MoreWine's Copper Sulfate Addition Procedure

Copper Sulfate ($CuSO_4$) is a chemical compound which can be used to treat wine which has been affected by Hydrogen Sulfide (H_2S) or "rotten egg smell." H_2S usually comes about through a stressed fermentation and is a natural byproduct of yeast processing sugars under conditions that are stressful to them, such as a lack of nutrition. If left untreated, the H_2S will "evolve" over time into more complex molecules which cannot be treated with copper. The copper works by "letting go" of its sulfate partner once in a solution, then "stealing" the sulfide from hydrogen. Together, copper sulfide is not soluble in either water or ethanol, and so it drops to the bottom of your vessel (black residue) and can be racked off of. The bench trial process is preferred to the old-world treatment that you may have heard of – racking the wine through a copper pipe – because elemental copper in high concentrations is toxic and with the pipe method you have no control over how much you are picking up. Bench trials allow you to determine the minimum amount of copper that you can add to the wine to be effective, as well as if the treatment will be effective at all.

Step 1: Confirmation of presence of Hydrogen Sulfide or mono-mercaptans

Obtain two 45mL samples of wine in glasses. Label one "Control" and the other "+Cu." To the glass marked "+Cu," add 1mL of 1% $CuSO_4$ solution[*1] (approx 50ppm[*3] - this is a strong excess of Cu)[*2]. Cover both glasses with a watch glass / plastic wrap and swirl. Let glasses sit for a few minutes and examine by smell.

[*1] See the end of this sheet for instructions on the preparation of a 1% solution from MoreWine copper sulfate crystals.
[*2] High concentrations of copper are **toxic**, do **NOT** taste experimental glass.
[*3] ppm is a unit of measure which corresponds to **Parts** of solute **Per Million** parts of solvent. This is often also expressed in terms of mg/L.

Note: If the experimental glass still carries sulfide-related odors this can mean 1) the odors are disulfides or poly-mercaptans which will not react with the copper; 2) the odor is dimethyl sulfide which will not react with copper; 3) there is insufficient copper to react with all the sulfides present. This is highly unlikely and would indicate extremely high levels of Hydrogen Sulfide. If the experimental glass is odor free proceed to Step 2.

Step 2: Bench trials to determine appropriate amt of Copper to add

Obtain 4-6 50mL bottles. Ideally these bottles should be capped, but a stoppered 50mL flask or saran-wrap with a rubber band are sufficient. Mark one bottle "Control" and the others with increments of copper to be added (e.g.: Cu +0.1ppm, Cu +0.2ppm up to Cu +0.5ppm). Notice the very weak concentrations of copper being added; take care not to add too much. The best way to make the addition is to dilute your 1% solution from Step 1 with distilled water to a 0.01% solution by combining 1mL of 1% solution with enough water to make 100mL. Dilutions should always be performed with distilled or de-ionized water. 0.2mL of 0.01% solution will add 0.1ppm of copper to 50mL of wine.

Make the appropriate volume addition to each test bottle, top it off, and cap tightly. This is where a cappable bottle will have an advantage over saran wrap, which is porous and can allow some H_2S to escape without having reacted. This can potentially cause one to determine that a particular concentration of copper was sufficient to remove the H_2S when it wasn't; the rest of the H_2S simply volatized (evaporated) out of solution. However, some idea is better than none, so if you don't have access to small cappable or stopper-able bottles use the saran wrap method – several layers would be best. Let the test bottles and the control sit overnight and evaluate in the morning by pouring each sample into a clean glass and smelling it. If the odor is diminished but not gone from your 0.5ppm test, consider adding up to 1.0ppm. Approx 30ppm of ascorbic acid (vitamin C) can also help.

Based on the concentration of copper that gets the job done, determine the appropriate amount of copper to add to your volume of wine. The following conversion factors may be helpful:

1% $CuSO_4$ solution =	1mL/L=	2.57ppm copper
	.15mL/gal=	0.1ppm copper

Preparation of 1% Solution:

% solutions are prepared by combining reagents on a weight to weight basis. Since 1mL of water has a mass of 1g, this is a pretty easy process. Normally, 1g of the solute (in this case, copper sulfate) added to 99mL of water means that the copper is 1g out of a total of 100g (mass of new solution), or 1% by mass. However, the copper sulfate crystals that you purchase from MoreWine are already hydrated to prevent them from picking up water from the atmosphere, and this must be accounted for. Since the water makes up 36% of the mass of the crystals, you must use 1.56g of crystals to yield 1g of copper sulfate. (1g crystals/0.64g $CuSO_4$ = 1.56g crystals/1g $CuSO_4$)

Keep in mind that a 0.1% solution can be made by diluting your 10mL of 1% solution into another 90mL of water, in which case you would want to add 15mL/gal to achieve 0.1ppm Cu in solution. This can be helpful if you are working with smaller volumes of wine and are having trouble measuring multiples of 0.15mL. Dilutions should always be performed with distilled or de-ionized water.

***Note**: Please be aware that the acceptable concentration of Copper in commercially available wine varies with jurisdiction, and it is the responsibility of the winery to ensure that they conform to any local or national regulations.

All chemicals should be stored in a cool, dry place and kept out of reach of children and pets. More Wine recommends the use of gloves when handling copper crystals (the solutions should be fine). Safety First!