



Kicking up a Stink: Treatment for Sulfur Off-Odors

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While the various mechanisms leading to the formation of sulfur compounds aren't fully understood, most winemakers are all too familiar with the aromas of sewer gas, spoiled vegetables, and rotten egg that these volatiles can lend to wine. Treatment of such reductive notes varies, based on fermentation stage and type of sulfur compound, and can range in difficulty from a fairly tricky fining operation to simply waiting for the aroma to dissipate.

In order to remove offensive sulfur compounds without producing a bigger stink, it's important to understand that several different compounds can produce a reductive character in wine (see table), and that not all of them can react with, and subsequently be removed by, copper. The best way to assess the problem is to run an aroma screen before deciding on further treatment. This fairly simple procedure, reproduced here: <http://grapesandwine.cals.cornell.edu/cals/grapesandwine/outreach/enology/upload/Aroma-Screen-for-HYDROGEN-SULFIDE.pdf> from Zoecklein *et al.*, involves the addition of the fining agents cadmium sulfate, copper sulfate, and ascorbic acid to the affected wine, then smelling each treatment to mark any changes to wine aroma. (Please note: cadmium is extremely toxic, and requires appropriate handling and disposal.) This screening process allows an assessment of the probable sulfur compound causing the wine fault, and should be used as the basis for further fining trials.

Sulfur Compound		Characteristic Odor
Hydrogen Sulfide (H ₂ S)		Rotten eggs, sewer gas
Mercaptans	Methyl Mercaptan	Rotten Cabbage
	Ethyl Mercaptan	Burnt match, earthy
Disulfides	Dimethyldisulfide (DMDS)	Onions, cooked cabbage
	Diethyldisulfide (DEDS)	Burnt rubber, garlic

The results of the aroma screen should indicate whether the off odor is caused by hydrogen sulfide (H₂S), mercaptans, a combination of H₂S and mercaptans, disulfides, or none of the above. Of the sulfur compounds, H₂S is the most common and probably the most familiar. While appropriate fermentation management is the best way to prevent excessive H₂S formation, during the last stages of fermentation and beyond, copper sulfate fining is the best means of removal. If an aroma screen indicates that H₂S is the culprit, the next step should be a bench trial of various of copper sulfate levels added to the affected wine. Fining trials should start with fairly small copper sulfate additions, starting at 50 ppb or the smallest aliquot that you can accurately measure, with concentrations increasing from there. If performed correctly, these additions

can remove up to 99% of the offending compounds. To achieve the best approximation of treatment effects, allow the treated wines to sit approximately 12 hours and re-smell before making decisions about treatment.

If the aroma screen indicates the present of methyl and ethyl mercaptan, aeration should not be attempted under any circumstances. Mercaptans are readily oxidized to form other less-potent compounds, e.g. to their corresponding disulfides, which are significantly harder to remove. Mercaptans can be removed to some extent with appropriate copper sulfate additions, though this operation has been found to be only about half as efficient as H₂S removal. The reaction forms an insoluble copper mercaptide salt that can be filtered from the wine.

If mercaptans have oxidized to form dimethyldisulfide (DMDS) and diethyldisulfide (DEDS), they must be converted to their parent mercaptan species prior to removal. Disulfides are first reduced with the addition of 50mg/L or more of ascorbic acid, immediately followed by an appropriate addition of copper sulfate. This reaction can be fairly slow, requiring as long as two months to reach equilibrium- obviously not something that you want to do right before bottling. It's important to make sure that free SO₂ levels are adequate before adding ascorbic acid, which can increase the potential for wine oxidation.

Regardless of the compound to be removed, bench trials should always be performed prior to copper fining to prevent excessive additions. US law allows copper sulfate additions up to 6 mg/L, but it's best to use the lowest effective amount. Obvious human health risks aside, excessive copper additions can lead to wine quality problems, such as the milky copper casse, or haze, that can result from the reaction of copper ions with wine proteins. Risk of haze formation is greatly increased if copper sulfate is added immediately prior to bottling, without allowing adequate time for the wine to stabilize during bulk storage. Copper can also act as an oxidation catalyst, so additions beyond that which can react with unwanted sulfur compounds can increase the risk of oxidation, especially in whites. Further, reactions with volatile thiols, which also contain sulfur, can mute or eliminate desirable aromatics in wines like Sauvignon blanc, rosés, and to a lesser extent Riesling and Gewürztraminer. For these reasons, adding copper sulfate prophylactically, a practice observed increasingly with wines sealed under screwcaps, should be avoided in most cases. After treatment, post-fining analysis should be performed to insure that levels are below the US legal limit of 0.5 mg/L in the finished wine. The quickest and most effective means of analysis is measurement with an atomic absorption spectrometry, which can be performed at most wine service labs for a nominal fee. (The NYSWAL offers it to NY wineries for \$25/sample.)

Sulfur stink can happen to the best of us, especially in years with difficult ripening conditions, and copper fining can be an effective way of cleaning up a faulty wine. Due to the risk to wine quality and human health, however, it's worth taking time to perform an aroma screen, fining trials and post-fining analysis--to protect your wine and your customers.

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