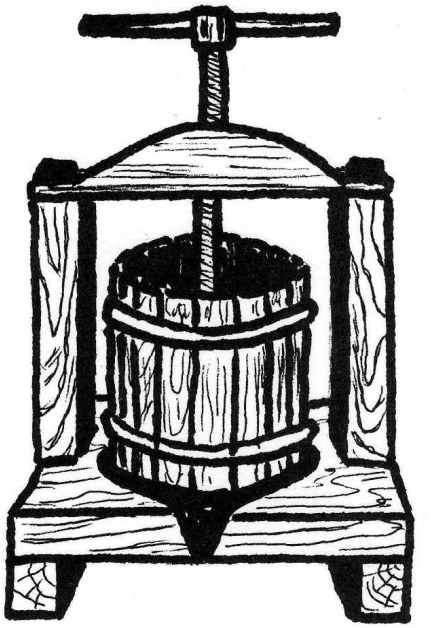

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Judicious Use of Sulphur Dioxide*

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*This is a special issue with two esteemed WVA guest authors and Life Members

Have you ever heard the saying, "Don't mess with Mother Nature"? Winemaking may be the only exception to this wise adage! The use of sulfur dioxide is the foundation of preserving wine. It is a very ancient preservative, but its wide-spread use is of a more recent date. The types of table wine we know today could only have been made possible through its use.

Wine does not keep by itself. Left alone, it alters rapidly and, at best, becomes vinegar. Without the use of some preservative, it could not withstand the manipulations of winemaking. In all ages it has been necessary to resort to artificial means of preservation. The ancient Greeks gave us retsina, which is a rather unpleasant pine-resin preservative. Following the discovery of distillation, the addition of high-proof ethanol gave us fortified wines; the high alcohol protects this wine from micro-organisms but not from oxidation, and it is the oxidation that gives these wines their character. Fast forward, and it is the use of sulfur dioxide that acts as both an antioxidant and anti-microbial, and has made it possible for aging in barrels, bottle aging, and the conservation of fruitiness and freshness.[1]

Sulfur is an element in nature. Sulfur dioxide (or SO_2), sulfites, and potassium metibisulfite are all names for the same chemical compounds. When discussing sulfur dioxide, two groups of words are used. The first group is sulfur, sulfur dioxide, SO_2, sulfites, and potassium metabisulfite. The second group is Total SO_2, Bound SO_2, Free SO_2, and Molecular SO_2. **Total** SO_2 is the total amount of SO_2 that is added to the wine (measured in parts per million or ppm). It should be less than 200 ppm. When SO_2 is added to wine, some of it becomes **Bound** to other chemicals in the wine, and the other portions of the SO_2 addition remain as **Free** SO_2.

[1] The Complete Handbook of Winemaking, American Wine Society

When sulfur dioxide is added to wine, it turns into three chemical forms - **Molecular** SO_2, bisulfite, and sulfite. They all protect the wine from oxygen and spoilage micro-organisms (mainly wild yeasts and bacteria), but molecular SO_2 is the more important of the three. Molecular SO_2 is active in the microbial control of the wine, and its effectiveness changes with the wine's pH (it is more effective when the pH is lower, and less effective when the pH is higher). To be protected, wine needs to have a certain level of molecular SO_2. Charts are available to relate a wine's pH to the amount of free SO_2 needed to achieve the target level of molecular SO_2. To use these charts, you need to know the pH of the wine and the amount of free SO_2 in the wine. Testing equipment and the chemicals (to measure the pH and free SO_2) are needed and they are costly. Without this information, any addition of SO_2 is a guess as to what is needed and a guess as to what the free SO_2 will be after the addition.

SO_2 is not like other additives to wine. When you add sugar, acid, yeast, yeast nutrients, fining agents, etc. to wine, it produces the desired effect, and you can proceed with the winemaking process. SO_2, however, needs to be monitored throughout the winemaking process. As mentioned earlier, when SO_2 is added to wine, some of the addition is immediately bound (1/3 to 1/2 in the first addition after fermentation) and the rest of the addition is the free SO_2. The free SO_2 protects the wine from oxygen and spoilage microbes. As the free SO_2 reacts to oxygen or microbes, it becomes bound, and the process continues until all of the free SO_2 becomes bound. This is why the amount of free SO_2 needs to be monitored and additions made when necessary to ensure the wine stays protected.

The important point is that the use of SO_2 is an integral part of winemaking. Good wine can be made even though no testing is done. But SO_2 needs to be used throughout the winemaking process. The remainder of this article will outline how to make additions without testing.

A. Sources of SO_2

1. Campden Tablets
    - each campden tablet weighs 0.55 grams
    - the tablets are 48% sulfur dioxide
    - the tablets need to be crushed before use
    - 1 campden tablet in 1 gallon yields 75 ppm, or 15 ppm in 5 gallons
    - the manufacturer recommended dosage is 1/2 tablet per gallon at each racking
    - possible issues about the consistency of tablet size from the manufacturer, and the ability of the tablets to dissolve
    - there may be difficulty with measurements if using any fraction of a whole tablet
    - because the tablets contain a smaller percentage of SO_2 than potassium bisulfite, additional campden tablets or portions are needed to obtain the same ppm as when using potassium metabisulfite; for example, to add 45 ppm to 5 gallons, it takes 1.77g of campden tablets and only 1.48g of potassium metabisulfite

- accuracy of SO_2 additions can be increased if you weigh the crushed tablets

2. Potassium Metabisulfite
   - sold in powder form, 57% sulfur dioxide
   - obviously easier to use because no crushing is required
   - product label says 1/4 teaspoon in 1 gallon adds about 225 ppm, or 45 ppm to 5 gallons
   - using potassium metabisulfite is strongly recommended because the benefits of potassium metabisulfite outweigh the benefits of using campden tablets

3. Potassium or Sodium SO_2
   - the campden tablets and metabisulfite are sold either as potassium or as sodium
   - for dietary and taste reasons, sodium campden tablets or sodium metabisulfite are not recommended for additions to wine
   - sodium campden tablets or sodium metabisulfite can be used for preparing your sterilizing solution, but be sure to rinse well after sanitizing

4. 10% Sulfite Solution
   - easy way to make additions to small volumes or when crushing grapes
   - mix 10 grams of potassium metabisulfite (57% SO_2) to 100 mL of water
   - in a 750 mL bottle, use 0.59 mL for 45 ppm
   - in 1 liter, use 0.79 mL for 45 ppm
   - in 1 gallon, use 3.0 mL for 45 ppm
   - in 5 gallons, use 15.0 mL for 45 ppm (Note: 15 ml = 1/2 ounce)

5. General notes about SO_2
   - SO_2 can oxidize, store it at 65 degrees or less
   - consider storing SO_2 in the refrigerator and in a small glass jar
   - buy fresh each year - old SO_2 loses potency with time and should be replaced every year to assure that you are getting correct levels of SO_2
   - buy the smallest amount available; in the first year, use it only for additions to the wine; the next year, use what is leftover to make your sanitizing solution

B. SO_2 Additions To Wine: When To Make Them and How Much

1. two ways to determine how much to add:
   a) from testing
      - if you tested for pH, you could look at a chart that relates amount of free SO_2 needed for various levels of molecular SO_2
      - if you test for free SO_2 currently in the wine, you could subtract what you have from what you need to determine what you should add

   b) guessing
      - you will need to guess what your pH is and how much free SO_2 is currently in the wine

2. if you are using the guessing method
    a) Table 1 below provides general guidelines for making your SO_2 additions; it uses some overall parameters for the pH in different wines, and the amount of free SO_2 that may be in the wine
    b) Table 2 below provides the number of grams for the various amounts of ppm that you will be adding from Table 1

3. Measuring SO_2
    a) teaspoon measures are easy but not very accurate; teaspoons may vary as to the amount they hold, plus the amount in the teaspoon must be level
    b) a level teaspoon vs a rounded teaspoon will vary in the amount of SO_2
        - I have three different 1/4 teaspoons and all 3 hold different amounts - ranging from 1.79g to 2.1g!
        - a true level 1/4 tsp contains 1.5 grams, enough for 45 ppm in 5 gallons
        - a heaping 1/4 tsp contains 2.53 grams, enough for 76 ppm in 5 gallons
        - adding an additional 30 ppm is the opposite of accuracy!
    c) accuracy is very important when making additions - try to make your measurements as accurate as possible; unlike many things in this world, more SO_2 is not better
    d) using a gram scale to measure the SO_2 additions is strongly recommend

[Note: There are a ton of digital scales for sale. I use a digital scale made by Amir, their Amir Digital Kitchen Scale. It has a capacity of 500 grams, with an accuracy of 0.01 (a similar scale sold on Amazon has only 0.1 accuracy). It runs on two AAA batteries and costs $14.00.

Here is the link: https://poshmark.com/listing/AMIR-DIGITAL-KITCHEN-SCALE-500g-5e2a7f2829f0305b67d0df57]

One Final note - you have heard this before, but it bears repeating:

Most common wine faults involve oxidized wine (keep your carboys and containers topped up) and bacterial problems (keep everything clean and sanitized). These good winemaking practices will help maintain your free SO_2.

Happy Winemaking!

Table 1. General Guidelines for Sulfur Dioxide Additions (the ppm numbers are total SO_2, not free SO_2)

	Country Wines	Fruit and Grapes with Low pH - #1	White, Rose, or Red Pails of Grape Juice - #2	Red Wine from Grapes
Prior to Fermentation	45 ppm	30 ppm	none, assume SO_2 has already been added to fresh juice	30 ppm
Rack at end of Fermentation	50 ppm	30 ppm	50 ppm	50 ppm
2nd racking	25 ppm	15 ppm	25 ppm	25 ppm
3rd racking	25 ppm	15 ppm	25 ppm	25 ppm
4th racking	n/a	n/a	n/a	25 ppm
at bottling	none, if bottled within 6 months - #3	none, if bottled within 6 months - #3	none, if bottled within 6 months - #3	none, if bottled within 9-12 months - #3
if more racking and/or longer aging	15 ppm	10 ppm	15 ppm	15 ppm
Footnotes:				
#1. Fruits like cranberry and lime, and some grapes, including Wis grown, have a pH of 3.0 or less.				
#2. If you start out with fresh grapes, add 30 ppm after pressing.				
#3. The number of months from the start of fermentation.				

Table 2. Sulfur Dioxide Additions Using Potassium Metabisulfite and Campden Tablets (the ppm numbers are total SO_2, not free SO_2)

	Potassium Metabusulfite	Campden Tablets	Campden Tablets
Desired PPM	grams in 5 gallons	grams in 5 gallons	number of tablets
10	0.33	0.39	0.71
15	0.49	0.59	1.07
25	0.82	0.98	1.78
45	1.48	1.77	3.22
50	1.64	1.97	3.58

If you have a different desired ppm or volume from those listed in Table 2, here is the formula to make the calculation:

grams = desired ppm, mg/L x 3.785 liters/gallon x number of gallons to be adjusted divided by percent sulfur dioxide of SO_2 source

$$\text{grams} = \frac{\text{DP mg/L} * 3.785 \text{ L/gal} * \text{G gallons}}{\text{PSD}}$$

here is an example using **potassium metabisulfite 57.76% sulfur dioxide**:

DP = desired ppm to be added, let's say 25 ppm
- this number needs to be converted from ppm to grams
- 1 ppm = 1 milligram/liter
- 1 mg = 0.001 grams, so 25 ppm = 25 mg/L = .025 g/L (25/1000)

3.875 = converts liters to gallons (3.785 liters = 1 gallon)
G = number of gallons being adjusted, let's say 5 gallons
PSD = percent sulfur dioxide for potassium metabisulfite is 57.775%

$$\text{grams for 5 gallons} = \frac{(.025 * 3.785 * 5)}{0.5776} = 0.82$$

here is an example using **campden tablets** (a separate calculation is necessary because the tablets have a different sulfur dioxide percentage - 48%):

DP = desired ppm to be added, let's say 25 ppm
- this number needs to be converted from ppm to grams
- 1 ppm = 1 milligram/liter
- 1 mg = 0.001 grams, so 25 ppm = 25 mg/L = .025 g/L (25/1000)

3.875 = converts liters to gallons (3.785 liters = 1 gallon)
G = number of gallons being adjusted, let's say 5 gallons
PSD = percent sulfur dioxide for campden tablets is 48%

$$\text{grams for 5 gallons} = \frac{(.025 * 3.785 * 5)}{0.48} = 0.99$$