

Overview: Sulfiting

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- Sulfites should be added shortly after crushing/ destemming, post-fermentation (MLC), during maturation, and before bottling.
- Sulfites (SO_2) inhibit oxidation, microbial spoilage, and enzymatic browning.
- Oxidation occurs when juice, must, and wine are exposed to air throughout the entire winemaking process and in the bottle. It can adversely affect color, taste, aroma, and palatability.
- Another advantage: it binds with aldehydes—precursors of oxidation (formation of vinegar) when alcohol is exposed to air. That's worth the price of entry!
- The addition of Sulfites after crushing is commonly based on the total volume (gallons) of the must.
- Why: volume in European presses is typically marked off in hectoliters (hL). One HL = 100 liters), that's about 26 gal. A 59-gal barrels hold close to 225L. Measuring HL of must in HL can be tricky. After crushing, 1000 lbs. of large red grapes yield about 4 HL (about 100 gal of must, give or take). The yield in **wine** for most red grapes, ranges from 60 to 70 gallons—give or take from 1000 lbs. of grapes.
- Actual yield is influenced by grape clone, berry size, relative size of seeds, skin thickness, shriveling due to wind and hot weather, pressing efficiency, and ability to salvage most of the juice/wine from the sediment.
- The standard SO_2 **dosage** after crushing is 50 ppm. You can get by with as little as 35 ppm for good protection, depending on the condition of the grapes. Grapes affected by mold, mildew, rot, or physical damage will require more.
- **Ways to add it:**
 - **Potassium Metabisulfite (PMBS)**, a crystalline powder, is the preferred sulfiting agent. It is the most economical means to add SO_2 to juice, must or wine.
 - PMBS powder, when added to water, juice, must, or wine, is measured in milligrams (mg) of SO_2 per Liter (L) of the liquid. There are 1000 milligrams (mg) in a gram of SO_2 and 1000 milliliters (mL) in a liter of water. This makes it possible to express the SO_2 addition in parts per million (ppm) — parts of SO_2 per million parts of juice or wine. One ppm is equivalent to 1 milligram (mg) (.001 g) in 1L of water, juice, must, or wine. To convert gallons of juice, must, or wine to liters, multiply the volume by 3.79. There are about 25 gal (about 1hL) of must in a 32-gallon fermenting bin filled to the inner ring about 6 inches below the top.
 - The Hectoliters (HL) is a common Metric unit used by commercial wineries when making Sulfite additions to grape must. The Metric system, is far easier to work with. The dosage rate of PMBS is based on a ton, 1/2-ton, or HLs (100L) of grape must.

Making additions:

- **8.9 g** of PMBS crystals will provide ~50 ppm per HL of must. (See Table below)
- To calculate the dose for a macrobin, holding about 1000#s or ~4 HL of must, multiply the rate: 8.9 g/HL X 4 = ~ **35.6 g**.
- **0.34 g/gal** of PMBS will also provide 50 ppm to grape must.
- 32-gal food-grade fermenter are convenient for fermentation because they hold about 1HL of must when filled to the inner ring, about 6 inches below the top. That makes dosing them a bit easier –just add 8.9 or 9 g (KMBS).
- To calculate grams of PMBS to add to must:

$$\frac{(\text{ppm Total SO}_2 \text{ desired}) \times (\text{Liters of must})}{(0.56 (\text{percent SO}_2 \text{ in PMBS}) \times 1000)} = \text{grams of PMBS (Winy (Enartis))}$$

Potassium metabisulfite addition guidelines for using Winy: an Enartis product.

SO ₂ ppm)	g/HL	g/barrel	g/1,000 gal	lbs./1,000 gal
5	0.9	2	33	0.07
10	1.8	4	65	0.14
30	5.4	12	196	0.43
50	8.9	20	326	0.72
60	10.7	23	392	0.86

Easy reference: Adding Potassium metabisulfite to **5 gal.** must or wine:

- To add **10ppm** to 5 gal., use 0.34 g PMBS juice/must (dissolved in water)
- To add **20** ppm to 5 gal., use 0.68g
- To add **30** ppm to 5 gal., use 1.02 g
- To add **40** ppm to 5 gal., use 1.35 g
- To add **50** ppm to 5 gal., use 1.70 g
- To add **50 ppm** to 1HL 26 gal. of must in a 32 gal. bin, use 8.9 g

Note: Dosage rates for additions of many winemaking products to juice or wine, are given as grams (g) /hL of juice or wine or g/gal. To convert g/HL to g./gal. divide that number by 26, and then multiply the result by the number of gallons to treat.

One exception is when adjusting °Brix by adding water to dilute the must, the amount of water should be calculated based on expected yield of juice from the must in gallons. The “conversion factor” home winemakers can use is 0.6 to 0.7. Thus, the yield after fermentation and pressing from 100 lbs. of grapes is 6 to 7 gallons of wine after pressing. So, if you harvest 1,000 of grapes, base your calculation a yield of 60 to 70 gallons, depending on berry size, pressing efficiency, and ability to salvage most of the juice/wine from the sediment.

10% stock solution – another inexpensive and convenient ways to add SO₂. You will need to get a 25 ml plastic pipette with a siphon and pressure bulb to dispense the solution

- Add 100g PMBS powder in 1 liter (1000 ml) of water or 75g in 750ml water. Bear in mind that PMBS form Enartis contains 56% SO₂. PMBS from other suppliers contain a little more SO₂ – 57.6%, not enough to worry about. Mix thoroughly. For each 5 gal of must, add 17ml of the solution to add 50ppm. Remember: you must stir the PMBS solution to get good distribution.
- SO₂ addition: 10% (5.6%) solution (Winy: Enartis)

	5gal	10 gal	15 gal	30 gal	60 gal
10 ppm	3.38	6.76	10.14	20.28	40.56
15ppm	5.07	10.14	15.21	30.42	60.84
20 ppm	6.76	13.52	20.58	40.56	81.12
25 ppm	8.45	16.9	25.35	50.76	101.39
30 ppm	10.41	20.28	30.42	60.84	121.67
35 ppm	11.83	23.66	35.49	70.98	141.95
50 ppm	16.9	33.8	50.7	104.39	202.79

Example: to add 30 ppm of SO₂ to 15 gal of wine, using a standard ‘10%’ solution, use ~30 mL of the stock solution.

More convenient, but more expensive: Pre-measured packets (2g or 5 g dose) containing a blend of Potassium Metabisulfite and Potassium Bicarbonate which releases CO₂ which aids in dispersion. As they dissolve, they releasing a precise dose of total SO₂.

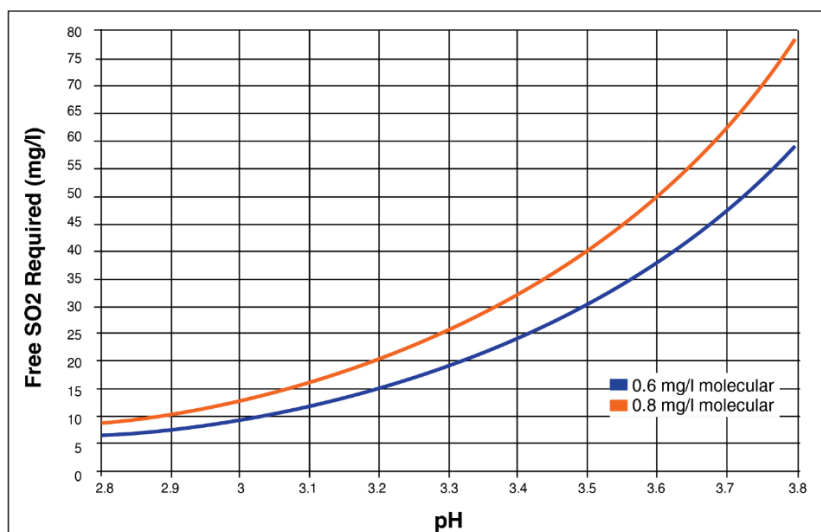
- Packets (granules or tablets) can accurately deliver a specific ppm of SO₂ to a 59 or 30-gal barrel/tank, or 15.5-gal beer keg. Another advantage is that you don’t need to stir the wine, as with other means of adding SO₂.
- Enartis offers: **Efferbarrique: 2-g** dose packets that contain 5 g of granules. Each will provide 2.1 g of SO₂. The reason is that the granules contain only 42% SO₂. **Effergran 5-g dose** packs contain 12 g of granules, but each provides 5 grams of SO₂. Yes, confusing!
- **Scott’s Inodose 2** or **5 Tabs**, provide either **2g** or **5g** of SO₂, respectively.
- In grape **must or juice** a **2-g** pack/tab will add about **21ppm** to roughly 1 HL of must in a 32-gallon food-grade fermenting bin. This is handy if you ferment in 32-gal food-grade bins.
- **Efferbarrique 2-gram dose** packet adds **9 ppm** Total SO₂ to a 59-gal barrel, ~ **18 ppm** in a 30-gal container and ~**36 ppm** in a 15.5-gal container. The **5-gram dose** packets will add 23 ppm total SO₂ to a 59-gal. barrel
- In grape **must**, a **2-g** packet/tab will add a little more than **20 ppm** to 25 gal (about 1HL) of must in a 32-gallon food-grade fermenting bin. Two, **2-g packets** will provide roughly 42 ppm of SO₂. That should be enough. Otherwise, 2 and ½ packs of Efferbarrique 2-g dose will add about 52 ppm of SO₂...
- **Inodose 2** tablet releases approximately the same levels of SO₂.

- An easier way is to add **8.9 g** of PMBS powder to do the same.
- If you make less than 30 gal of wine, the 10% stock solution is best.
- If you divide a packet, remember there is 5 grams of material (PMBS plus the effervescent agent) in a 2.1 g-dose pack. So, 2.5 g of the granules will provide only 1.05 g of SO₂, enough to add 10.5 ppm to 25 gal. Inodose tabs should not be broken to adjust the addition.
- One pack of **Effergran Dose 5 packet** releases 5-g of SO₂ provides **23** ppm total SO₂ in a 59-gal barrel of wine and one **Inodose 5** tablets adds **22** ppm.

Maintaining enough free-SO₂ from crush to bottling:

- When SO₂ is added to water, juice, must or wine it quickly binds with sugar, tannins, pigments, acids, acetaldehyde, and other grape components. In wine, SO₂ is either free or bound. The latter is largely unavailable for protecting wine from oxidation and spoilage. Total SO₂ refers to both **free** and **bound** SO₂
- The amount of SO₂ needed is pH dependent, and how the wine is it is stored, and how often the wine is exposed to air is also a factor.
- Free-SO₂ must be periodically replaced as it binds with components in the wine, or reacts with acetaldehydes, the precursor of vinegar, otherwise the level will drop below what is needed to protect the wine.
- Testing is required:
 - monthly or at least every 6 weeks
 - after fermentation (most whites), or after reds have undergone Malolactic Conversion
 - during cellaring
 - and just before bottling
- After fermentation, very little free-SO₂ remains– most is bound up, unavailable to do it's job.
- Wine stored in 'porous' oak barrels is continually exposed to low levels of O₂, so SO₂ depletion is greater than if the wine is stored in impervious stainless-steel tanks and glass carboys.
- When Potassium Meta Bisulfite powder or solution) is added to water or wine, some dissociates into 2 chemically charged ions (**Bisulfite** and **Sulfite ions**), some remains as molecular (undissociated form of PMBS) – **SO₂ gas**) in different proportions, depending on pH.
- **The three Sulfite fractions:**
 - **SO₂:** the **molecular (gas) form**, by far, the most important fraction, dissolves in water or wine, much like Carbon Dioxide (CO₂) does in water. The level can be as high as 6% for a wine with a pH of 3.0, or as little as 0.5 percent when pH is 4.0. It has powerful antimicrobial agent that inhibit bacteria, wild yeasts, malolactic bacteria, and others spoilage microbes.

- **Bisulfite** (HSO_3^-): Most of the SO_2 added to juice or wine exists as Bisulfite ions, which help protect juice and wine from oxidative browning reactions. It also reacts with hydrogen peroxide (H_2O_2) formed from oxidative reactions. More importantly, Bisulfite ions bind with acetaldehyde, a volatile compound with a distinct odor. Bear in mind that acetaldehyde is a precursor of VA (vinegar) that develops when wine is exposed to air, and there is insufficient to free- SO_2 to bind with it.
- **Sulfite** (SO_3^{2-}): The amount in wine is rather small, except at high pH. But even in minute amounts, it deactivates enzymes that cause browning, and removes free-oxygen (O_2) from wine. In this reaction, O_2 reacts with phenolic compounds, and then is converted to hydrogen peroxide (H_2O_2) that reacts with alcohol, forming acetaldehyde, however, if there is sufficient free- SO_2 the hydrogen peroxide will react with the Sulfite ion, resulting in the formation of Sulfate (which is innocuous) and water.
- To protect wine from oxidation and bacterial spoilage, there must be a specified level of the **molecular** SO_2 from crush to bottling. The established levels is **0.8** ml/L for whites, and **0.5** ml/L for reds, except those that will undergo MLC. Many winemakers, though, now prefer to use 0.6 ml/L or ppm molecular level for reds. How much (parts per million (ppm)) is needed will be determined by pH and the **molecular level** you are adhering to (see the table below). Note: (1mg/L = 1ppm).
- To maintain the 0.8 ml/L molecular level, the level (ppm) level you add will be significantly more. That's because the proportion of SO_2 (the molecular form is quite low. At normal wine pH, most of what is added is the Bisulfate ion. For example, to maintain a level of 0.8 ml/L molecular SO_2 for a white wine with a pH of 3.3, you must add no less than 26 ppm of SO_2 .



Minimum free- SO_2 needed for 0.6 ppm molecular (reds) and 0.8 white and rosé wine.

- By keeping the pH of whites below 3.5, preferably 3.2 to 3.3, depending on variety, you can use less. It's also best to keep the pH of reds under 7. Reds with a pH much above 3.8 are unstable.
- When Free SO₂ is lost, chemical equilibrium in the wine can shift causing some of the bound SO₂ to revert to its free state. This is why it's a good idea to build a solid foundation of Total SO₂; the more you have, the more stable the Free SO₂ tends to be.