some vintages with purchased fruit (e.g. Merlot in 2012) or with wine from other vintages. The brown and the grey fields reflect the time allocated for barrel ageing and bottle ageing. Note, even after release for consumption, the wine in the bottles continues to improve for years until it reaches its peak value and after that, it slowly deteriorates. From harvest to peak value takes 8 to 15 years. The more tannic the wine, the longer it takes to reach its full potential.

The following graphic illustrates how the different vintages from 2009 to 2015 are linked across the elevages as top-up wines are used across vintages and as portions of wine from surplus years (e.g. 2012) are used later to compensate for shortages in years when the harvest was not big enough to fill one or two barrels. This tracking is essential for determining what the final composition of the wine is when it gets bottled each year. The graphic also shows what adjustments have been made to the wine during elevage.
Starting with the 2016 vintage, the process became more complicated. We fermented different varietals and blended them during cellaring. We needed to replace our data management in spreadsheets with a relational database. It will take some more time to develop comprehensive reports from data the new database describing the cellaring across vintages.

Here is a link to a pdf-file of the Cellar section as of March 3, 2018.

Previous page: Home
Top of page: Go
We cellar the wine in stainless steel tanks, oak barrels and glass or plastic (polyethene) containers. We use:

- **Steel tanks and steel barrels** for mixing and transferring wine: They are easy to clean and maintain and they last forever.
- **Oak and steel barrels** for maturing wine: Oak barrels, up to 3-4 years old, add desirable flavours and tannins to the wine. After 4 years, they are called neutral. The advantage of oak barrels, in addition to adding flavours, is that they breathe: they allow very slow oxidation from air that enters through the wood staves. As air enters, liquids evaporate through the wood. Consequently, the barrels need to be topped up every 1-2 months. A similar effect can be achieved in steel tanks by inserting oak staves or chips and by injecting oxygen at an extremely slow and controlled rate (micro-oxidation).
- **Speciality steel tanks and glass containers** for keeping odd lots and top-up wine. They are easy to clean and come in various sizes (glass carboys) or have adjustable volume (steel tanks with variable tops or pressurised inert gas covers).

We currently don’t use plastic containers (they are easy to clean and very versatile) or micro-oxidation systems (too expensive).

**Economics of oak barrels**

For large wineries, stainless steel tanks are hands-down the most economical solution because they come in enormous sizes and are easy to clean and maintain. Only commercial wineries which can charge over $40 retail per bottle tend to use new oak barrels. A new 60-gallon oak barrels costs between $600 (for American and East European varieties) and $1200 (for French varieties) and they add desirable flavours to the wine for 3-4 years; after that, they are called neutral and trade for $150-$300 in the secondary market. Neutral barrels, when properly maintained can last for over a decade. New 60-gallon stainless steel barrels cost $500-700 and last forever. So, using new French oak barrels for every vintage would cost around $20/gallon or $3.50/bottle. We use a mixture of mostly French, and some American oak barrels 50% new and 50% neutral. Our average cost for using French barrels is below $2/bottle or less than the combined subsequent cost of the glass bottle, cork and label.
Choosing Oak Barrels

At trade shows, barrel makers have the fanciest booths and spend the most on brand marketing. That is because the characteristics of barrels are hard to measure and much depends on individual taste and image. On top of the difficulty to quantify qualities, research studies indicate that characteristics of the same type of barrels from the same manufacturer vary widely.

We buy maximum two new barrels a year. Consequently, we have no opportunity to test a wide range. So we decided, somewhat arbitrarily, to concentrate on buying our barrels from Radoux, one of the large, well regarded French “Tonneliers”. We tried a couple of barrels from Seguin Moreau but found them to impart too intense flavours. American oak, as compared to French oak, imparts different flavours and has a slightly higher oxygen transfer rate (see the page on Elevage). As these comments indicate, we conservatively end up buying from an established large supplier – not much analysis or research involved here.

Choosing Stainless Steel Tanks, Barrels & Kegs

Stainless steel containers are made to individual specifications by speciality manufacturers or bought from catalogues according to standard sizes and specifications. We are using 4 types of stainless steel containers:

- **Mixing and settling tanks** can hold the contents of multiple barrels and are used to mix different barrels or hold young wine for a short period to settle out suspended particles. We prevent the wine from coming in contact with oxygen by a floating blanket of a “heavier than air” inert gas; we use Argon or CO2. These tanks have large openings on top and the side for easy cleaning. We use a round stationary 200-gallon mixing tank (made to order by Santa Rosa Stainless Steel) and another square 200-gallon mixing tank (ordered from Metalcraft ) which can be raised with a hydraulic forklift.
- **Storage & transfer barrels** can hold 30 or 60 gallons of wine and are used to hold wine while a barrel is cleaned, or for ageing without exposure to oak and oxygen (unless oak chips or staves are used, or oxygen is infused with micro-ox equipment). We bought our 30 & 60-gallon steel transfer barrels from Transtore.
• **Variable top tanks** are designed to hold variable amounts of wine. Their top floats on the surface of the wine in the container and is sealed with an inflatable gasket to prevent exposure to air. We use them for small batch fermentations and, in the past, to hold odd amounts of young wine set aside for topping-up barrels. We bought our 100 & 200-liter variable-top tanks from Fermentation Solutions.

• **Pressurized kegs** are designed to hold variable amounts of wine (usually 5-15 gallons) under slight pressure of an inert gas (e.g. Argon). We use them to hold young wine set aside for topping up barrels. We bought our two 15 gallon kegs and associated piping from GW Kent.

All of our tanks and barrels are on dollies so they can be moved around easily and they are designed so they can be lifted (by hoists or forklift) to move the contents by gravity instead of pumps.

**Carboys**

Carboys are glass containers that usually come in 4, 5, 6 & 7-gallon sizes. We use them to hold odd lots of excess wines. They always need to be filled to the top to prevent the contents to be exposed to air.

**Barrel Maintenance**

Barrels need proper maintenance. They must be adequately humidified to tighten up before first use, they must be cleaned regularly of sediments and wine spoilage organisms, and they must be stored properly when not full of wine.

**Cleaning methods**

Cleaning is about removing sediments settling at the bottom of the barrel and about killing wine spoilage microorganisms (bacteria and fungi, mostly hiding in crevices and near the top of the barrel). There are for primary methods of cleaning:
• Water: spraying the inside of barrels with cold or warm/hot water is the most common method of washing out crud and sediments, but it is not very effective in removing spoilage microorganisms

• Sulfur Dioxide: Barrels can be washed out with a solution of SO2 or KMBS (potassium metabisulfite which when dissolved in water creates molecular SO2, a dissolved gas) or they can be gassed by burning a pure elemental sulfur wick. Sulfur is cheap and pretty effective against wine spoilage microorganisms, but it is toxic when inhaled.

• Steam: Barrels can be steamed to wash out and kill microorganisms. Steam is very effective to clean, but it is expensive to apply (equipment), and it only works for a short time while hot – as soon as the steam cools down, new microorganisms can resettle.

• Ozone: Barrels can be washed out with water containing Ozone molecules O₃ which are very useful in killing all kinds of harmful microorganisms (bacteria, fungi and biofilms). This requires an ozone generator and diffuser. The disadvantages of Ozone are: it deactivates fairly quickly, it is pretty harsh on anything containing rubber (gaskets, seals etc.) and should only be used in well-ventilated areas as it can be toxic when inhaled in quantities above 0.2 milligram ozone per cubic meter of air.

What we do when

Here is our current barrel maintenance practice:

• Initialization: before we use new barrels we fill them with filtered warm water (stripped of chlorine and contaminants found in regular drinking water) and let the stave soak up and tighten. This takes a few days. Then they are rinsed out with the barrel washer (see below) and immediately filled with new wine.

• Regular cleaning between uses, at racking: We wash barrels with a specially built washing apparatus. It first removes residues with a sprayer applying warm water until the water runs clear. Then we spray out the barrel with cold ozonated water, and we clean around the bung-hole with KMBS spray. To conserve water, a basin under the barrel catches the outflow, and a pump circulates the water back through a prayer inside the barrel. For the ozone treatment, a bubbler fed by the ozone generator is placed inside the barrel.

• Storing used barrels: if a barrel is not refilled with wine after washing, we burn a sulfur pill inside and close it, so the trapped SO2 prevents the growth of new microorganisms. The burning pill is held in the centre of the barrel in a small stainless steel basket.
suspended from the bunghole. The burning is repeated every 4-6 months if barrel storage is extended. Before the barrel is reused, it is washed inside with the barrel washer (see above) and outside with a steam power washer used for general cleaning of the steel tanks, destemmer and the press.

The pictures show the barrel washer, the steam pressure washer and sulfur pill holder.

Data Management

The database has a table dedicated to describing the tanks and barrels. Each new vessel is entered into the database with the following layout. The key items are a unique name and dimensions to calculate the usable volume.

The following screenshot shows the current set of vessels:
<table>
<thead>
<tr>
<th>#</th>
<th>Vessel Name</th>
<th>Brand</th>
<th>Spec</th>
<th>Year</th>
<th>Type</th>
<th>Tonnage</th>
<th>Primary Use</th>
<th>Diameter</th>
<th>Width</th>
<th>Depth</th>
<th>Height</th>
<th>Weight (gal)</th>
<th>comments</th>
<th>Use (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3250gallonsH-1</td>
<td>Degram-Moncaus</td>
<td>3250gallon H</td>
<td>2008</td>
<td>Full French Oak barrel</td>
<td>MLTH</td>
<td>Cellar</td>
<td>53.00 inch</td>
<td>35.50 inch</td>
<td>40.00 inch</td>
<td>387 gal</td>
<td>200 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3250gallonsH-2</td>
<td>Degram-Moncaus</td>
<td>3250gallon H</td>
<td>2008</td>
<td>Full French Oak barrel</td>
<td>MLTH</td>
<td>Cellar</td>
<td>53.00 inch</td>
<td>35.50 inch</td>
<td>40.00 inch</td>
<td>387 gal</td>
<td>200 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3250gallonsH-3</td>
<td>Degram-Moncaus</td>
<td>3250gallon H</td>
<td>2008</td>
<td>Full French Oak barrel</td>
<td>MLTH</td>
<td>Cellar</td>
<td>53.00 inch</td>
<td>35.50 inch</td>
<td>40.00 inch</td>
<td>387 gal</td>
<td>200 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3250gallonsH-4</td>
<td>Degram-Moncaus</td>
<td>3250gallon H</td>
<td>2008</td>
<td>Full French Oak barrel</td>
<td>MLTH</td>
<td>Cellar</td>
<td>53.00 inch</td>
<td>35.50 inch</td>
<td>40.00 inch</td>
<td>387 gal</td>
<td>200 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3250gallonsH-5</td>
<td>Degram-Moncaus</td>
<td>3250gallon H</td>
<td>2008</td>
<td>Full French Oak barrel</td>
<td>MLTH</td>
<td>Cellar</td>
<td>53.00 inch</td>
<td>35.50 inch</td>
<td>40.00 inch</td>
<td>387 gal</td>
<td>200 gal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Next page: Malolactic Fermentation
Last updated: February 24, 2018
Malolactic Fermentation

Malolactic Fermentation is the final step in making young wine. We cover it in the Cellar section because it is managed in the cellar. There are three steps

- Racking the pressed or free-flowed wine: We let the sediments settle, then rack the barrels, the variable capacity steel tank or the mixing tank into the barrels and keep the remainder in a fresh topup tank.
- Initiate the Malolactic Fermentation: we may inoculate with malolactic bacteria and add nutrients. Then we maintain the temperature at around 70°F until it the fermentation is completed (this may take 1-6 months)
- Rack the wine: We let the sediments settle, then rack the barrels and the steel tank, top up the barrels from the steel tank, and protect all wine with SO2

Racking

Racking is about removing sediments from the bottom of the barrels or the steel mixing tank. At this juncture, the sediments consist mostly of dead yeast cells and other remanents of the fermentation.

Malolactic Fermentation

In the Malolactic Fermentation malic acids are transformed into lactic acids. This reduces the acidity and harsh fruitiness of the young red wine and helps to create a rounder mouthfeel. This fermentation is not induced by yeasts (like the Primary Fermentation) but by lactic acid bacteria. These bacteria occur naturally in the vineyard on the outside of the grape skins and find their way into the must during crush. If they have been killed by an earlier SO2 addition, they may be purchased from specialised laboratories/providers and added back in. If the Primary Fermentation was done naturally (i.e. no SO2 was added at crush), then the Malolactic Fermentation is usually also left to occur on its own. Here is a more detailed discussion of the process and potential pitfalls from MoreWine.com:


Malolactic Fermentations takes between 2 and 9 months, and its progress should be measured by tracking the concentrations of malic and lactic acids. During ML fermentation, the
temperature should be kept at around 70°F, and it can help to stir up the sediments bi-weekly, at least in the beginning. Because the cellar is kept at 55-60 °F the barrels with wine undergoing ML fermentation, need to be kept in a separate compartment and slightly heated. We built insulated warming boxes shown in the picture, open on the left, closed on the right. A heating pad slides under the barrel on a tray. The heating pad is controlled by a temperature controller. The temperature is monitored with a probe inserted through the bung.

Thus following inoculation with lactic bacteria, we have a monthly process (which coincides with the regular cellar monitoring process of the older wine still in barrels – as described in the Barrel Ageing page):

- Open the vessels and stir the lees (dead yeast cells and other sediments)
- Take samples and top up the barrels with wine from the topup tank
- Taste and measure temperature, chemical properties and spectra for phenolics.

In the past, we used a paper chromatography test every month, or two confirm completion of the malolactic fermentation. This proved to be too time-consuming. Since 2017, Malic and lactic acid measurements are part of the OenoFoss analysis.

**Rack & SO₂**

Once the Malolactic fermentation is completed we rack again in the cellar where ambient temperatures are stable at around 55-60 °F. Next, we protect the young wine by adding SO₂. How this is done is described in the Laboratory Section on page Measuring and Adding SO₂.

**Data Management**
We enter actions regarding Malolactic Fermentation in the Cellar Actions table. This screenshot shows the cellar actions on Jan 31, 2018, when we inoculated the 2017 barrels with malolactic bacteria (samples # 6 & 7).

Last harvest: 2017 vintage

In 2017 we decided free-flow the juice directly into barrels rather than into a temporary holding tank. We removed the rough lees, seeds and few skins by running the freeflow through a sieve.

Since we had not used any SO2 yet, we hoped for an indigenous ML fermentation. However, when we could not measure any conversion after a month, we decided to inoculate with malolactic bacteria (Vinflora CH16).

The following screenshots show the detail for the two barrels.
### Cellar Batch 17MeCFPVCHwb2

#### Key Metrics

<table>
<thead>
<tr>
<th>Date</th>
<th>pH</th>
<th>TA</th>
<th>VA</th>
<th>Temp</th>
<th>Malo</th>
<th>Lacto</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct 10, 2017</td>
<td>4.25</td>
<td>5.48</td>
<td>7.305</td>
<td>1.590</td>
<td>0.086</td>
<td>0.27%</td>
<td></td>
</tr>
<tr>
<td>Dec 12, 2017</td>
<td>4.03</td>
<td>5.18</td>
<td>7.532</td>
<td>1.750</td>
<td>0.070</td>
<td>0.29%</td>
<td></td>
</tr>
<tr>
<td>Jan 11, 2018</td>
<td>3.91</td>
<td>5.11</td>
<td>7.458</td>
<td>1.880</td>
<td>0.060</td>
<td>0.33%</td>
<td></td>
</tr>
</tbody>
</table>

#### Additional Notes

- **pH** and **TA** readings are 4.0-4.2, 5.0-5.5 g/L. No adjustment for temperature or indications of off-flavors.

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**Previous page:** Tank & Barrel Management  
**Top of page:** Go  
**Next page:** Elevage  
**Last updated:** February 26, 2018
The term “Elevage” comes from French and in this case, relates to maturing or growing up. Wine is kept in oak barrels, steel tanks and carboys for 1-4 years to settle and mature. We mature our wine in new and used (“neutral”) oak barrels for 2-4 years. The new oak imparts desirable flavours and allows the intake of a small amount of oxygen (around 4g O\textsubscript{2} per barrel per year) – this combination helps in the polymerisation of tannins and anthocyanins and improves the quality of the wine.

During elevage, the wine needs to be checked regularly for changes in key chemical properties and possible infections by spoilage organisms (creating “wine faults”). Barrels also need to be topped up regularly because wine evaporates through the wood staves. However, there is a trade-off: each time a container is opened, the wine gets exposed to oxygen and microbes in the air with the potential for spoilage. We open each barrel every 1-2 months, taste and measure the chemical properties and spectra and then decide whether we need to make adjustments (filtering, fining, cold stabilisation, other adjustments or racking/blending – each discussed in the following pages). The following picture shows from left to right tasting, chemical testing and spectral analysis.

After adjustments have been made, if any, SO\textsubscript{2} is replenished, and the barrel is topped up and closed. The right amount of SO\textsubscript{2} controls spoilage organisms and excess oxygen – otherwise, their joint presence would tend to convert ethanol into acetaldehyde, creating a severe wine fault.

**Measuring Chemical Properties**
The extracted sample is tested and the results recorded in a spreadsheet which also calculates the required (if any) addition of SO₂ in the form of KMBS (Potassium Metabisulfite). The tests are described in detail on the respective pages in the Laboratory section of the website.

1. Look, Nose & Taste: most important is to inspect the wine surface for film and smell and taste the wine to check for any irregularities or faults – this is done right after the barrel is opened.
2. Dissolved Oxygen (see the page on measuring Dissolved Oxygen)
3. Full set of OenoFoss measurements
4. UV-Vis Spectrum to measure Phenolics: (see the page on Measuring Phenolics in Wine)

Since 2017 we run all the tests, except DO, all the time on each vessel. The most important are Nose & Taste to check for faults and pH & SO₂ to calculate necessary additions of Metabisulfite. If tasting or any of the tests reveal potential faults, we need to make corrections/adjustments.

Identifying & Correcting Wine Faults

The nose and tastebuds are man's most valuable organs for identifying potential problems in wine. The following tables were excerpted and adapted from an ETS Laboratories' Winemakers' Quarterly (see www.ETSLabs.com), from the British Columbia Winemakers Association website www.bcawa.ca/winemaking/flaws.htm and Enotools website www.enotools.com/wine-faults--whats-wrong-with-my-wine.html. They summarise key off-odours and tastes, the chemical compound responsible for them, their indicative sensory threshold, the most probable origin of the problem, how the problem can be prevented and possible corrections. Treatment should always be preceded by first eliminating the original cause. All treatment with chemical additions are problematic and should be done in stages or on samples first.
## Rotten Egg: Hydrogen Sulphide & Mercaptans

<table>
<thead>
<tr>
<th>Odour &amp; Threshold</th>
<th>Cause</th>
<th>Prevention</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotten Eggs or Hot Springs.</td>
<td>Yeast stressed by low nutrition in must produces excess amounts of H2S. Much of the H2S is blown off by the CO2 generated by the yeast</td>
<td>Measure YAN (Yeast Assimilable Nitrogen) in must – target 250 mg/L. Add nutrition to yeast at time of hydration and add nutrition again at the beginning of phase 2.</td>
<td>Aerate, by racking, or bubbling CO2. Persistent cases may be treated with copper sulphate solution, but only after converting the untreatable H2S into thiols by adding ascorbic acid (50mg/L) – the copper binds with the thiols and can be racked or filtered out.</td>
</tr>
<tr>
<td>H2S 1 – 5 ppb (microgram/L)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Cooked vegetables / Canned Corn: Disulfides

<table>
<thead>
<tr>
<th>Odour &amp; Threshold</th>
<th>Cause</th>
<th>Prevention</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooked vegetables or canned corn.</td>
<td>Excessive aeration following H2S/Mercaptans problems; on-lees aging.</td>
<td>Limit aeration. Remove lees early.</td>
<td>Remove lees by racking.</td>
</tr>
<tr>
<td>Disulfides (DMDS,DEDS) &amp; Dimethyl Sulfide (DMS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-20 (microgram/L)</td>
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</tr>
</tbody>
</table>

## Vinegar & Nail Polish: Acetic Acid (Volatile Acidity) & Ethyl Acetate

<table>
<thead>
<tr>
<th>Odour &amp; Threshold</th>
<th>Cause</th>
<th>Prevention</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinegar</td>
<td>Most Acetic Acid develops during fermentation and elevage either a) when Acetobacter bacteria consume ethanol in the presence of oxygen or b) when Lactobacillus consumes residual sugar. Ethyl acetate forms from the reaction of ethanol and Acetic Acid.</td>
<td>SO2 additions kill Acetobacter and other aerobic bacteria. So must should be treated with SO2 if cold soaking precedes fermentation and oxygen exposure limited during elevage (by frequent topping up and gassing containers). Any residual sugars should be removed by sterile filtering or treatment with Velocrin.</td>
<td>First, the causes of VA production must be eliminated (Acetobacter or residual sugar). Only when ongoing VA production is eliminated, should VA levels be reduced. This can be achieved by blending (with wine with less VA) or Reverse Osmosis filtering.</td>
</tr>
<tr>
<td>Acetic Acid and other volatile acids 600 - 900 ppm (milligram/L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nail Polish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethyl Acetate 150 – 200 ppm (milligram/L)</td>
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<td></td>
</tr>
</tbody>
</table>
### Barnyard, Band-Aid, Wet Dog: Brettanomyces

<table>
<thead>
<tr>
<th>Odour &amp; Threshold</th>
<th>Cause</th>
<th>Prevention</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnyard 4-Ethylphenol (4EP) &amp; 4-Ethylguaiaacol (4EG) 400 ppb (microgram/L)</td>
<td>Brettanomyces, a spoilage yeast, producing a myriad of aroma compounds (for which 4EP &amp; 4EG are markers) particularly in warm conditions, low SO2, high pH and residual sugars – often during ML. A little Brett is considered house-style in some Bordeaux wines.</td>
<td>Brett comes in from the vineyard and can get established in old barrels in poor sanitary conditions. Once established in a barrel, it can hardly be eliminated, and the barrel needs to be discarded</td>
<td>Brett aromas can be eliminated from affected wine by reverse osmosis followed by a carbon block filter taking out the slightly larger 4EP/4EG molecules.</td>
</tr>
</tbody>
</table>

### Popcorn, sweet butter: Diacetyl

<table>
<thead>
<tr>
<th>Odour &amp; Threshold</th>
<th>Cause</th>
<th>Prevention</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Popcorn, buttery smell and taste Diacetyl (2,3 butane dione) 0.3 - 3 ppm (milligram/L)</td>
<td>A product of malolactic bacterial metabolism particularly in the absence of yeast lees which tend to neutralise the diacetyl produced. Frequently diacetyl results from the breakdown of citric acid after the malic has been consumed.</td>
<td>Keep wine on lees until malolactic fermentation is completed. Delay citric acid addition, if necessary, till after completion of malolactic fermentation</td>
<td>Rack and add a batch of clean lees to barrel.</td>
</tr>
</tbody>
</table>
**Straw/Sherry nose & surface film: Candida – Acetaldehyde**

<table>
<thead>
<tr>
<th>Odour &amp; Threshold</th>
<th>Cause</th>
<th>Prevention</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straw-like, sherry-like or chocolate odour; surface film</td>
<td>A surface yeast, Candida vini, an obligate aerobe, may grow on the surface of wines in storage containers - particularly when ullage is too great. At the wine’s surface, the combination of available oxygen, low sulphite levels and depleted alcohol provide suitable conditions</td>
<td>Minimize exposure to air while removing barrel samples and topping up. Maintain 25 ppm free SO2 levels</td>
<td>Remove surface film, spray the surface with sulfite solution, add 25-50 ppm SO2.</td>
</tr>
<tr>
<td>Acetaldehyde 100 ppm (milligram/L)</td>
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</tbody>
</table>

**Replenishing Sulfur**

The level of free SO2 which defines whether sulfur (in the form of KMBS - Potassium Metabisulfite) needs to be added. See “Adding SO2” on the page “Steps 3-11: Upfront Wine Making Decisions” in the Winery Section. We add KMBS when topping up after adjustments have been made, as KMBS needs to be first dissolved in a small amount of wine.

**Topping up**

Oak barrels need to be topped up regularly because a small amount of wine (called “angels’ share”) evaporates through the staves. The evaporation rate is usually around 3% p.a., depending on the humidity in the cellar. Wine components inside the barrel migrate through the wood at various rates and evaporate from the outside surface. Assuming the migration rates of the liquid components (say 87% water and 13% alcohol) depend mostly on the differences in concentrations between the inside and outside of the barrel, the alcohol concentration in the wine changes. We keep the cellar at around 60% humidity, so the concentration differences are 27% for water and 13% for alcohol (assuming the alcohol in the cellar air is zero). Therefore at 60% cellar humidity water leaves the barrel twice as fast as alcohol, and the 3% annual evaporation consists of approximately 93% water and 7% alcohol. If you start the year with 100L wine at 13% alcohol, then you end the year with $87\times0.93 + 3\times0.07 = 84.2L$ of water and $13\times0.93 + 3\times0.07 = 12.89L$ of alcohol and the new alcohol concentration in the remaining 97.09L of wine is $12.89 / 97.09L$.
97.09 = 13.27%, an increase of 0.27%. This calculation illustrates why barrel cellars should be kept humid.

For topping up, we use a system based on kegs sold by St. Patricks of Texas (http://www.stpats.com/index.htm). The wine is stored in a stainless steel keg and preserved under minimally pressurised Argon. The system has a dispenser/topping gun which allows to easily top up barrels and carboys with minimal exposure to air while keeping the wine reserve sealed. We extended the setup sold by St. Patrick’s to two kegs to allow dispensing different top-up wines, and we adjusted the inert gas injection. Whenever we refill the kegs or open them up for inspection, we need to close the keg and replace the air with Argon. This is done in 3 cycles: first extracting the air with a vacuum pump and then filling the vacuum with Argon; then twice extracting the Argon/air mix and refilling with Argon. After 3 cycles the gas above the wine should be close to 100% Argon.

Data Management

We record all elevage actions in the Cellar Actions table. Here is a screenshot of the data entered on January 18, 2018, for the barrel containing the 2017 Merlot-PetitVerdot-CabFranc mix.
Usually, we enter this data in the "INPUT: Cellar Action by Cellar Batch Collection"-layout shown on the previous page.

Last year: 2017 elevage

We have not yet developed a layout which succinctly summarises the elevage actions across all barrels during a year. However, we have started to develop a layout which summarises all elevage actions for a particular barrel across all years, the “Review: Cellar Batch”-layout. Here is a screenshot of the first tab in that layout for the 14-13CSCHwb2 barrel.
The layout is analogous to the “REVIEW: FermentationBatch”-layout: different tabs describe details and provide a context within which we add commentaries.

Previous page: Malolactic Fermentation
Top of page: Go
Next page: Fining
Last updated: February 29, 2018
Fining (with egg-whites)

Fining is about extracting selected chemical compounds from wine. It works by adding a fining agent which binds to that compound and then precipitates so the sediment can be removed by racking. There are two kinds of fining agents: some hold an electrical charge which attracts large particles with the opposite charge, others form a chemical bond with selected large particles. In large commercial wineries fining has become a sophisticated industrial process – quite an evolution from fining with egg-whites practised for over a hundred years.

Industrial Fining

With the industrialisation of winemaking, we have seen a proliferation of fining agents developed and marketed by speciality chemical companies to adjust wine for a plethora of “faults”.

The table on the right, extracted from the November 2015 Newsletter by Enartis-Vinquiry (http://www.enartisvinquiry.com) highlights a large number of the fining agents they currently suggest for different effects.

Fining has a long tradition, especially in the Bordeaux. There, egg-whites had been used for decades to tame strong tannins, reduce astringency and give the wine a rounder mouthfeel. Recently in Europe, however, regulation has been passed that forces wine-makers to disclose on the bottle label any addition of animal products – e.g. egg whites, while the same disclosure requirement does not apply to industrial fining agents. The consequence is that egg-whites are being replaced by industrially produced albumin which represents the key fining agent in egg-whites.
To date, we have not used any industrially produced fining agents. We have opted for fining with egg-whites only once: to contain the harsh tannins and astringency in the over-extracted 2010 vintage.

Fining with egg-whites

Egg-whites are one of the oldest fining agents. The positively charged peptide linkages of the albumin and globulin proteins form hydrogen bonds with negatively charged hydroxyl groups found in large tannins. Once the two attach, they become neutralised, and the particles settle, due to their heavier weight.

Process: The egg-whites need first to be separated from the egg-yokes. Then the egg-whites (one third) are mixed with a 0.7% salt water solution (two thirds) because globulin is only soluble in salted water. Then the solution is added to the wine and stirred in well. Finally, a week later, the wine is racked.

Timing: The opinions on when to fine vary. Some argue red wines should be fined and racked just before assemblage and bottling; others argue red wines should be fined right after malolactic fermentation is completed. We tried egg-white fining for the first time in spring of 2013 right before bottling on the 2010 vintage. Time will tell.

The optimal Dosage varies anywhere between 1 and 6 egg-whites per barrel. So first we need a test for the optimal dosage. We do this by tasting 1-litre samples of wines at concentrations equivalent to 1, 3 and 5 egg-whites per barrel. We call these samples 1E-wine, 3E-wine and 5E-wine respectively. Because the amount of egg-whites needed for 1 litre is so small, we first create a sample which has a concentration of 22 egg-whites per barrel (22E-wine) and then dilute it down. This is the process we use to prepare the samples:

1. Mix 1 egg-white (~32 g) with 65 ml of water with 0.65g of salt and stir well (the “1E-solution”); the total is ~95 g.
2. Pour 4.5 g of 1E-solution into 450ml of unfined-wine to get the 22E-wine
3. Mix 45ml of 22E-wine with 955 ml of unfined wine to get a 1 l sample of a 1E-wine
4. Mix 140 ml of 22E-wine with 860 ml of unfined wine to get a 1 l sample of a 3E-wine
5. Mix 240 ml of 22E-wine with 760 ml of unfined wine to get a 1 l sample of a 5E-wine
We then compare the samples daily for 6 consecutive days and select the solution which tastes best.

For more background on fining with egg-whites consult the following links:

http://winemaking.jackkeller.net/finishin.asp

http://www.starchefs.com/cook/wine/technique/egg-white-wine-finishing

Filtering (reverse osmosis)

Filtering separates a solution into two parts: the Permeate is the part which passes through (permeates) the filter, the Retenate is the part which is retained by the filter.

In conventional filtering, the Retenate is the part which is to be taken out, and the Permeate is the part to be kept. It is used for removing large particles in a solution which do not easily settle (and can be taken out as sediment).

In reverse osmosis filtering the Permeate is the part to be taken out and the Retenate is the part to be kept. It is used for removing the smallest atoms or molecules in a solution.

The challenge in all filtering is the clogging up of the filter membrane. In conventional filtering, it is solved by replacing or scraping the filter when that happens. In reverse osmosis filtering, clogging is prevented by moving the solution at high speed tangentially along the filter surface under high pressure (thus its other name: Cross-Flow Filtering). Clark Smith patented the use of reverse osmosis filtering in 1992 for the removal of Volatile Acidity and alcohol reduction in wine. Since then “reverse osmosis” or “cross-flow” filtering has become widely used, and many large wine equipment manufacturers and consultants sell or rent the equipment. One of the smallest viable cross-flow filter on the market is the Sweetspotter by VA Filtration in Napa, CA (www.vafiltration.com ). We are currently experimenting with their smallest model the SS4-1-10.

The remainder of this page is organised as follows:

- Basic Concepts: explains how we use the Sweetspotter for finding the optimal alcohol level in wine and for reduction of Volatile Acidity.
- Description: shows the internal logic of the Sweetspotter in a flow diagram and provides pictures
- Preparation: describes how the Sweetspotter is rinsed before use
- Use for Alcohol Reduction: describes how the Sweetspotter is used for reducing alcohol
- Use for VA Reduction: describes how the Sweetspotter is used for reduction of Volatile Acidity.
- Cleaning: explains how the Sweetspotter is rinsed, cleaned and filled before storing
- Regeneration: explains how the pH Column and the Anion Exchange Column are refreshed or regenerated.

1. Basic Concepts
The basic idea behind a “reverse osmosis” or “cross-flow filter” is a mechanism to remove the smallest particles in a solution. The solution is moving sideways under high pressure past a filter with very small pores. The continuous flow prevents the larger particles from clogging up the filter, and the high pressure pushes the small particles through the filter. The small particles in this application are water molecules (H₂O), small alcohol molecules (ethanol) and small acid molecules (acetic acid). The other molecules which make up the wine are much larger and remain behind the membrane. We use the Sweetspotter for reducing the ethanol concentration (i.e. alcohol) and removing Volatile Acidity (i.e. acetic acid) from the wine.

- **Reducing Alcohol:** In many regions in California, grapes get more sunshine hours and warm weather days combined with cool nights than say in the Bordeaux. Consequently, the grapes can be picked at higher maturity levels which generally implies higher sugar levels. On the one hand the higher maturity levels translate into better phenolics and more fruit-forward wines; on the other hand, the higher sugar levels translate into more alcohol. Thus the demand for alcohol reduction. Studies have shown that wine with a given alcohol level of say 15% may have “alcohol sweetspots”, that is a significantly better nose and taste at specific lower alcohol levels (say at 12.5%, 13.3% and 14.6%). To find these sweetspots a sample is taken from the wine, and the alcohol in the sample is reduced from say 15% to 12%. Then taste test samples are created in 0.1% alcohol increments from 12% to 15% by mixing the reduced alcohol sample with the original in the required ratio, and all samples are tasted.

Alcohol can be removed with a reverse osmosis membrane and a distiller. The membrane has very small pores – so small that only the smallest molecules can pass through. The first step extracts a combination of water and alcohol (the “Permeate”) from the wine; the leftover “Retenate” is essentially the same wine with now lower alcohol and less water. The second step is to distil the Permeate, i.e. removing the alcohol from the water with a distiller. The third step is to recombine the remaining water left in the distiller with the Retenate.

The challenge in this process is distillation; it requires a government license which is hard to get. In the absence of such a license, the options are a) to outsource the process to somebody who has the license, or b) to simply add distilled water back in the amount of the Permeate (but this is not permitted for commercial wineries).

- **Correcting Excessive Volatile Acidity:** Volatile Acidity refers to the steam-distillable acids in wine. They consist mostly of acetic acid (CH₃COOH) which gives vinegar its
characteristic aroma and is therefore considered a fault in wine at a concentration exceeding 900 ppm (the legal limit is 1200-1400 ppm). Volatile acids are mostly formed a) by yeasts during fermentation and b) by spoilage organisms (Acetobacter plus air, or lactic acid bacteria) during fermentation and ageing.

Acetic acids are very small molecules; they can be removed in three steps. The first step extracts a combination of water, alcohol and acetic acids (the “Permeate”) from the wine through a cross-flow filter - the leftover “Retenate” is essentially the same wine with now lower alcohol, less water and less acetic acids. The second step binds the acetic acids in the Permeate to a resin in an anion exchange column leaving only the water and the alcohol. The third step is to recombine what remained (water & alcohol) in the Permeate with the original wine.

2. Description

The following diagram describes the flows inside a Sweetspotter. A pump delivers the wine to an Intensifier that increases the pressure in the wine flowing past the membrane (when the Back Pressure Valve is closed) to 300-700 psi. At this high pressure and with constant flow, the smallest particles pass through the membrane and constitute the Permeate. The Permeate then can then be either collected at Valve 1 for alcohol reduction or flowed through various filters which take out the acetic acids before it is recombined with the wine.
The following picture shows on the left the sweetspotter from the top and the front and, on the right, the VA Column and the auxiliary pump:

![Picture of sweetspotter, VA Column, and auxiliary pump]

The remainder of this page is basically an “operations manual” for using the sweetspotter.

3. Preparation

The sweetspotter is a) either stored long term with a 30% ethanol solution or b) stored short term with a 1% solution of citric acids and sulfur (in the form of KMBS, potassium metabisulfite) inside the reverse osmosis filter, the main pump, the intensifier and the pipes and hoses. This prevents the growth of spoilage organisms inside the machine during storage. The anion exchange column is stored with KOH, potassium hydroxide, inside. Before use, the sweetspotter and the anion exchange column need to be rinsed. This section describes the rinsing process to be followed before first use or between treatments of different wines.

If the sweetspotter has been stored for a long time with ethanol, it needs to be blown out and the ethanol stored for reuse; then the rinsing continues the same as when stored for short term. This initial rinsing consists of 3 cycles: cold water rinse, followed by 1% citric acid rinse (0.5lbs citric in 5 gal water), followed by another cold water rinse. Each rinse follows the same process:
1. Place end of Wine Inlet hose into 5 gal bucket containing cold water or citric acid
2. Place end of Wine Outlet hose into empty 5 gal bucket
3. Turn Valve 1, so it points open-ended tube into a catch bucket
4. Open Back Pressure Valve on Intensifier (2 turns counter-clockwise)
5. Turn on Main Switch and rinse for 5 minutes
6. Close Back Pressure Valve on Intensifier (2 turns clockwise) for 2 minutes to ensure complete water rinsing, then open again and let run until water exiting Wine Outlet Hose is free of taste when rinsing with water

If the system is used for VA reduction, the Anion Exchange column needs to be rinsed:

1. Blow out at 10-15 psi then rinse until water exiting the column has reached a pH of 10.5.
2. Check that the column is full using the bleeder valve on top

4. Use for alcohol reduction

The first step in alcohol reduction is to collect a required amount of Permeate in a collection bucket. The system is started up as follows:

1. Place end of Wine Inlet hose into the barrel to be treated
2. Leave the end of Wine Outlet hose in an empty 5 gal bucket
3. Check the valve positions:
   a. Valve 1 so Permeate can flow into a collection bucket. Note, the hose needs to be taped to the bucket because pulsation will otherwise dislocate it.
   b. Back Pressure Valve: open (2 turns counter-clockwise if closed)
4. Turn on Main Switch (turns on Pump)
5. Watch for wine exiting the Wine Outlet hose into the bucket (this takes ~10 seconds). As soon as wine is tasted at the Wine Outlet hose, turn off the Main Switch, place end of the Wine Outlet hose into the barrel and turn on the Main Switch again.

6. With wine flowing again, close the Back Pressure Valve (turn clockwise thumb tight) and watch flow in the Flow Meter.

7. The system will pulse as pressure builds up. Watch the Pressure Gauge; pressure should not exceed 700 psi; if it does, shut the system off and clean the Cross-Flow filter.

8. Taste the liquid exiting Valve 1 for alcohol. When alcohol is tasted, the rinsing water has been flushed out, and the Permeate can be collected. Change the bucket, and again tape the hose to the bucket. Put a hydrometer in the bucket and monitor the average alcohol concentration.

The system is kept running until enough Permeate is collected to reduce the alcohol in the wine to the target level. If the alcohol concentration in the Permeate is roughly the same as the starting alcohol level in the wine, and the flow rate of the Permeate is 10 gals/hr then a 10% reduction in the alcohol concentration of the wine (say from 15% to 13.5%) should take only 6 gallons of Permeate to be replaced with distilled water. Under normal circumstances the Permeate flow is ~7 gals/hr, the Retenate Flow is ~70 gals/hr.

Process recording: The following should be measured and recorded every 15 or 30 minutes: a) Retenate pressure, b) Permeate Flow, c) Alcohol concentration in Permeate retained, d) Cumulative volume of retained Permeate.

At the end of the Permeate production cycle, the system needs to be flushed out with Nitrogen or Argon to reduce the loss of wine, Retenate and Permeate. This is done as follows
1. Open the Back Pressure Valve to reduce the pressure in the cross-flow filter.
2. Turn off the main switch to stop the pump.
3. Disconnect the Wine-In hose, attach a Nitrogen or Argon tank instead and blow out the Pump and Intensifier at 20 psi until no more wine comes out of the Wine-Out return hose.
4. Disconnect the Nitrogen tank from the Wine-In port and attach it to the Cleaning Port on the ingoing side.
5. Attach a hose to the Cleaning Port outgoing side which leads to a collection bottle for the Retenate and open Valve 5.
6. Open the pressure on the Nitrogen or Argon tank to 20 psi, then open Valve 6 to flush out the Retenate side of the cross-flow filter.
7. Close Valve 5 to fill the Retenate side with gas and flush out the Permeate side of the cross-flow filter.

Now the wine, Permeate and Retenate are flushed out, the system is full of inert gas and is ready for rinsing and cleaning.

5. Use for VA Reduction

Acetic acids are very small molecules; they can be removed in three steps.

- The first step extracts a combination of water, alcohol and acetic acids (the “Permeate”) from the wine through a Cross-Flow filter (the leftover “Retenate” is essentially the same wine, but now with lower alcohol, less water and less acetic acids).
- The second step first reduces the pH in a pH Column and then binds the acetic acid in the Permeate to a VA resin in an anion exchange column leaving only the water and the alcohol. Getting down to the nitty-gritty, the VA resin is designed to remove molecular...
acetic and not the ionic form – acetate ion. When the Permeate entering the cartridges has a pH approaching 4, that Permeate needs to be run through a pH correction cartridge first, followed by the VA resin. This increases the removal rate of VA from the wine. The reason is: as the Permeate hits the resin, the pH increases due to residual KOH. As the pH increases to 4.7, the amount of molecular acetic to acetate is 1 to 1. At this point, it is typical to only see a 50% reduction in the level of VA from the Permeate. If the pHC resin is used first, this lowers the Permeate pH to less than 3, and when it hits the resin, it remains fairly low – resulting in a higher concentration of molecular acetic, which then gets adsorbed on the resin. The result of the pHC is also to balance out the pH change in the wine.

- The third step is to recombine what remains (water & alcohol) in the Permeate with the original wine.

The VA Reduction Startup Process is:

1. Place end of the Wine Inlet hose into the barrel to be treated
2. Leave the end of the Wine Outlet hose in an empty 5 gal bucket
3. Insert the pH Column into filter housing 1 and connect the VA Column at Valve 2 and Valve 3 and check the Valve positions
   a. Valve 1, so the Permeate flows into a collection bucket
   b. Valve 2a, so the Permeate can flow into pH Column
   c. Valve 2b, so the pH adjusted Permeate flows to the VA column
   d. Valve 4, so the treated Retenates flows into a collection bucket
   e. Back Pressure Valve: open (2 turns counter-clockwise if closed)
4. Turn on the Main Switch (turns on Pump)
5. Watch for wine exiting the Wine Outlet hose into the bucket (this takes ~10 seconds)
6. As soon as the wine is tasted at the Wine Outlet hose, turn off the Main Switch, place end of the Wine Outlet hose into the barrel and turn on the Main Switch again
7. With wine flowing again, close the Back Pressure Valve (turn clockwise thumb tight) and watch flow in the Flow Meter. The system will pulse as pressure builds up.
8. Taste liquid exiting Valve 1 for alcohol, when so, turn Valve 1 and see liquid filling up cartridge housing 1
9. Bleed the cartridge housings by pressing Red Bleeder valves on top of housings. Leave bleeder valve on the VA column open until liquid is seen exiting
10. Filling the VA column takes a long time (~20 minutes?). Taste liquid exiting Valve 4 for alcohol; when alcohol is tasted turn Valve 4 180 degrees to return the Permeate to the Wine Out and barrel (never leave Valve 4 in 90-degree position – otherwise the cartridge housing will burst
The VA Reduction can be left to run for as many hours as is necessary. To reduce VA in a single barrel by 20%, we need to treat 40% of the volume as permeate. The flow rate should be 10-12 gal/hr; so a 20% VA reduction in a barrel should take approx. 2 ½ hours. To reduce VA by 50%, we need to treat 70% of the volume as permeate – this takes approx. 4 hrs.

The following measurements should be taken every 30 minutes:

1. Measure the pH of the permeate exiting the bleeder valve on the column with the pH Column cartridge. The pH should be 2.5 – 3.5. When pH rises above 3.5, then the pH Column is saturated and needs to be replaced. That process is:
   a. Open the Back Pressure Valve, turn off Main Switch and wait 2 minutes
   b. Close the Valves 2a and 2b. Unscrew the filter housing; pour out the Permeate, blow out and replace the pH Column; pour back the Permeate into the filter housing, and screw it back on
   c. Turn the Main Switch on, wait 1 minute then close the Back Pressure Valve.
2. Measure the pH of the Permeate exiting the bleeder valve on cartridge 4. The pH should be 6 – 10.5. When the pH drops below 6, the VA column is saturated and requires regeneration (see VA regeneration).
3. Watch the Flow Meter. The permeate should be flowing at 10-12 gal/hr or 0.16-0.2 gal/min
4. Watch that the system is pulsing; record the permeate pressure. If the pressure exceeds 600psi, the membranes are fouled, and the system needs to be cleaned.
At the end of a VA Reduction run, the contents of all Collection Buckets are emptied into the wine barrel. Then the system needs to be flushed out with Nitrogen or Argon to reduce the loss of wine, Retenate and Permeate. This is done with 3 separate flushes as follows:

1. Open the Back Pressure Valve to reduce the pressure in the cross-flow filter and turn off the main switch to the pump
2. Disconnect the outgoing side of the Anion Exchange tank and pour the contents into Collection Bucket #3 at incoming side of Valve 3
3. Flush #1: Disconnect the Wine-In hose, attach a Nitrogen or Argon tank instead and blow out the Pump and Intensifier at 20 psi until no more wine comes out of the Wine-Out return hose. Then open the empty filter container and pour contents into Collection Bucket #3.
4. Disconnect the Nitrogen tank from the Wine-In port and attach it to the Cleaning Port on the ingoing side.
5. Disconnect the incoming side of the Anion Exchange tank at Valve 2b and put the hose into Collection Bucket #2 for Permeate exiting the pH Column.
6. Attach a hose to the Cleaning Port outgoing side which leads to Collection Bucket #1 for the Retenate and open Valve 5
7. Flush #2: Open the pressure on the Nitrogen or Argon tank to 20 psi, then open Valve 6 to flush out the Retenate side of the cross-flow filter.
8. Close Valve 5 to fill the Retenate side with gas and flush out the Permeate side of the cross-flow filter through the pH Column into collection bucket; then unscrew pH Column cartridge, remove pH Column and poor Permeate collected into Collection Bucket #2 and close Valve 2a.

9. Flush #3: Disconnect Nitrogen or Argon tank from Cleaning Port at Valve 6, attach to the incoming side of the Anion Exchange Column and blow out the Anion Exchange Column into the Collection Bucket #4.

10. Empty the Collection Buckets #1 to #4 into the Wine Barrel.

6. Cleaning

At the end of use, the system needs to be cleaned thoroughly and then filled with a preservative solution to prevent the build-up of spoilage organisms. The cleaning is performed in two steps: first, the cross-flow filter is cleaned on its own, then the pump and intensifier are cleaned with the cross-flow filter in the loop. The strainer, filter cartridges and hoses are cleaned separately.

The process for cleaning the cross-flow filter is:

1. Connect external pump to the Cleaning Port 1, and the drain hose to the Cleaning Port 2
2. Open the Strainer and remove the cartridge. Rinse debris under running water and return to the housing
3. Open Valves 5 & 6 and close the pressure valve
4. TSP cycle: Dissolve 0.5 lbs of TSP in 5 gallons of 130 dF water (i.e. 1% TSP solution) in the Cleaning Solution bucket and turn the pump on move solution through the
membranes to drain. Expect 8-10 gpm of flow. Monitor the outflow. At first, it is dark brown, then turns to light brown and then to almost clear. When 5 gallons are used up, turn the pump off. Repeat the TSP wash at step 4 until the outflow is clear.

5. Cold water rinse: Hook the Cleaning Port 1 to cold water supply and flow cold water until the outside of the filter feels cool.

6. Citric rinse: Dissolve 1 lbs of Citric Acid in 5 gallons of cold water (i.e. 2% Citric solution) in the Cleaning Solution bucket. Reconnect the Cleaning Port 1 to the external pump and turn the pump on to move Citric solution through the membranes to drain. Expect 8-10 gpm of flow. Monitor the outflow. At first, it is yellow, then turns to almost clear. When 5 gallons are used up, turn the pump off.

7. Cold water rinse: Hook the Cleaning Port 1 to cold water supply and flow cold water until the outside of the filter feels cool.

8. Close Valves 5 & 6 and disconnect hoses from the Cleaning Ports

The next step is to clean the whole system. The process is:

1. Put the Wine-In hose into the hot water bucket. Point the Wine-Out hose and the hose exiting Valve 1 to the drain
2. Flush system with hot water: Open Back Pressure Valve; turn the main switch on; rinse for 3 minutes; close the Back Pressure Valve for 2 minutes – and repeat until water colour is clear. This can take 25 gallons. Turn the main switch off and wait 1 minute.
3. Put the Wine-In hose into the bucket with 25 gallons of 1% TSP solution in hot water and flush: Open the Back Pressure Valve; turn the main switch on; rinse for 3 minutes; close the Back Pressure Valve for 2 minutes – and repeat until the water colour is clear. Turn the main switch off and wait 1 minute.
4. Put Wine-Out hose into the bucket with hot water TSP solution (refilled if necessary) for circulation (clamp down hose on bucket because of pulsation): Open the Back Pressure Valve; turn the main switch on; circulate for 3 minutes; close the Back Pressure Valve for 2 minutes. Turn the main switch off and wait 1 minute. If water is not clear/light brown, go back to step 1.
5. Put the Wine-Out hose back to drain, connect the Wine-In hose to a hot water tap and flush system with hot water: Open Back Pressure Valve; turn the main switch on; rinse for 3 minutes; close the Back Pressure Valve for 2 minutes – and repeat until water colour is clear or slight yellow. Turn the main switch off and wait 1 minute.

6. Prepare 5 a gallon 2% citric solution in a bucket and add 1% KMBS. Then put the Wine-In hose into the bucket and flush the system: Open the Back Pressure Valve; turn the main switch on; rinse for 3 minutes; close the Back Pressure Valve for 2 minutes. Turn the main switch off and wait 1 minute. All hoses are now full of citric/1%KMBS combination.

7. Clean all the filter cartridges and corresponding valves separately in TSP – water – citric – water cycle.

Now the system is ready for storage. If the system remains unused in storage for more than 6 weeks, then the citric/KMBS solution should be refreshed to prevent the buildup of spoilage organisms. For longer storage period fill system with 30% Ethanol.

7. Regeneration

The final step is to regenerate the pH Column Cartridge and the Anion Exchange Column if they have been used (for VA reduction).

The Anion Exchange Column is regenerated with KOH (Potassium Hydroxide). The process is as follows:

1. Put the inlet hose from the auxiliary pump into a bucket with 10 gallons of KOH solution (8lbs of Potassium Hydroxide)
2. Connect the outlet hose of the auxiliary pump to the inlet of the Anion Exchange Column
3. Put the outlet hose from the Anion Exchange Column into a waste bucket.
4. Turn on the auxiliary pump and check that Anion Exchange column has no air by opening and closing the bleeder valve.

The Anion Exchange Column is stored full of KOH solution.

We let VA Filtration regenerate the pH Column resin because it involves highly toxic material. (VA Filtration uses 30% Hydrochloric Acid at 22psi). Contact at VA Filtration: Sue Poynter, office: 707-552-2616 x102

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Last updated: February 27, 2018
Cold Stabilization

Cold Stabilization is used to reduce the formation of sediments (i.e. to prevent the precipitation of crystals when bottles are stored at low temperatures for extended periods) and to reduce the amount of tartaric acid in wine.

Theory

Tartaric Acid ($H_2T$) dissociates into Bitrate ($HT^-$) and Tartrate ($T^{2-}$) depending on the pH and the temperature of the wine. The chart shows the distribution at 25°C.

In the presence of Potassium ions ($K^+$), of which there is plenty in wine, Bitartrate combines to form Potassium Tartrate (KHT). At high concentrations, Potassium Tartrate will crystallise and fall out as sediment. The concentration at which crystallisation happens (i.e. the wine becomes unstable) depends on the pH, the temperature and the alcohol content of the wine. The ability for wine to hold KHT in solution increases the higher the pH, the higher the temperature and the lower the alcohol. As a consequence tartrate crystals will form in the bottle when the wine is cooled down or stored for a long time. The crystals show up at the bottom of the cork and as sediment in the bottle. While they are not harmful or degrade the wine, their appearance as crystalline sediment is considered unattractive.

Practice

The ideal temperature $T$ to create rapid precipitation of tartrate crystals in °C is in approximate terms: $T= -A/2 + 1$, where $A$ stands for the % alcohol level in the wine (e.g. if $A=13\%$ then the ideal temperature is minus 6.5 °C or 20.3 °F). To get there, we need a glycol cooled vessel. We built such a vessel: it is a 30 gal steel tank with copper cooling coils on the outside and both inserted into a plastic drum holding cooling fluid which itself sits inside an insulated wood box.
The cooling fluid inside the copper coils is Propylene Glycol cooled down by our chiller (Kreyer Chilly Max). The picture shows the components on the right and the fully assembled Cold Stabilization unit on the left.

The cooling fluid in the plastic drum needs to be at least 20% propylene glycol in water (which has a freezing point of -8 °C or 18 °F) or 20% ethanol in water (which has a freezing point of -9 °C or 15 °F).

If the wine is cooled down to only 32 °F or slightly above, then cold stabilisation takes longer (days instead of hours). This may be preferable because then water can be used as cooling fluid in the plastic drum. The crystallisation of tartrate can be accelerated by seeding the process with a small amount of Potassium Tartrate (KHT) powder.

Special care has to be taken to limit the wine’s exposure to oxygen during cold stabilisation; at these low temperatures, wine is prone to absorb oxygen more rapidly and thus age faster. This is especially important when cold stabilisation takes longer and is done in a tank which is not completely air-tight. To mitigate oxidation, we fill the airspace in the tank with Argon and seal the lid.

We cold-stabilise during the winter months. Our process is:

1. Cool down the barrel from the usual 55 °F in the cellar to around 45 °F by taking it out and exposing it to the cool nights in winter.
2. Take a barrel sample and measure key parameters (pH, TA, phenolics)
3. Rack the wine from the barrel into the two 30 gallon cooling tanks.
4. Clean the barrel with the barrel washer and burn a sulfur pill inside it to keep it clean during the cold stabilisation process.

5. Cool the tanks down to 35 °F (using water in the cooling drum) then add 10g of Potassium Tartrate powder (KHT) to each tank.

6. Wait for 7 days to let the KHT crystallise

7. Test whether the TA has dropped enough. If yes, proceed to step 8, if no, go back to step 6.

8. Rack the treated wine back into the barrel and take a full set of measurements (pH, TA, SO₂, phenolics)

9. Replenish the sulfur (SO₂) level with KMBS as needed, top up the barrel and close it up.

10. Clean the tartrate sediments out of the cooling tanks.

For more details on Cold Stabilization see the following document written by Virginia Smith: 

Cold Stabilization has two important negatives: The wine needs to be chilled down to ~20 dF which takes a fair amount of energy and makes the wine vulnerable to oxidation (oxygen solubility in wine increases with low temperature). There are two alternatives to handle excess KHT: one is Electrodialysis (which due to the complex machinery required needs to be outsourced) and Addition of Tartrate Crystal Inhibitors.

Example

We only tried cold stabilisation once – in late 2015 on a barrel of 2012 cabernet which we judged to have too much acidity. The attempt was not entirely successful. After 3 weeks at a temperature between 35-40 °F we measured only a slight increase in pH and instead of tartrate crystals at the bottom of the tank, we found dark-red sediment. We never figured out what happened.
This page details the treatments suggested in the tables describing common wine-faults in the Elevage page. It has yet to be written.

To date, we have only used exposure to copper surfaces to alleviate sulfur-related odours (rotten eggs, cabbage, onions, asparagus) to correct the 2011-12 CSV topup wine.
Racking

Racking stands for syphoning the wine out of a barrel, cleaning the barrel and then moving the wine back into the barrel. Wine is racked for multiple reasons. First and foremost to remove sediments in a barrel. Secondly to aerate the wine to remove dissolved gasses left over from fermentation and to accelerate ageing in very tannic wines. Thirdly, racking always precedes mixing wines from different barrels or moving the wine from one barrel to another. Wine can be racked by sucking it out with a pump or force of gravity, or by pushing it out with an inert gas. We do not use pumps as some argue that even the gentlest pumps can be detrimental to wine. We use gravity flow whenever possible and inert gas in rare circumstances.

Racking is always followed by cleaning the barrel. This is described on page “Tank & Barrel Management”.

The following picture shows the steps in racking two different barrels while moving the contents between the barrels. The pictures illustrate a barrel switch which we decided to do for the 2014 Cabernet Sauvignon in early 2015, to give the wine in both barrels some exposure to new oak.

Blending

For blending we rack different barrels into a blending tank, let the mixture integrate for a few days and then moving the blend back into barrels or the bottling machine. Blending is essential
in large wineries where the winemaker has access to a multitude of barrels of various qualities which may complement each other. In our case we did not have that many options to blend up to now because we produce max. 2 barrels and only in 2012 had Merlot in addition to Cabernet Sauvignon. This changed in 2016 as the second vineyard started to produce Merlot, Cabernet Franc and Petit Verdot – we start harvesting Merlot in 2016 which should make it into the blending tank by 2020.
Before bottling we make final adjustments to the SO2 and CO2 levels in the wine. Then, when the desired blend of wine is ready in the mixing tank,

- we sparge each bottle and then fill it with wine
- we insert a cork
- we cap the top of the bottle with a foil
- we put a printed label on each bottle

We sparge, fill, cork and cap a bottle in a continuous process. With two people it takes around 30 seconds per bottle – so we can process 100-120 bottles, per hour. Labelling is done later. The picture shows a friend, Jost von Allmen, in action with the Sparger (bottom left) the Bottle Filler (left), the Corker (middle) and the Foil Spinner (top right). This page explains the final adjustments and the 4 bottling steps.

**Final adjustments in SO2 and CO2**

We make one, possibly two, final adjustments to the wine just before it is bottled. The first is adding more SO2 to enhance its resilience against spoilage organisms; the second is increasing the level of dissolved CO2 to enhance the perception of fruitiness if desired.

We increase the level of molecular SO2 to 0.50 ppm right before bottling; this is an increase from the 0.40 ppm target level during cellaring. We discussed the reasoning for SO2 additions in the Winery section, Step #8: Adding SO2. We measure the level of free SO2 with OenoFoss and then calculate the amount of KMBS (Potassium Metabisulfite) that needs to be added to reach the target level for molecular SO2 of 0.5 ppm. The details are explained in the Laboratory Section, page “Measuring and Adjusting SO2.”

If we decide that the perceived fruitiness of the wine needs a boost, then we measure the dissolved CO2 in the wine with a Carbodoseur. For Bordeaux style red wines 400-800 ppm is a reasonable target range. To increase the level of dissolved CO2, we add dry ice, which is frozen CO2. The amount of dry ice to be added depends on the volume of wine to be treated, and the assumed uptake of the CO2 gas as it bubbles through the wine. The page “Measuring Dissolved CO2” in the Laboratory section describes the Carbodoseur and the formula. We start out by adding 30%-50% of the required amount of dry ice and retest before adding more.
Filling the bottles

We buy standard greenish Bordeaux bottles from regional distributors by the pallet. (e.g. Vitroval USA, www.vitrovalusa.com). In bulk, they cost around $0.50 per bottle.

The wine flows from the elevated mixing tank by gravity to the bottling machine. We sparge the bottles (i.e. filled halfway with Argon) before we fill them with wine. Sparging has two purposes: first, it reduced the wine's contact with oxygen as it pours into the bottle. Second, it fills the headspace; the airspace left to make room for the cork, with the inert gas, to reduce oxygen contact while the wine matures in the bottle.

The bottles are placed by hand under one of two spouts, and the filling machine (Zambelli Tivoli2, http://www.zambellienotech.it/index.php/en/products/enologia/item/filling-machine-tivoli, purchased from Napa Fermentations) automatically fills each bottle to a predefined level. When full each bottle is handed to the person operating the corks and the foilers.

Corking

As we plan for extended bottle ageing, we buy high-end corks. Our supplier is Portocork in Napa, http://www.portocork.com and we end up paying around $0.75/piece for natural corks.

Our corksing machine (Zambelli Bacco Vacuum Corker, http://www.zambellienotech.it/index.php/it/zambelli-prodotti-enologia/enologia/item/linee-di-imbottigliamento, purchased from Napa Fermentations) is fully pneumatic. A vacuum is created before the cork is pushed in and the pushing action is created by pressurised air. So we need both a compressor and a vacuum pump to operate the corks.
Capping with a Foiler

Foils are put over the top of the bottle to protect the cork from mould formation. While mould is no longer a significant threat, foil tops survived mostly for aesthetics. Foils are today made from thin heat-shrinking plastic or metal slightly larger than the bottle top. They shrink and form a tight seal when the Foil Spinner is lowered over the bottle top.

Our Foil Spinner is Italian made (Binello - Alba); we purchased it from Napa Fermentation. We buy our foils in boxes of a thousand from Ramodin USA in Napa (www.ramondin.es/en/).

Labelling

As with all other steps, we decided to design and print the labels in-house and affix them to the bottles ourselves. This requires some equipment choices (label printer, software and labeller) Because we do not sell our bottles, we have the freedom to design labels without artistic or content restrictions – for commercially distributed wines, the government specifies what can and what must be on each bottle label.

Equipment Choices: We purchased a special-purpose label printer in 2012 (Zeo! from QuickLabel Systems, www.quicklabel.com) with associated spooler and label design & printing software plus rolls of label stock. This was a poor choice because the software and the printer are badly designed, and the company refuses to upgrade the software to work on Windows operating system beyond XP – thus we need to maintain an old PC running Windows XP dedicated to the printer! The company introduced a new printer at twice the price instead. Bad customer service. In recent years we have thus switched to an external label-printing service Fernqvist Labelling Solutions in Mountain View, CA (www.fernqvist.com/); the material and printing costs for a simple design are around 50 cents per label.
We bought a basic electric labeller (Bottle-Matic II, from Dispensa-Matic, www.dispensamatic.com/bottle-matic/) which works very well, is ideal for our requirements, is reliable and easy to operate. With it, we can easily label around 150 bottles per hour.

Labels Produced

We decided to produce very classic labels with a fair amount of information about how the wine was produced on the back label. We also manually number each bottle.

2009: we produced 3 very similar labels: one for each type of cellaring we tried out. “2009 oaked” for the 450 bottles we got out of mixing the contents of the new French oak barrel with half the contents of the neutral American barrel. “2009 unoaked A” for the 150 bottles we got out of the neutral American half-barrel, and “2009 unoaked B” for 150 bottles we got out of the remaining half of the neutral American oak barrel.

The back label texts were similar; for the “2009 oaked” it read: This wine is made entirely from Cabernet Sauvignon grapes grown, vinified and bottled at 21891 Via Regina, Saratoga, California. We harvested 1.3 tons of grapes at 23.6 Brix on October 10, fermented without the addition of yeasts over 2 weeks and pressed into 2 ½ barrels plus top-up carboys. The wine was aged 27 months in a new French oak barrel and 1 ½ neutral American barrels. The goal was to produce a benchmark wine. In March 2012 we blended the entire French oak barrel with half of the neutral American barrel and filled 450 bottles labelled “oaked”. The remaining neutral wine filled 150 bottles each labelled “neutral A” from half barrel and “neutral B” from the full barrel. Chief winemaker Aran Healy, assistant Till Guldimann. / This is bottle # of 450. / Government Warning: (1) According to the Surgeon General, women should not drink alcoholic
beverages during pregnancy because of risks of birth defects. (2) Consumption of alcoholic beverages impairs your ability to drive a car or operate machinery and may cause health problems. Contains sulfites. Alcohol 13.5%. General Warning: Consumption of this wine may also make you feel smarter and funnier than your mother ever thought possible.”

2010: We changed the text on the back label

2011: We changed the text of the back label
2012: we changed the design of the front label slightly and started using an external printing service (www.fernqvist.com/contact-us).

2013: we changed the back label.

2014: we changed the back label to.
Bottle Storage

Our wine takes 2-5 years to mature in the bottle until it becomes good enough to drink. After that, it can take another 5-10 years until it reaches its peak. We produce around 600 bottles per year. Thus we need storage capacity for around 5000 bottles. Bottles are ideally stored in a dark room at a constant temperature of around 55°F and 50-70% relative humidity. When we built the winery we did not adequately plan for this storage space in the cellar, so we needed to retrofit and air-condition a room in the barn a few years later.
Cellar Summaries

This page reviews our cellar activities for the 7 vintages cellared to date. Before 2017 we used a spreadsheet to track the sensory qualities, the laboratory results and the actions taken approximately every 1-2 months as we monitor each vessel. In 2017 we switched to a relational database. This page shows the screenshots of the summary tab in the Cellar Batch Reviews for each vintage (note, the commentaries in the database are not yet complete). The laboratory measurements show up only in the later years as we became more diligent with chemical analysis and recording. In summary:

- **2009:** with the help of an experienced nose & palate (Aran Healy) we took a minimalist approach (only 2 rackings) and recorded very little of the few lab tests taken.
- **2010:** we changed to regular racking to soften the tannins through more oxidation; the young wine was over-extracted in fermentation. We continued to rely on Aran’s tasting experience for monitoring and only recorded very few lab tests.
- **2011:** we were challenged by a poor harvest and the departure of the nose. I failed to properly rack and monitor the top-up wines and so introduced wine faults which may have affected the barrels. We ended up bottling a mix of 66% 2011 Cabernet with 33% 2012 Merlot.
- **2012:** the harvest was excellent but our cellaring continued to be challenged by the lack of a professional “nose”, poor laboratory analysis/recording and faulty racking practices on the top-up wines. We combined all top-up wines and struggled with the resulting cross-contamination.
- **2013:** an outstanding harvest combined with corrected barrelling practices. We welcomed a new nose (David Fenyvesi in late 2012) and significantly improved laboratory practices. There is hope. We decided to extend barrel ageing for this vintage from our standard 3 years to 4 years.
- **2014:** the harvest was good in quality but 30% less in volume, so we had to mix in 12 gallons of 2012 CSV topup wine and 6 gallons of Jim Barth’s Merlot to fill the second barrel. Acidity was low, so we added tartaric acid, but it turned out too much, and we struggled through barrel ageing until we cold-stabilised.
- **2015:** the harvest was poor, both regarding quality and volume. We could fill one barrel, and that only by adding 8 gallons of the 2012CSV blend to be bottled. We also had to set aside 15 gallons of that blend for topping up. *More to come*
• 2016: the harvest included, for the first time the Merlot, Petit Verdot and Cab Franc from the upper field; it was plentiful, but phenolics were poor. We free-flowed into 3 oak barrels. *More to come*

• 2017: the harvest was poor both in volume and quality We free-flowed into one full and one half-barrel. *More to come*

The following paragraphs describe each vintage.

2009 Vintage

2009 was our first year of wine-making and cellaring. We continued the minimalist winemaking approach into barrelling. The process remained very basic: On completion of Malolactic fermentation in barrel, we added a 25ppm dose of sulfur and maintained a level above 8 ppm checking quarterly. We racked the barrels only twice, the first time 6 months after harvest, the second time just before bottling. We took minimal measurements and judged progress mainly by smelling and tasting (mostly Aran Healy’s nose and palate). We kept extra wine in a few glass carboys (between 1 and 6 gallons each) and topped up the barrels every 3-6 months.

We used one new French oak barrel (Seguin Moreau Select Cabernet ML), one neutral American barrel (unknown provenance) and a refurbished half-barrel (unknown provenance). We had a recording gap between June 2010 and October 2011 and don’t remember how many times we adjusted SO2 and topped up.

Following are screenshots of the Cellar Batch Reviews for the three 2009 barrels:
After 27 months in the barrel we decided to bottle in 3 separate batches so we could continue to see the effect the different barrels had on the wine:

- Oaked: we mixed the entire contents of the French oak barrel with 30 gallons of the used American barrel and put into 450 bottles labelled 2009 Oaked.
- Unoaked A: we put the remaining 30 gallons of the used American barrel into 150 bottles labelled 2009 Unoaked A
- Unoaked B: we put the entire content of the refurbished / neutral half barrel into 150 bottles labelled Unoaked B.

2010 Vintage

In contrast to 2009, we became far more interventionist: We decided to rack more frequently (every 3 to 6 months) to expose the young wine to more oxygen. We also decided to fine the wine with 3 1/2 egg whites just before bottling. We used a new French oak barrel (Seguin Moreau Icone) and a new American oak barrel (Saint Martin M+) to evaluate the difference in oak.

We mixed the remaining 2009 topup wine with the 45 gallons of press wine from 2010 and kept the lot in a 50-gallon steel tank with variable top lid. We traded juggling the heavy glass carboys with a steel tank which tended to attract fruit flies and microbial infections at the seal of the variable top lid.
We continued to rely on Aran Healy's nose and palate to judge progress and did not record the few laboratory tests we took other than the SO2 measurements required to calibrate the sulfur additions. The exception was in May 2013 when we brought samples to Fermentation Solutions for a test panel based on their new OenoFoss spectral analysis instrument.

After 30 months in the barrel we decided to mix the wine from the 2 barrels; tame the excessive tannins with an egg-white fining and bottle in a single lot of 48 cases (570 bottles). The flavour profiles of the French and American oak complemented each other. The wine was over-extracted during fermentation and will take a long time in the bottle to mellow out.

Following are screenshots of the Cellar Batch Reviews for the two 2010 barrels:
2011 Vintage

2011 was a difficult harvest (low yield, not fully ripened fruit). The challenges kept compounding in the winery as the Aran Healy's nose and palate, on which we relied on to judge progress, departed in early 2012 (together with Aran himself) and left me struggling without the support of an experienced winemaker for over a year. We used a French Oak barrel (Radoux Blend Evolution R), and we set the second barrel (Seguin Moreau Icone), we had already purchased, aside for next year. We combined the little amount of 2011 excess wine with the leftover 2010 topup wine. After 1 ½ years in the French oak, we racked the wine into an American oak barrel (Saint Martin M+) to cover up the green apple character (pyrazine).

In retrospect, the trouble started when I forgot to rack the topup steel tank in 2012 and did not pick up any fault until July 2013 while using that wine all along to top up the 2011 barrel. We then compounded the problem by adding to it the bulk of the contents of the 2012 topup tank which had similar problems. As a result, we lost half the topup wine and may have polluted the 2011 barrel.
By February 2014 we concluded that the 2011 Cabernet was not strong enough to stand on its own and decided to mix it with half a barrel of the 2012 Merlot from Bargetto (see next paragraph). The problem with that Merlot was that it did not complete its malolactic fermentation (even after a second inoculation). So we ended up with a weak Bordeaux mix (Anthocyanins at 93) with a high level of malic acids. As we store the bottles at 55°F, the risk of a late ML fermentation in the bottle is minimal.

**2012 Vintage**

2012 was an excellent vintage, both regarding quality and yield. We produced two barrels of Cabernet from our fruit, we purchased half a ton of Merlot grapes from Bargetto to yield another barrel, and we traded in a carboy of Merlot wine from Jim Barth. The idea behind the Merlot purchases was to get an option to for blending down the road. By mid-2013 we had introduced a solid quarterly cellar review process which produced reasonable laboratory figures, we got started to benefit from an experienced nose and palate of our new live-in winemaker, David Fenyvesi, and we introduced phenolic analysis in the 3rd quarter.

**Merlot:** We put the Bargetto Merlot first into a neutral French barrel and changed 6 months later to a French barrel used for 2 years (2011 Radoux Evolution R). We only noticed in early 2014 that it never went through malolactic fermentation. We treated it with 225g of potassium bicarbonate to increase the pH to 3.5 and re-inoculated with Viniflora CH16 bacteria. In the summer of 2014, we used half the barrel to blend with the 2011 Cabernet Sauvignon and
moved the rest to a neutral half-barrel. By September 2014 that half-barrel proved to be problematic – the wine developed a bad smell and high Volatile Acidity; so we decided to discard that half-barrel and move the Merlot to a pressurised steel keg and carboys.

**Cabernet Sauvignon:** We barreled the wine into two French oak barrels, one new left over from 2011 (Seguin Moreau Icone) and one used previously for the 2009 vintage (Seguin Moreau Select). We had 24 gallons of topup wine which we merged with the remaining 10 gallons of the 2011 topup wine; then we moved the topup wine from the variable top steel tank into two new pressurised steel topup tanks. Again we made the mistake of not checking the SO₂ levels in the topup tanks, and we missed to rack it for the first 9 months. As a consequence, we may have polluted one of the two barrels, but the rotten egg smell disappeared after another racking of the barrels and KMBS additions. For bottling, we merged the two Cabernet barrels with the remaining 15 gallons of the 2012 Barghetto Merlot. Because by then we were running out of the top-up wine we moved 15 gallons of this mix in a pressurised topup tank as 12CSMerCHBargTopup and bottled the rest in 45 cases as 12CSMeCHBargb.
2013 Vintage

2013 was splendid vintage with good yields and excellent berry quality. This is the first year we tracked the phenolics from the start (see Winery section) and thus have a better understanding of its evolution. We used a new French oak barrel (Radoux TR M+) and recycled a 3-year-old French barrel which was used for 2 years (2010 Seguin Moreau Icone). We had 20 gallons of extra press wine which we kept in the 200-litre variable-top steel tank. We detected a slight off-nose in the second barrel which may be a result of a microbial infection from its prior use. So we
racked the wine into a steel barrel while treating the empty barrel with a KMBS solution and sulfur fumigation.

By February 2014 malolactic fermentation had still not progressed, so we decided to re-inoculate all wine with Viniflora CH16 while keeping the temperature elevated at ~70dF. By July 2014 we noticed a slight decrease in malic acid and a slow buildup of lactic acid which gave us hope that malolactic fermentation was restarted, albeit weak. We kept the barrels at close to ~70dF. By late 2014 the malolactic fermentation looked complete.

We found significant film in the 2013 top-up tank in late January 2014 which we scooped out judging it as dead yeast brought to the surface due to the slight vacuum in the headspace created by sampling. To protect, we added 15 ppm of SO2 as a preventative measure although malolactic fermentation had not completed and we moved the topup wine into a freed-up pressurised steel tank. By April 2014 the 2013 topup wine had developed a strong rotten egg smell, and we decided to treat it with a heavy dose of KMBS and move it aside into carboys; after that, we used the leftover 2012 topup wine for topping up the 2013 vintage. The 2013 topup wine recovered by the end of 2014 and we used it to fill up the second barrel in the 2014 vintage which was a little short.

The Bound Anthocyanin levels peaked in mid-2015 at slightly over 380 (ppm ME), a record. By late 2015 the wine developed well, except for the relatively high level of Volatile Acidity at 0.8 g/L.

On September 24, 2016 we bottled 42 cases as 13CSCHb and kept 15 gallons into topup tank 13CSCHTopup
2014 vintage

2014 was an average year, quality-wise, and poor on volume as we continued to fight the Eutypa infection. We could barely fill the second barrel by adding 12 gallons of the 2012 CSV top-up and 5 gallons of the 2012 Merlot from Jim Barth. The Malolactic fermentation was again slow, probably a cause of the relatively high acidity. The more diligent cellaring routines showed good results: compared to previous vintages we had hardly any microbial infections in either barrel. After 9 months, we decided to rack and switch the new and the 3-year-old barrels to
even out the impact of the new oak. The Bound Anthocyanin levels seem to have peaked at around 250 (ppm ME) after 1 year in the barrels.

More to come here.

In September 2017 we put the two barrels into Mixing Tank, added 1 lbs (1 ppm) of Potassium Carbonite to adjust the pH up to 3.55, then bottled 42 cases as 14-13CSCHb and leaving 14 gallons for topup as 14-13CSCHTopup. Unfortunately, we failed to stir the wine in the Mixing Tank properly so early bottles came out with pH of 3.7 and late bottles with pH of 3.35!
2015 Vintage

2015 was a poor year both regarding volume (less than a ½ ton of fruit) and quality (a fair amount of shrivelled berries due to a mildew infection). We could fill one barrel, and this only by transferring 8 gallons of the 2012 CS bottling blend. We also had to put aside 15 gallons of that blend for top-up wine as we had exhausted other top-up sources.

More to come

2016 Vintage

The 2016 vintage included for the first time the Merlot, Petit Verdot and Cab Franc grapes from the upper field. The yield was above expectation and the fruit somewhat overripe. We fermented in 7 separate batches and free-flowed into 3 barrels. The first barrel had a mix of Long Row CS plus half the Me-PV-CF crop; The second had a mix of Short and Long Row CS plus the other half of the Me-PV-CF crop. The third had mostly Short Row CS.

More to come
## REVIEW: Cellar Batch 16CSMePVCCHwb1

### Components of Cellar Batch

<table>
<thead>
<tr>
<th>Component</th>
<th>Total Volume</th>
<th>pHL</th>
<th>pH</th>
<th>TA</th>
<th>Titratable Acidity</th>
<th>pHYSX</th>
<th>Vol %</th>
<th>Vol %</th>
<th>Vol %</th>
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<tr>
<td>F Batch 1</td>
<td>2016_C6L_Batch_1</td>
<td>24</td>
<td>3.9</td>
<td>3.5</td>
<td>12.3</td>
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### Sensory and Sugar Correlation

- Acidity in Batch 1 correlates with:
  - TA: 0.79
  - pH: 0.68
  - Vol %: 0.68

### Physical Correlation

- Vol %: 0.85

---

## REVIEW: Cellar Batch 16CSMePVCCHwb2

### Components of Cellar Batch

<table>
<thead>
<tr>
<th>Component</th>
<th>Total Volume</th>
<th>pHL</th>
<th>pH</th>
<th>TA</th>
<th>Titratable Acidity</th>
<th>pHYSX</th>
<th>Vol %</th>
<th>Vol %</th>
<th>Vol %</th>
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---

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2017 Vintage

The 2017 vintage was poor in volume and quality, mostly because of mildew and severe heat-spikes in the summer. In the lower field, we abandoned the Short Row block and picked only the Long Row Cabernet which yielded one barrel. The upper field yielded a half barrel of Me-PV-CF mix. All fermentations were done with indigenous yeast.

More to come
### REVIEW: Cellar Batch

**17MeCFPVC/Hwb2**

**Overview**
- **Composition Data:**
- **Grapes & Sugar Manip:**
- **Notes:**
- **SO2 Additions:**
- **Aroma & Ill:**
- **Phenolics:**
- **Pneumatics Composition:**

#### Principal Harvest Data
- **Date:** Oct 21, 2017
- **Volume:** 30 gal
- **Color:** 14.2% Vol.

#### Components of Cellar Batch
- **Date:** Oct 21, 2017
- **Type:** 10 day batch in celler

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
<th>Nature of Slc</th>
<th>Aroma</th>
<th>Ill</th>
<th>Presence</th>
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<tbody>
<tr>
<td>Tannins</td>
<td>8%</td>
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<tr>
<td>Phenols</td>
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</tbody>
</table>

#### Notes
- **Acidity Commentary:**
- **Phenol/Aroma:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Nature of Slc</th>
<th>Aroma</th>
<th>Ill</th>
</tr>
</thead>
<tbody>
<tr>
<td>VA [g/L]</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total Phenols</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

#### Sensors and Sugars Commentary
- **Total Acidity:** 0.5 g/L
- **Free Acidity:** 0.5 g/L
- **Matrix Acidity:** 0.5 g/L

---

Previous page: Bottle Storage
Top of page: Go
Next page: Home
Last updated: March 3, 2018