GENCO Tech Sheet: WINE ACIDITY AND SO_2
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Wine acidity is one of the most important factors in wine and winemaking. Acidity can be expressed as either pH or total acidity (**TA**).

pH is a measure of acidity (literally the number of hydrogen ions in solution and is expressed logarithmically on a scale of 0 to 14.

Acidity **increases** 10 fold for each whole number on the scale 14 to 0. It **decreases** 10 fold for each whole number from 0 to 14. For example, the acidity of pH 3 is 10 times greater that of pH 4. A sparkling wine with a pH near 3 is much tarter than a red wine with a pH close to 3.8. A pH of 7 is considered neutral, neither acidic nor basic. Above 7, solutions are considered alkaline or basic.

What you need to know about pH:

- **The higher the pH, the lower the acidity the lower the pH, the higher the acidity.**
- **pH, rather than TA , indicates a wines potential to resist oxidation and microbial spoilage, and how much SO_2 is needed to protect a wine.**

Why worry about pH of your wine?

- It influences appearance and how a wine tastes and feels in the mouth.
  - A low-pH wine will taste tart due to a higher acid concentration.
  - Conversely, a high-pH wine will taste soft or flat and may lack freshness.
  - A red wine with lower pH is generally very red. It is also more stable during aging, the taste is fruitier, fresher, less complex, less-full bodied than a higher pH red.
  - A red wine with a pH of 3.8 is close in closer to purple in color. It may initially taste good, but it generally will generally decline more quickly than a lower pH wine. See SO_2 addition below.
- It affect longevity and aging:
  - High-pH wines tends to age (oxidize) more quickly. With age, color changes from red to red-brown (brick) or yellow to golden to golden brown.
  - For reds, color becomes bluer or purple as pH increases.
  - High pH wines are more prone to microbial spoilage (*Acetobacter*, Brett, *Lacobacillus*, *Pediococcus*, etc., thus requiring more sulfite (SO_2.

- Most wines fall within a pH range of 3.0 (sparkling) to as high as 4
- Normal pH range for most white wines is 3.2 to about 3.6 German Rieslings may be as low as 2.9
- Most reds wines fall within a range of about 3.4 to about 3.9
- The general recommendation is to adjust pH of most reds to ~3.6. Many reds, however, despite a high pH are fairly stable due to high tannin levels.

To lower pH by 0.1 unit (increase acidity), add tartaric acid at the rate of approximately 1 g/L of wine or 3.8g per gal of wine. For example, to reduce the pH of 5 gallons (19-liters) of wine from 3.6 to 3.4, add 38 g of tartaric acid. Dissolve the acid in water or the wine and mix well.

To reduce acidity (increase pH), add 1g/liter or ~3.8 g/gal of potassium carbonate to the wine to reduce TA 1g/L or 0.1% or pH by 0.1, ex., 3.3 to 3.4

- Adjust acidity gradually and to taste, check after each addition to make sure you don't overdo it.

Note: CO2 in a wine can result in a lower pH reading.

Ways to adjust pH:

- Add tartaric acid to raise the TA and **lower** pH.
- Add potassium carbonate to **raise** pH.
- Blend wines of different pH to increase or lower the pH.
- Induce malolactic fermentation (MLF) to raise the pH.
- Cold stabilization will generally reduce acidity.

Total acidity **(TA**)

- Is determined by measuring (approximating) the total amount of acids present in a wine* by **titration**—adding a strong base (NaOH) to neutralize the acid. TA is then calculated from the volume of NaOH used.
- It is expressed as grams of acid per L of wine, or as a percentage (6 g/L = 0.6% TA)
- Most white wines have a TA of about 6 to 7.5. Sweet whites are somewhat higher. Most reds have a TA of around 6 to 7.
- TA is applied to the perception of acidity, i.e. its tartness, sourness, or crispness.

Adding 1.0 g/L or 3.8 g/gal of **tartaric** acid will increase TA by about 1.0 g/L or .1% and decrease pH by 0.1 pH units.

SO2 (Sulfur dioxide):

- SO_2 protects wine against oxidation, microbial spoilage, and enzymatic browning.
- When you add SO_2 to a wine, some of it binds up with various chemicals, molecules and substances in the wine. The remaining SO_2 is called **free SO_2**, The active component of free SO_2 is called the **molecular SO_2**. The idea is to target a free SO2 level that provides a molecular level appropriate to the wine's pH and color—red or white.
- SO_2 binds up with aldehydes, a byproduct of oxidation, thus eliminating that odor.
- Total SO_2 includes both the bound and free SO_2.
- Aldehydes impart a sherry/Madera-like aroma, hints of apple cider, cooked vegetables, or stale or pungent notes to the wine. To experience oxidation leave a opened bottle of wine on the counter for 4 or 5 days and then smell it.

- SO2 (sulfite) must be added periodically to protect your wine.
- Free SO_2 in the wine dissipates (binds up with various components) over time and escapes as a gas during racking.
- Once SO_2 is bound up it is no longer effective.
- Every time you open a barrel or carboy you introduce oxygen and free SO_2 is used to bind up with it.
- Every time you rack, you lose a significant amount of SO_2. You generally need to add 20 to 30ppm after each racking.
- SO_2 added to a slightly oxidized wine can help eliminate the odor by binding with the aldehydes.
- *Acetobacter* bacteria common in the air can convert alcohol into ethyl acetate (volatile acidity or VA) and ultimately, acetic acid (vinegar), however, they need oxygen to do this. So as long as you keep your containers full and properly sealed, and there is enough SO_2, you don't need to worry much about them.
- VA is precursor to vinegar and smells like 'airplane' glue or finger-nail polish remover.
- Top your barrels every 4 to 6 weeks to fill the voids that develops due to evaporation, check for off odors, and test for SO_2.
- You need about 25 to 50 ppm SO_2, depending on pH and type of wine, to prevent oxidation and minimize microbial problems. (see tables below)
- If your SO2 test shows a very low SO_2 level, add **more** SO_2 than the ideal free- SO_2 level. Because the SO_2 you add will be quickly bound up, leaving you with a less than you need.
- Retest a few days after making your addition to make sure you are within the targeted range.
- Keep the SO_2 level somewhat higher than the recommended minimum free SO_2 level so that the molecular levels doesn't drop too low between additions.
- **It's better to make one large addition rather than several smaller doses.** That way the level is unlikely to drop below the recommended molecular level
- **Keep track of the amount of SO_2 you add. Try not to exceed 120 ppm (total).**
- **Even if you add 150 ppm total to your wine, the total amount in the finished wine will be less due to precipitation and racking of lees and loss of SO_2 gas.**
- SO2 is detectable at higher levels in the aroma and taste.
- When you bottle, target the correct free or molecular level needed to protect the wine, but also add some addition (~10ppm) to cover the portion lost when bottling and to deal with the exposure to oxygen.

Note: At fermentation you should add 35 to 50ppm of SO_2, immediately after crushing. At the end of fermentation, there will be little or no free SO_2 remaining. It's a good idea to add another 50ppm at that point unless you intend the wine to undergo malolactic fermentation.

Making SO_2 additions:

- Potassium metabisulfite powder
  - 0.33 grams per gallon of wine results in 50ppm SO_2.
  - Inexpensive, but measurement accuracy can be a problem.
- SO_2 stock solution

- To make a 10% solution, add 100g potassium metabisulfite to a liter of water (~34 ounces).
- Add 3.3ml/5gal to raise the free SO_2 level 10ppm.
- Use a pipette with bulb to make precise additions.
- Stir to avoid statatification in carboy or barrel.

- SO2 granules or tablets.
  - For example: Inodose (Scott Lab) or Efferbacktol (Vinquiry)
  - A 2 g packet will raise the free SO_2 level of a 60 gal barrel 9ppm, 18 ppm in 30 gal barrel and 36ppm per 15 gallon keg.
  - A 5g packet will raise the free SO_2 level in a 60 gal barrel 23 ppm.
  - If you divide the packages, remember that there is actually 5 grams of material in a 2g packet.
  - No mixing is necessary because the material is effervescent
  - Cost is ~50 cents per packet, suitable for use in wine barrels and large quantities of wine.

Maintaining the right amount of SO2:

- How much SO_2 is needed is dependent on the pH of your wine *the higher the pH of your wine the higher the* SO_2 *level*
- As a rule of thumb, you should target a specific free SO_2 level based on the pH of your wine. The numbers below reflect a level that will provide an effective **'molecular'** level. White wines require a molecular level of .8 SO_2 (left). Red wines require a molecular level of .5 (right).

White wines:	
pH	Free SO_2
3.0	13
3.1	16
3.2	20
3.3	26
3.4	32
3.5	40
3.6	50
3.7	63
3.8	81
3.9	99
4.0	125

Red wine	
pH	Free SO_2
3.3	16
3.4	20
35,	25
3.6	31
3.7	39
3.8	49
39	62
4.0	80

Note: A molecular level of .8 at bottling helps prevent MLF in the bottle

- TA is really the amount of acid that is *available* to react with the NaOH (Sodium Hydroxide) solution used for titration.