Barrels & Ageing

Wine 3
Introduction to Enology

4/1/2014

Tonight's Lecture

- Types of Barrels.
- Costs and benefits of using barrels
- Types of oak used for barrels
- How barrels are made
- Managing wine as it ages
- Alternatives to barrels
- Cleaning and storing barrels

History

- Barrels were first used for wine by the Romans. They were a big improvement over amphorae (Greek) and goat skins, can be built without metal using pegs and split willow hoops.

Barrel Morphology

Types of Barrels

- Export Barrels
  - Originally made for shipping, thicker & stronger wood, can be shaved and stacked easier.

Types of Barrels

- Chateau Barrels
  - Made for use at the winery, thinner staves, some have willow hoops and a headboard, they are lighter but not as strong, there is more loss from evaporation while aging.
Shapes of Barrels

- **Burgundy vs. Bordeaux**
  The same as far as wine flavor is concerned but have slightly different shapes. Burgundy BBLs are shorter and fatter and usually hold a few liters more (228 vs. 225); Bordeaux are longer and narrower.
  - If you are stacking high use Bordeaux.
  - It’s difficult to have both types in one stack.

Barrel Sizes

- Most French & American BBLs are 225 Liters (59 gal.) 65 and 70 gallon are also available (Bordeaux length x Burgundy width)
- Puncheons (hogsheads) are 120 gal.
- Smaller home winemaking BBLs are available but have a high surface to volume ratio and oak up the wine very quickly.
- Bourbon barrels are 52 gal, and should not be used for wine.

Wooden Tanks

- Uprights or tanks
  - They do not extract as much from the oak due to the lower surface to volume ratio.
  - 2500 Gal Tank is 9.3 Gal/ft² vs. barrel is 2.7 Gal/ft².

Cost

- **Stainless steel** (6,500 gallon) = $2.75/gal (can be much more)
- **French Oak** $850+/BBL = $14.40/gal
- **Hungarian Oak** $650+/BBL = $11.00/gal
- **American Oak** $350+/BBL = $5.93/gal
- Wide variation in cost between coopers.
- There is no sales tax on barrels; why? A: They are considered an ingredient.

Ullage

- In addition to the cost of the barrels, there is the expense of ullage, the loss of wine due to evaporation through the wood.
- Wood is semi-permeable; water and alcohol defuse out faster than air can defuse in.
- This is shown by the vacuum that develops BBLs are tight bunged.

Barrels are non-sterile

- Wine is absorbed into the oak pores and inhibits the sterilization of BBLs. Barrels are often repositories of both beneficial and harmful microbes such as: *Saccharomyces*, malolactic bacteria, *Brettanomyces*, and *Acetobacter*, which cleaning can reduce but not eliminate completely.
So, why use them?

- Question?
  If they cost more and are more difficult to work with why are they so popular?

- Answer:
  Aging wine in oak can make a strong positive contribution to the flavor and style of a wine.

Benefits of barrel ageing

- Concentration
  - Concentrates the wine due to evaporation.

- Aeration
  - Slowly incorporates air (oxygen) into the wine.
    - Color is stabilized from oxidation of free anthocyanins and the condensation of tannins.
    - Tannins soften due to polymerization & precipitation reduces astringency.
    - $O_2$ is also introduced by filling, topping and emptying.

- Oak flavor
  - Wine absorbs extractives from oak surface including:
    - Aromatic Compounds Oak lactone (coconut / Band-Aid taste), vanillin, phenyl ketones, furfurals, and volatile phenols, guaiacol and eugenol (closes/ cinnamon).
    - Wood Tannins That are soluble in wine contribute to body astringency and bitterness.

Compounds extracted from oak

Result from:

- Direct diffusion from wood into wine.
- Transformation of non-volatile compounds into volatile compounds by yeast and bacteria.
Compounds extracted from Oak
- The amount and composition of these extractable compounds determines the flavor of the barrel and result from:
  - Species of oak
  - Source of the oak (where it was grown)
  - Coopering methods

Effects of barrel age on red wine
- Fruity character is diminished.
- Color goes from blue/purple to ruby red.
- Wine becomes softer and less tannic as polyphenolic compounds polymerize (join together) and settle out.
- The wine picks up flavor and aroma compounds from the oak.

Effects of barrel age on white wine
- Fruity character is diminished.
- Wine may become slightly more tannic by absorbing oak tannins.
- If fermented in oak the wine will take on a toasty aroma.
- The wine picks up flavor and aroma compounds from the oak.

Why Oak?
- It meets the requirements for porosity (won't leak), strength and flavor.
- Historically chestnut was also used to make barrels.
- Acacia is still used today if you want aged character without oak flavor. Unusually used on whites like Viognier and Pinot Blanc.

Source of oak
- **Sapwood** the cambium layer and the new wood under the bark this is the conductive portion of the tree.
- **Heartwood** older growth rings in the center of the tree.

Trees get their structural support when the conductive vessels in the heartwood are plugged with intrusions called **tyloses**, as the tree ages, so only heartwood is used for cooperage because it is stronger and less likely to leak.
European Oak

Quercus petraea or Q. robur in some forests they grow side by side. These species are higher in extractable phenols and less woody character, so they contribute more to astringency. They grow throughout France and Central Europe.

American Oak

- American oak is sourced from White Oak, Q. alba, more dense (BBLs heavier) because they have more tyloses, they are also less likely to leak.

American Oak

Q. alba is native to the Eastern U.S.

Oregon Oak

- Barrels are also made from Oregon oak, Q. garryana, has a flavor profile that is closer to French oak than American. However, the availability of the wood is limited.

French Oak forests

- If an oak tree grows in rich soil, a warmer climate, or has more water it will grow faster and be lose grained.
- Lose grained oak is more easily and quickly extracted. If the opposite is true the tree will grow more slowly and the wood will be tight grained.
- The soil of the forest also will affect the flavor of the barrel.

French Oak forests

In France, they have graded the different forests by the tightness of the grain and found that each is suited for particular types of wine.
**FOREST**  |  **GRAIN**  |  **WINE USE (traditional)**
--- | --- | ---
Limousin  |  loose  |  Fortified wines and distilled spirits
Nevers  |  average  |  Table wines (Big wines), Brandy (with heavy toast)
Troncais  |  tight  |  Table wines
Allier  |  tight  |  Table wines
Vosges  |  tightest  |  Table wines

**French Oak forests**
- The data in the previous table is generally true, however most people can't taste the difference between the forests (except for Limousin).
- The difference from tree to tree is so great that some cooperers use a blend of woods from different forests in the center of France for greater consistency from barrel to barrel.

**Sustainably Farmed**
- French oak forests have been farmed for hundreds of years. Forests are managed so the trees produce tall and straight trunks.

**Eastern European Oak**
- Former east block countries such as Hungary, Romania and Russia have been producing oak barrels for years and a increasing amount of it is finding it way to California.
- Priced between American & French Oak they have an attractive value. Under communist rule, construction was mediocre, but they are now on par with French Oak.

**American Oak Forests**
- The different forests of oak in America are also similarly rated; for example, Minnesota Oak is tight grained due to cold climate.
Coopering (Barrel Making)

- Coopering methods can have a greater effect on barrel flavors than wood source. They include:
  - Splitting/sawing
  - Drying
  - Bending
  - Toasting

French vs. American coopering

- Originally, American oak barrels were only mass-produced for the bourbon industry. So winemakers in California had to buy bourbon barrels if they wanted American Oak.
- As the wine industry grew, by the 1980s, cooperers were making American Oak barrels in the French style for use in wine.
- Now almost all wineries buy only "French Style" American Oak Barrels.

Bourbon Barrels

- American Oak
- 52 Gallons
- Kiln Dried
- Steam Bent
- No Toasting
- Not Good for wine
- Success of Bourbon is reducing the supply of oak.

Splitting

- Split vs. quarter sawn.
- Split is better for European Oak because it has fewer tyloses and when the wood cleaves along the grain there are fewer leaks.
- Sawn (flat sawn or quarter sawn) exposes the wine to more grains and gives more efficient usage of the wood. Quarter-sawn gives a more intense woody flavor. It allows for more efficient use of the wood.

Seasoning/ Drying

- After harvesting wood is dried from 75% to 15% water content. Open air-drying exposes the wood to rain, which leaches out some of the bitterness and astringency.
- Air drying takes from 2-3 years.

Stave Diagram
Bending

- The wood is heated to bend it in the curve of the barrel. Fire bending can cause blistering and breakage if done improperly.

Toasting

- Caramelizing rather than charring (blistering).
- Decrease in phenols and increase in aromatic compounds. Reduces raw wood character bringing out a more complex flavors like vanilla, spicy, toasty, coffee.

Toasting

- Toasting level is stylistic, generally:
  - Chard, Pinot & Syrah higher toast
  - Cabernet, Merlot & Zin medium toast
- I prefer medium to medium plus toast on most wines because it is more versatile. There can be big variation between coopers.
- Heads can be left toasted or untoasted.

American vs. French, for flavor which is better?

- Neither is better but they are different, American oak was traditional made for bourbon production and the barrels did not taste very good for wine, so they got a bad rap. Made in the French style they taste much better.

American vs. French, for flavor which is better?

- Generally, I think AMO is best used in red wines, it's too strong of a flavor for most whites and delicate reds such as Sangiovese and Pinot Noir.
- On Reds besides Pinot Noir or Sangiovese I like to have a mix of both, it gives me more options during blending.
**Video**

- Barrel making video

---

**New Barrel Treatment**

- New barrels should be filled with water to rinse them out and test for leaks. You can either fill the barrel all the way or fill it with 5 gallons of hot water and roll it around.

---

**Filling and emptying**

- Barrels are filled and emptied with the use of a barrel wand. The wand releases the wine at the bottom of the barrels so it does not splash.

---

**Filling and emptying**

- Disgorging wands use nitrogen gas pressure to remove the wine in the barrel. Slower but more gentle with less oxygen pickup.

---

**Racking Barrels**

- Barrels are stacked or racked for storage during ageing.
  - Barrels stacked directly on top of each other are more picturesque but also are more difficult to work with.
  - Racked barrels are more efficient for processing and take up less storage space. They can be stacked up to 6 levels high.
### Racking Barrels

![Racking Barrels Image]

### Inventory Control

- Large wineries use barcode scanning systems to recode barrel inventory.

![Barcode Scanning Image]

### Safety

- Four Barrel racks are more stable than two barrel racks.
- Short stacks (4 high) are safer than tall stacks (7 high).
- Don’t climb on racks when taking samples, using a ladder or lift.
- Barrel stacks are hazardous during earthquakes, strapping down the top barrels and using a “earthquake rack” base make them safer.

### Earthquakes and Barrels

Not a good combination, just ask Chile

![Earthquake Image]

### Storing Barrels

- Barrels should be stored at about 55 to 60 °F, higher temperatures result in faster ageing and more loss to evaporation.
- While they are being aged the barrels need to be periodically sampled for tasting and analysis to ensure everything is O.K.
- A good time to sample is just prior to topping.

### Humidity

- Ullage increases with high temperatures and lower humidity (evaporation increases). Average loss ranges between 0.5 & 2.5 gal/ year.
- Humidity also determines the relative rates of water and alcohol loss.
  - <80% more water is lost, alcohol increases
  - >80% more alcohol is lost, alcohol decreases
**Humidity**

- Most caves run 90 to 95%. Alcohol loss can be beneficial to many California table wines.
- Either way the remaining wine is more concentrated in flavor, character, and acid during ageing.

**Topping**

- Topping replaces the headspace that builds up with time. Some of the same wine is used to top off the barrel.

**Topping**

- Whites are usually topped more frequently than reds, every week to every two months. Often whites are topped when the lees are stirred.
- Reds usually topped every 2 to 3 months
- If the wine is sampled and tested before topping any adjustments that are needed can take place when the wine is topped.

**Barrel Programs**

- A BBL loses its flavor after 6 to 8 years depending on use. The structural integrity of a BBL will last basically forever if it is cared for properly.
- Often barrels are first used for whites then reds and expensive wine before inexpensive wines.
- Then their sold for planters or Scotch production.

**Shaving**

- To extend their life barrels can be opened up and the first layer of wood scraped off (About 1/4 of an inch) and re-toasted for more use.
- The toasting is usually not as uniform and the BBLs sometimes leak. They are also not as strong for stacking.
- Costs about $100 to $200 dollars per barrel, its nice not to do it if you can afford not to.
**Barrel Inserts**
- When the oak flavor is gone from the wood the BBL is opened up and strips of new wood are put in that approximate the surface area of a barrel.
- New wood can also be added through the bung hole.

**Oak Adjunct in Barrels**
- They come in spirals, chains, socks, and in every type of wood and toast.
- Adjunct is relatively cheap ($20 to $80/barrel) so don’t skimp!

**Oak without barrels**
- **Stave systems**, placing oak staves in stainless steel tanks to pick up oak flavor without using barrels.
- Don’t put the wood near the thermo-wells.

**Tank Staves**
- Tank staves take about 5 months to give up their flavor and are usually used only once.
- Cost about one tenth as much per gallon as French oak barrels.
- Used on less expensive wines.
- You only need to have 30 to 40% of the surface area of a new barrel (22 ft²) to get new barrel character.

**Micro-Oxygenation**
- **Micro-ox** is an attempt to get the flavor of barrel aging without the high cost, some wineries are using tank inserts combined with micro-oxygenation.
- In micro-ox very small amounts of oxygen are defused into the wine at a similar rate that the wine would receive in barrels.
**Micro-Oxygenation**

- The wine picks up the oak flavor and aged character but there is no concentration because there is no evaporation.
- Good for inexpensively priced wines.

---

**Oak Chips**

- These are small pieces of oak that are added to a wine or a portion of the wine for blending. The best are small chips that are toasted rather than sawdust.
- One method is using old BBLs combined with chips to make a moderately priced wine.

---

**Barrel Sanitation**

- Wood is a porous substance and any cleaning agent that you use has a chance of being absorbed by the wood and later being released into the wine.
- For this reason, use only food grade products while cleaning.
- Chlorine should never be used around barrels due to risk of formation of TCA.

---
Barrel Sanitation

- After cleaning out the barrel a rinse with ozoneated water will sanitize the inside of a barrel and is a very good method of preventing growth of spoilage bacteria and yeast.

Gamma Jet makes a mechanical high-pressure spray jet that will fit through a bunghole that blasts off tartrates. However they are expensive and somewhat delicate.

Storing dry barrels

- When barrels are stored empty they may dry out shrinking the wood and causing them to leak, microbes can grow on any residual wine in the wood causing off odors and VA (Volatile Acidity) to form.
- To prevent this barrels should be well cleaned before storing and they should be treated with SO$_2$ if they are going to be empty for some time.

A short blast of SO$_2$ gas will help preserve them or a small amount of sulfur on a sulfur wick can be burned to fill the barrel with SO$_2$.
- Silicone bungs are sensitive to SO$_2$ so paper cups are used or a plastic bag is placed around the bung.

Stupid new law

- In 2009 the FDA reclassified SO$_2$ gas as a pesticide when it is used in gas form in an empty barrel, it is not classified as a pesticide when SO$_2$ gas is added directly to wine.
  - TTB regulates SO$_2$ as an additive
  - DPR (Department of Pesticide Regulation) regulates SO$_2$ gas when it is used for barrels.

- Wineries must now must pay a user fee, have personnel with pesticide safety training and monitor how much SO$_2$ gas is used for barrels.
- There is only one approved supplier for "pesticide" use, any supplier is OK for additive used.
A barrel can usually be soaked up so it will hold wine no matter how badly it has dried out.

One method is to tighten up the loose hoops and then fill with water and wet down the outside. Repeat the filling every few hours until it holds water.

Soaking Dry Barrels

Cooperage companies recommend a different method, place the barrel on its end and fill the barrel half way through the bung hole then fill up the head, let it soak then turn it over and do it again.

They do not recommend tightening the hoops because they might bust when the barrel expands from soaking.

Treating a sour barrel

A barrel that has been stored dry for a period of time with no SO₂ in it will be a breeding ground for microbes and can develop a moldy or a vinegar smell.

It is important to remove these smells and kill the bacteria or these off aromas will be imparted to the next wine placed in the barrel.

Treating a sour barrel

First clean with a hot water spray and make sure it holds water then fill half way with cold water then add 1000 PPM SO₂ (400 grams) and 600 grams of citric acid (wear a respirator!) then fill the barrel the rest of the way up.

Treating a sour barrel

Let it soak over night and then rinse well. A small amount of residual SO₂ and citric will not hurt the wine.

Soaking the barrel overnight in ozonated water is very effective as a treatment for sour barrels.

Treating a sour barrel

Scobicia declivis Also known as the lead cable borer. Lives and breeds in dead wood (hardwoods & oak in particular)

They leave holes in barrels that look like someone drilled them. It usually hits empty barrels sometimes it drills into full ones causing leaks.
Oak Borers

- Prevention:
  - Don’t leave dead wood around the winery.
  - Screen vents and windows.
  - Store barrels in the dark.
  - Don’t leave empty barrels outside (particularly in the spring).
  - Coat barrels with linseed oil
  - Holes left by borers can be easily fixed with wooden dowels (hand made or store bought)

Closures (Bungs)

- Silicone Bungs, good seal and very durable, there are several different makers, SO₂ sensitive.
- Wood bungs Softer wood (redwood) there is no reason to purchase these anymore.

Closures (Bungs)

- Ferm locks to use during fermentation to let out CO₂ and keep oxygen out. Available in surgical grade plastic and silicone; the silicone one seems to work better.

Next Week

- Finning Agents and Winery Sanitation.
- Next week we will also discuss the final presentation.
- 2nd exam in two weeks.