Winemaking Chronicle

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Lower the level of SO2 in red wines: good practices during ageing process

Example of a Merlot, Popular Premium segment for international markets

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Our vision

Market demands vary widely in space and time and our job as consultants is to help the wineries answer and adapt to these demands from the markets through technique and the application of winemaking good practices.

Lower levels of SO2 in wines is one of today's challenge, particularly in fresh fruity wines where it participates in the sensory style but in which consumers are most likely to remark its presence.

Our definition of good practices: A set of techniques applied to the winemaking process in order to reach planned objectives of price x sensory profile x target market.

As many fermentations are now going on in many wineries in Northern Hemisphere, in this harvest chronicle we start the process at the beginning of ageing right as the sugars are finished and you prepare for the devatting. Pre-fermentation and fermentation phases will be the core of a chronicle in June 2020.
In order to keep this chronicle brief, we will only review the reduction of SO2 level in wines containing sulfites. We will not talk of « wines without sulfites ». We plan a future chronicle on the subject.

A practical example

This chronicle is based on a practical protocol for a popular premium Merlot (3-5€ F.O.B.) with bottling at the end of spring. This protocol is a recommendation for one of our consulting clients. They have applied it for several years obtaining conforming performances on their markets.

Key figures for a good SO2 efficiency

SO2 efficiency for a Merlot is quite simple to be defined with a few figures. Of course reaching stable and consistent results is more complex and this is what this chronicle describes through our good practices.

A reminder: the juice and wine pH is an absolute key-point for the balance between the different forms of SO2 and their stability. In this chronicle we recommend a pH of 3.5 in the juice and the wine, a pH adapted for fruit expression and longevity and to manage the SO2 efficiency when kept at moderate levels.

The 4 key moments and 4 key levels for SO2 (at pH 3.5):

- **Key-moment #1: Filling of the tank**

Key level: maximum of 30 mg/L Total SO2 to ensure a level of protection from external contaminants in the early stages of maceration. We recommend the inoculation with a *Torulaspora delbrueckii* (Biodiva) during the filling of the tank that will bring bio-protection to the must and limits the need for SO2.
At this stage Free SO2 is not an operational indicator.

- **Key-moment # 2: The end of alcoholic and malolactic fermentation.**

Note: When sugars are finished, Total SO2 should be below 20 mg/L

As soon as the sugars and malic acid are finished, add SO2 in the wine for an immediate and intense anti-microbial action on the yeast and lactic bacteria and protection from external contaminants at the very beginning of ageing. For a fruity-yet-complex style Merlot, we recommend the coinoculation with *Lactobacillus plantarum* (ML Prime) which population will have consumed all malic and will have strongly started its decline by the end of A.F.. As a consequence, at pH 3.5, with our recommendation of adding 4 g/hl (or 40 mg/L) SO2 during a racking 12-24 hours after the end of sugars we manage all remaining possible microbial populations. With the malolactic strategy with ML Prime, when we sulfite right after the sugar are finished, the sulfite-reductase from the yeast could be still active.

In any case, our recommended protocol is more efficient than leaving the wine without SO2 during one week or two after the end of malic and sugar. It represents less risks of alteration of the aromas and helps in the stabilization of the colour.

- **Key-moment # 3: from day 1 of ageing to the day before bottling.**

Keep 0,6 mg/L **Molecular** SO2. Right after key moment #2, analyse frequently (every month for example) the FREE SO2, the pH and the alcohol level and calculate the Molecular SO2. If below 0.5 mg/L, add SO2 to go back to 0.7 mg/L.

The early Spring filtration (and then the addition of inactivated yeast like Noblesse) is a key point in the SO2 efficiency and stability at such a low level to keep wine from contamination and keep the fresh fruit and vivid color.

- **Key-moment # 4: the day of bottling.**

A few days before bottling analyze FREE and TOTAL SO2, pH and alcohol. Check that **molecular** SO2 is conforming.

Then calculate how much SO2 you need to add on the day of bottling (or the day before) to reach the following FREE SO2 levels according to the closure used:

screw-cap	33/34 mg/L
technical cork (examples: Nomacork, Diam)	34/35 mg/L
natural cork	36/38 mg/L

With the proposed complete protocol, TOTAL SO2 should be below 80-90 mg/L after bottling, allowing to respect organic wines maximum legal limits.
Of course there are many factors influencing the stability and consumption of the different SO2 during ageing and the shelf-life in bottle. They are key factors to reach the key levels of SO2 at the 4 key moments.

Key points influencing a good SO2 efficiency

Brief reminder of pre-fermentation and fermentation key factors:

Filling of the tank: adjustment of pH (below 3.5), addition of SO2 (3 g/hL) (as SO2 solution or metabisulfite). Add selected yeast correctly rehydrated (see below) to the bottom of the tank right before filling. The biomass will instantly occupy the medium and prevent external contaminations **and excessive oxidation of grapes compounds.** This way we lower the need for SO2 protection on fresh grapes since we only need it for the short latency phase of the F.A.

Alcoholic fermentation: low-SO2-and-acetaldehyde-producing yeast (e.g. ICV-D254 or Lalvin Persy) ; rehydration with inactivated yeast concentrated in sterols (e.g. GoFerm Protect Evolution) ; immediate addition of organic nutrient (e.g. O'Tropic) ; **beginning of** fermentation between 18 and 20°C.

Malolactic coinoculation with a *Lactobacillus* bacteria: co-inoculation with ML Prime as soon as the pomace cap is formed presents many benefits which among other things allow us to lower SO2 additions:
-Co-inoculation with a great number of selected microorganisms helps with the bio-protection of the must in the first phase the F.A. => Less need for SO2.
-The population doesn't really multiply and consumes malic acid very rapidly which means that, by the end of F.A., malic acid is completely consumed and most of the population of bacterias is dead or dying => Only one relatively moderate addition of SO2 at the end of F.A. to protect from future contaminations during ageing.
-MLPrime doesn't consume sugars and doesn't produce acetic acid in normal alcoholic fermentation conditions.
-Participate greatly in the fruit and complexity of the sensory profile of red wines

Removal of heavy fermenting lees with délestages: Heavy 'vegetal' lees (bits of stems, of leaves, seeds, pulp, dirt and later dead yeast cells) that sediment at the bottom of the maceration tank as soon as the cap is formed are a big consumers/combiners of SO2. Additionally if left in contact with colouring matter, they absorb said color before it can stabilise. They must be removed (once or twice a day) through regular délestages. Well made délestage allow the removing of most solid part that sediment at the bottom of the reception tank

Reminder: along with the winemaker, the yeast is the potential main source of too-high TOTAL SO2 in wines. It can produce high amount of additional SO2 and also high amount of acetaldehyde that then combine SO2 very strongly. That is why the choice of yeast strain, the rehydration, the early nutrition are key points to limit as much as possible yeast-produced SO2 and acetaldehyde production.
Note: In the following protocol we recommend some enological products and oaks types. Through our experimentations and field experiences on many vintages and in many different countries we have deemed them the most apt to reach planned objectives of style and cost.

To calculate Molecular SO2:
http://www.delteil-consultant.com/pdf/RD/molecularSO2_Changins_english.xls

NOTE: - In order to work on style, gain time and lower SO2 additions we recommend to work with *Lactobacillus plantarum* (MLPrime) in coinoculation for the Malo-Lactic Fermentation (M.L.F.). The population will normally have consumed all malic acid before the end of A.F. and will be almost dead (they don't really multiply in classical fermentation conditions) allowing to add SO2 only once to manage the remaining yeast population and ensure protection from external contaminations.

- Maceration: For a fruity style you want to avoid too long macerations. Here, we recommend a maximum of 7 days total duration of maceration with 200g/hL of blocks in bags (French oak, medium+ in bags), after which you want to drain, even with A.F. still going.

- On this level of price and style, we strongly recommend to separate the pressings from the drained wine. They undergo additional treatments to bring them to the right level of quality and are then blended with the rest.

DRAINING: 1-2 g/hL Reduless in the reception tank. Recover the bags of oak blocks. Wash them. They will be added in the pressings

PRESSINGS: (see next page)

Racking #1
12h after draining: Rack to another tank. Make sure each time you rack you leave the heaviest less at the bottom of the initial tank. Here what has settled in 12 hours.
Check malic acid level. If A.F. or M.L.F. are still going, maintain temperature at 20°C.
Add 100 g/hL French oak blocks medium toast + (Odysé 210°C), add 10 g/hL Noblesse.
In good conditions of use, MLPrime should have finished consuming the malic acid before the A.F. finishes.

Racking #2
When sugar is consumed:
Add 1 g/hL Reduless. After 24h: rack the wine without aeration leaving the heavy lees at the bottom of the tank, wash the blocks with clean water and transfer them.
In the reception tank, adjust pH to 3,49 and add 4 g/hL SO2. Adjust temperature to 10-12°C.

Racking #3
1 week after racking #2: Add 1 g/hL Reduless
After 5 days rack leaving the heavy lees at the bottom of the tank, wash and transfer the blocks. Analytical control of the number of live germs. Two mixing of the tank per week.

Racking #4
1 month after racking #3: Add 1 g/hL Reduless
Let Reduless settle for 24 hours and then rack again leaving the heavy lees at the bottom of the tank.

Work with the lees: Add 10 g/hL Noblesse.
Maintain temperature at 10-12°C. Maintain pH at 3,49 and SO2 at 0,6 mg/L of Molecular SO2. One mixing per week.
Each month evaluate the necessity to rack and/or to add 1 g/hL Reduless and/or to add 10 g/hL Noblesse and/or to use micro-oxygenation at a dose of 1mg/L/month

Bottling:
At the beginning of April (Northern hemisphere) crossflow filtration (or at 3µm on Sartorius Jumbo)
After filtration, add 0,5 g/hL Reduless, 20 g/hL Noblesse.
Check the levels of FREE SO2 and adjust the concentration depending on the closure you use. (see page 2)
On the day of bottling adjust mouthfeel with 2-3 g/hL of Mannolees.

NOTES:
- Addition of SO2 right as soon as sugars are finished is here to control the microbial population. In the complete protocol malolactic fermentation is made with ML Prime.
- pH often naturally rises during A.F. To ensure the efficiency of SO2 and hence the lowest possible addition, pH must be checked and adjusted if higher than 3,50.

- Heavy compacted lees are a big consumer of SO2 and have a potentially harmful influence on the aromatic profile of the wine. This is why it is important to follow a strict program of lees segmentation to remove frequently the most harmful part of lees while keeping what is potentially interesting.
Starting at Racking#1, each time we remove heavy lees with a racking, we partly replace them with an addition of an inactivated yeast (Noblesse). Regular addition of such inactivated yeast is important to bring roundness to the style. Such inactivated yeast do not consume or combine SO2.

- Large French medium toasted oak segments (like blocks used during maceration or staves during ageing) allow for a balanced and slow interaction with the wine and a good stabilisation of compounds of interest inside the colloidal matrix of the wine. That is why the same blocks that were put during the A.F. remain until the first half of ageing to keep on doing their double job of giving light oak aromas that push the Merlot fruity aromas AND adsorbing unstable compound into their porous structure, including instable color. Oak as recommended has no negative impact on SO2 stability.

- Possible aggressive/negative aromas in the wine at this stage generally result from an over concentrated and unstable pool of sulfur compounds. A balanced pool of sulfur compounds participate to fruity and fresh aromas. Regular additions of Reduless allow to eliminate the excess amount of sulfur compounds and progressively stabilize the sulfur pool with a stable colloidal matrix: building step by step the wine longevity (see introduction). Reduless additions in this protocol do not transfer detectable amounts of copper to wine preventing the negative oxidative effects of solved copper.
Such inactivated yeast do not consume or combine SO2.

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PRESSINGS

1. Pomace in the press
Transfer the pomace to the press in bins rather than with a pump.
Press up to 0,5 bar.

2. 1st Reception tank
Add 3 g/hL Reduless.
Add 1 g/hL pectolitic enzymes (e.g. Lallzyme Ex-V).
Transfer the blocks that were in the maceration tank.
Set temperature at 18°C.
Adjust pH to 3.40.
After 24 hours in this tank, rack, removing the heavy lees even if the wine is still fermenting. Clean the blocks with clean water and transfer them to the next tank.

3. 2nd reception tank
During the filling of the tank:
Add 2 g/hL Reduless
Add the bags of blocks
Set temperature to 18°C
After 48-72 hours in this tank, malic acid and sugars should be finished. Rack, leaving the heavy lees at the bottom.
Rinse the blocks with clean water and transfer in the reception tank

4. 3rd reception tank
During the filling of the tank:
Check that pH is below 3.40.
Add 4 g/hl SO2 and 2 g/hL Reduless
Add the bags of blocks
Set temperature to 18°C
After 48-72 hours in this tank, rack to blend with the free run wine, leaving the heavy lees at the bottom.
Clean the blocks and put them in a wine of lower price.

-When our whole protocol is respected, at bottling, the wine has a balanced colloidal matrix and the right roundness. That is why we recommend addition of a rather low dosage of soluble mannoprotein. Such a dosage brings a last touch of mouthfeel to the wine while also acting as a buffer to protect the colloidal matrix from the shocks induced by the various pumping actions during bottling. This protection helps the wine return faster to its original profile after bottling and allows for a more stable matrix hence a wine more stable in time = longevity
Such mannoproteins do not consume or combine the SO2 in the bottle.