

## ENARTIS NEWS

### FERMENTATION HAS FINISHED: TIME FOR SO<sub>2</sub> MANAGEMENT

*When both alcoholic or malolactic fermentations finish, a winemaker's instinct is to add SO<sub>2</sub> as soon as possible to protect wine from oxidation or from the risk of microbial contamination. In reality, this action can prejudice wine quality and longevity. Let's see how.*

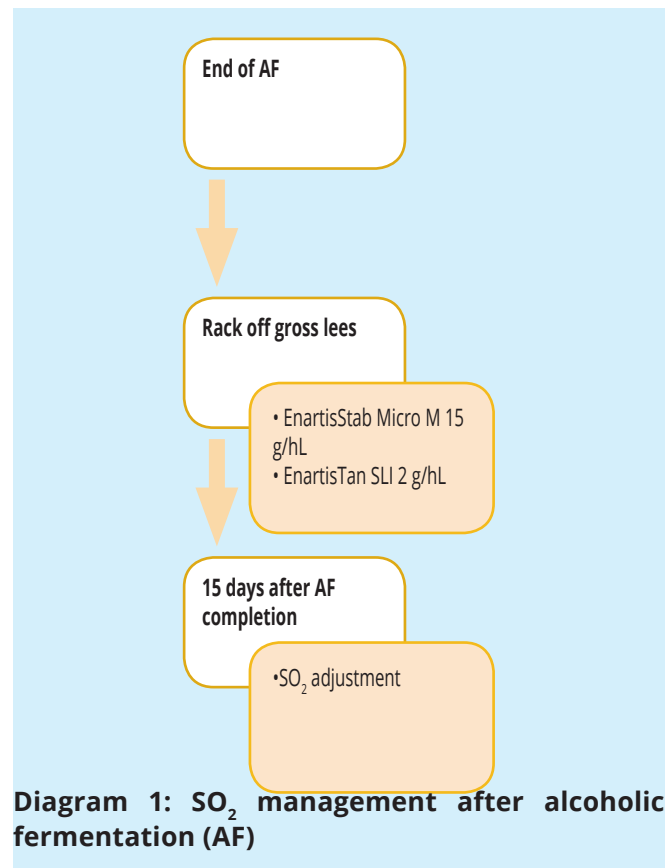
#### END OF ALCOHOLIC FERMENTATION

Let's consider the situation of a wine that is not meant to go through malolactic fermentation. Usually, right after alcoholic fermentation, wine is racked off gross lees and then SO<sub>2</sub> is added to prevent malolactic fermentation onset and for antioxidant protection. The fine lees that remain in the wine consist of residual yeast cells from fermentation. They are intended to positively contribute to wine quality by increasing mouthfeel, aroma complexity, colloid stability and by keeping redox potential low. All this is very true if SO<sub>2</sub> addition is done at the right time. In fact, it takes approximately 10 to 15 days for yeast to die after the completion of fermentation. Any addition of SO<sub>2</sub> done in this time period, when yeast is still active, will lead to the formation of H<sub>2</sub>S and SO<sub>2</sub> binders which are mainly acetaldehyde, pyruvic acid and α-ketoglutaric acid.

These two mechanisms help yeast turn SO<sub>2</sub> into less harmful compounds, but also create enological problems: appearance of reduction and increase of bound SO<sub>2</sub> content.

#### What are the possible solutions? How do you postpone SO<sub>2</sub> addition without risk of oxidation or wine spoilage?

Activated chitosan is an effective alternative to the early addition of SO<sub>2</sub> (Diagram 1). It can be used to avoid malolactic fermentation onset and to protect wine from other contaminants. Chitosan kills bacteria and wild yeast by altering their cell membrane permeability, without triggering any biochemical reactions that could produce spoilage compounds. Hydrolysable tannins can replace the SO<sub>2</sub> antioxidant effect and help to protect wine during this delicate phase.



**Diagram 1: SO<sub>2</sub> management after alcoholic fermentation (AF)**

## ABOUT ACETALDEHYDE

Acetaldehyde or ethanal is the most important volatile wine carbonyl compound. It can be formed biologically (by yeast at the start of alcoholic fermentation) and chemically (mainly after alcoholic fermentation when wines are not protected from oxidation from atmospheric oxygen). Acetaldehyde has a green grass, apple-like or nutty aroma (threshold of approx. 100 mg/L) and can combine SO<sub>2</sub> (1 mg/L acetaldehyde combines 1.4 mg/L SO<sub>2</sub>). According to a recent study conducted by Cornell University on 200 wines, it typically accounts for about 80% of the irreversibly bound SO<sub>2</sub> in white wines and 50% in red wines (Figure 1). Acetaldehyde can be degraded by yeast during the later stages of alcoholic fermentation. Malolactic bacteria degrade acetaldehyde during malolactic fermentation but most significantly in the first week after malic acid depletion.

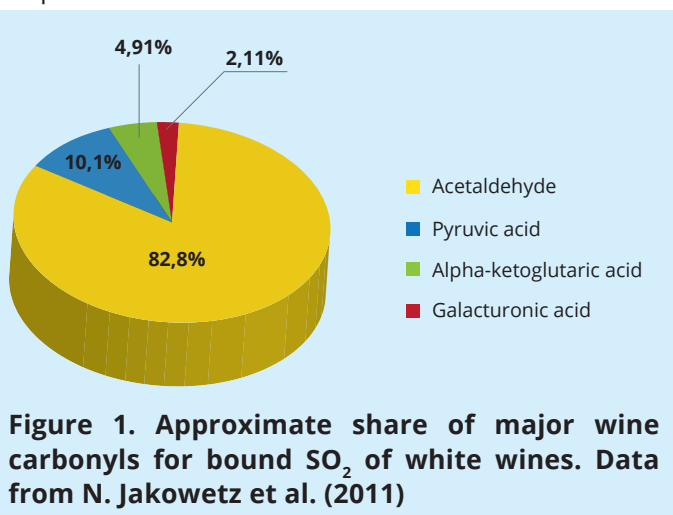


Figure 1. Approximate share of major wine carbonyls for bound SO<sub>2</sub> of white wines. Data from N. Jakowetz et al. (2011)

## END OF MALOLACTIC FERMENTATION

It is known that lactic acid bacteria have the ability to degrade acetaldehyde. Acetaldehyde is produced by fermenting yeast. Depending on the strain, its content at the end of alcoholic fermentation can vary from 10 to 50 mg/L. Acetaldehyde degradation by bacteria takes place, in part, simultaneously with malic acid fermentation but mainly after malic acid depletion: acetaldehyde content decreases only by 1/3 during malolactic fermentation and by 80-85% in the 3 weeks after its completion (Figure 2). In a similar way, lactic acid bacteria also reduce other carbonyl compounds produced during alcoholic fermentation like pyruvic acid and α-ketoglutaric acid. This means that an early addition of SO<sub>2</sub> after malic acid depletion, can turn into the bound form by up to 80%.

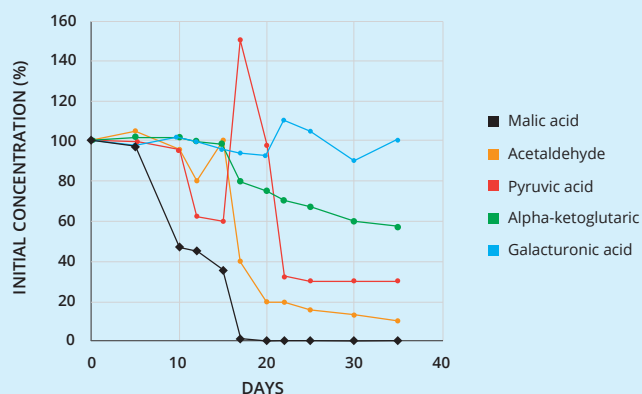


Figure 2: Kinetics of carbonyl compound degradation by lactic acid bacteria. Data from N. Jakowetz et al. (2011)

## WHEN SHOULD SO<sub>2</sub> BE ADDED?

To fully take advantage of malolactic fermentation's contribution towards decreasing the total SO<sub>2</sub> level, delaying SO<sub>2</sub> addition by 7-10 days after malolactic fermentation completion is advised (Diagram 2). This is a good compromise that allows the reduction of SO<sub>2</sub> by approximately 75% without unnecessarily increasing the risk of organoleptic deviations caused by possible contaminants. The addition of tannins can help protect wine from oxidation.

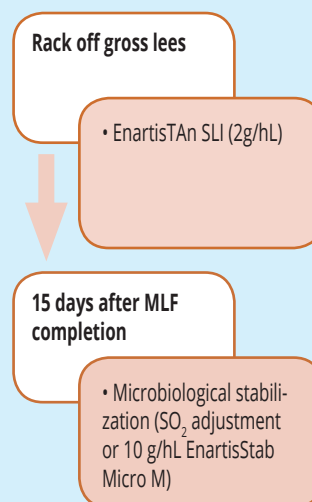


Diagram 2: SO<sub>2</sub> management after malolactic fermentation (MLF)

## HOW TO MANAGE SO<sub>2</sub> ADDITIONS DURING WINE MATURATION?

If SO<sub>2</sub> content is sought to be reduced or even eliminated, the use of antioxidant and antimicrobial alternatives are a great help.

**Activated chitosan** is an antimicrobial fining agent that can be used during the entire vinification process to control spoilage microorganisms. Contrary to SO<sub>2</sub>, it is an allergen-free substance and its antimicrobial activity is not significantly influenced by wine pH. It can be used to control *Brettanomyces*, *Acetobacter*, *Pediococcus*, *Lactobacillus*, *Oenococcus* and *Zygosaccharomyces*.

The **copolymers of polyvinylimidazole and polyvinylpyrrolidone (PVI-PVP)** and activated chitosan are capable of absorbing iron and copper, the real culprits of turning oxygen, a weak oxidizer, into the most active and dangerous free radicals.

**Tannins**, particularly hydrolyzable ones, are very effective in scavenging both oxygen and free radicals and limiting their effects.

**Fine lees** maintain a low redox potential and consume active oxygen.

<b>Activated chitosan</b>	EnartisStab Micro M	Preparation based on activated chitosan designed for the treatment of must and cloudy wine. It can be used for reducing spoilage yeast and bacteria and to prevent the onset of unwanted malolactic fermentation.
	EnartisStab Micro	Pure activated chitosan. Recommended for removing <i>Brett</i> and its off-flavors.
<b>PVI-PVP</b>	Stabyl Met	Copolymer of PVI/PVP and silica. Prevents oxidation, browning, pinking and formation of haze by removing the main catalysts of oxidation, iron and copper.
	Claril HM	Synergistic combination of chitosan and PVI/PVP to reduce the concentration of iron, copper, hydroxycinnamic acids and catechins, which are key players in the process of oxidation.
<b>Tannins</b>	EnartisTan Blanc	Gallic tannin with a high antioxidant effect that strengthens the protective action of SO <sub>2</sub> .
	EnartisTan SLI	Tannin produced from untoasted American oak with a unique process that makes it extremely effective in blocking oxidation and prolonging wine shelf life.
<b>Fine lees</b>	Surli One	Inactivated yeast enzymatically activated for replacing natural lees and simulates the effect of <i>sur lie</i> ageing.
	EnartisStab SLI	These selected "active lees" balance wine redox potential, scavenge oxygen and prevent the oxidation of wine color and aromas during storage.