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CANTON
*Members of Chêne & Cie*

# Chêne Développement Newsletter

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Contents



***The Chêne & Cie Research and Development team***
Dominique de Beauregard, director. Marie Mirabel, PhD, enologist
Anne-Charlotte Monteau, agricultural engineer, enologist. Rémi Teissier du Cros, forest engineer

## Sulphur dioxide: a review

Sulphur dioxide is a compound that has been used in oenology since the 16th century for its antimicrobial properties. It is a biocide i.e. a substance that can destroy, prevent or render harmless any harmful organism. In 1998, when Directive 98/8/EC concerning the placing of biocidal products on the market was published, $SO_2$ did not appear on the list of compounds authorised for surface treatments, since its non-toxicity to humans and the environment had not been established. An application to include it is under development. It has been financed by a consortium that defends the interests of winemakers and coopers and should be submitted to the European Commission in November 2012. If the effectiveness of sulphur dioxide and the absence of risk to human health and the environment are demonstrated, **it will be authorised for the disinfection of barrels.** If not, this would be problematic since the wood of empty barrels contains several litres of wine that risk spoilage if barrel storage is not controlled.
However, there are other available methods that could complement this compound.
This is why we wanted to review the use of $SO_2$ and the effectiveness of these alternative techniques.

### *The use of sulphur, a traditional technique*


Lavigne-mag.fr

Sulphur dioxide is an effective biocidal agent and antioxidant that is used to disinfect and protect barrels when they are stored empty. Its use is rapid (approximately 5 min./barrel) and its persistence, while influenced by the moisture in the barrels, can last for up to 12 weeks. Solid sulphur allows the reaction with the oxygen in the barrels, which produces $SO_2$ in its gaseous form. This gas is toxic to yeasts and bacteria and seeps deep into the wood. Solid sulphur is used in various forms:

- **Sulphur wick** is not recommended because the drips that form limit the production of gaseous $SO_2$ and therefore the containers' protection. Moreover, its effectiveness varies depending on the moisture in the barrels.
- **Sulphur pellets** burn in a more controlled fashion but are sensitive to the moisture in the barrels.
- Sulphur dioxide can also be used in **gaseous cartridge or liquid form**.

**Burning five or more grams of sulphur per barrel is said to be sufficient** to effectively disinfect the wood, i.e. to fully remove all *Brettanomyces* to a depth of 9 mm. Sulphur is therefore used to disinfect barrels but also increases the amount of free $SO_2$ in the wine. Furthermore, in humid conditions, it can play an acidifying role through the production of sulphuric acid when the water contained in the barrels reacts with oxygen gas and gaseous sulphur dioxide.

### *Heat treatment using hot water and steam*

Effective heat treatments are long due to the inertia of wood.

**Hot water** (70°C) alone can reduce surface microorganisms by approximately 75%, which is not sufficient to minimise the risk of the wine being contaminated. Its use is highly recommended in order to raise the wood's internal temperature, thus increasing the steam's effectiveness.

**Steam** penetrates the staves deep-down and can reach microorganisms to a depth of 8 mm. Heat treatment is over 99% effective for acetic acid bacteria (K.L Wilker, 1997) when applied for 15 minutes at a temperature of over 85°C. Superheated steam (>120°C) is not recommended in order to preserve the wood's structural integrity.


old.dupray.ca

Chêne & Cie collaborated with A. Oelofse in 2008 to develop a disinfecting protocol reducing levels of acetic acid bacteria and *Brettanomyces bruxellensis* to less than 1 CFU/cm3.

- **Rinsing** with cold water: 2 min.
- **Washing** with high-pressure hot water (70°C): 8 min.
- **Steaming:** 8 min.
- **Rinsing** with cold water: minimum 2 min.

**This treatment lasts 20 minutes per barrel**. Rinsing with cold water is essential because it rapidly lowers the wood's temperature, thereby avoiding a window of optimal temperatures for the multiplication of residual microorganisms. However, heat treatment, while effective on the spot, in no case guarantees the absence of future contamination if the barrel is stored empty.

### *Miscellaneous chemical treatments*

Chemical treatments can eliminate microorganisms in three different ways depending on their nature:

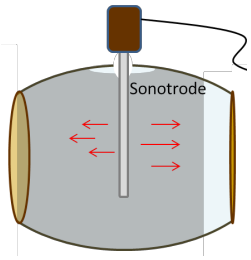
- **Oxidation** of cellular compounds (oxidants)
- **Lysis** or alteration of cell membranes (surfactants)
- **Fatal interactions** with cellular components (aldehydes)

**Alkaline/detergent protocol**: This method comprises prewashing with heated water (50-70°C, 10 minutes). A cleaning phase is then initiated by applying an alkaline detergent (10 to 60 minutes, 15 to 40°C, use recommended amounts) containing carbonate to remove tartar. This is followed by a rinsing phase to ensure that there are no residues from the previous treatment. The next disinfection phase is characterised by the application of an acid detergent (20 minutes, ambient temperature, use recommended amounts). Thorough rinsing is necessary to ensure that no residues remain before barrelling.

**Peroxide salts** are powerful antioxidants that act on various cellular compounds and have real advantages for barrel disinfection. For example, sodium percarbonate requires a shorter contact time and a lower temperature increase than soda and potassium permanganate to be effective. This treatment produces better results than the aforementioned method with less pollution and toxicity. Thorough rinsing remains essential.

These are purely surface treatments with limited product penetration. Furthermore, these techniques have zero persistence and do not protect empty barrels.

## *Ultrasound disinfection, a new technique*




This technique is used to simultaneously clean and disinfect barrels. The container is filled with hot water (60°C) and a sonotrode is inserted through the bunghole. Ultrasound propagation results in the generation of high cavitation pressure (>2000 atm) and a strong local increase in temperature. These parameters cause the surface and deep cells to burst.
According to a publication by Andrew Yap (2009) based on the observation of pieces of contaminated staves that were attached to the inside of a barrel, **a 5-minute treatment** is sufficient to fully remove all initial tartrate deposits (99.6%) and microorganisms from a used barrel. This process is considered promising but too few results have been published to issue a definitive opinion on the topic.
Although it appears effective, this treatment has no persistence and does not prevent risks of future contamination if the barrel is stored empty.

**The persistence of sulphur remains unequalled to date, which makes it a reliable and effective technique for storing empty barrels. If its prohibition becomes effective, new techniques may be implemented. Heat treatment and the use of ultrasound are promising but there are also other techniques that are presented below.**

## Overview of barrel disinfecting methods

| | Method | Disinfection | Persistence | Time/barrel | Impact on human health | Environmental impact | Availability |
|---|---|---|---|---|---|---|---|
| SULPHUR | Pellets | Effective | Approx. 3 months | 5 min. | Irritating, allergenic | Low | Yes |
| | $SO_2$ in solution | Effective | Approx. 3 months | 5 to 10 min. | Irritating, allergenic | Low | Yes |
| | Gaseous $SO_2$ | Effective | Approx. 3 months | 3 to 5 min. | Irritating, allergenic | Low | Yes |
| ALTERNATIVES | Chemical products | Moderately effective | None | 5 min. + rinsing | Irritating, toxic | Established | Yes |
| | Ozonated water | Ineffective | None | 15 min. | Toxic | Low | Not authorised by the EU |
| | Gaseous ozone | Effective | None | 15 min. | Toxic, irritating, explosive | Highly corrosive | Not authorised by the EU |
| | Steam | Effective | None | 3 to 8 min. if pre-rinsing with hot water | Risk of burns | None | Yes |
| | High-pressure hot water (80°C) | Moderately effective | None | 10 to 15 min. | Risk of burns | None | Yes |
| | Projection of dry ice | Effective (waiting for scientific publication) | Low (a few hours) | No data | Toxic, irritating | None | Developed in the USA |
| | UV | Ineffective | None | 5 to 30 min. | Carcinogenic | None | Yes |
| | Ultrasound | Effective | None | 5 to 15 min. | No risks | None | Yes |

*Key:*

**Effective:** over 90% of microorganisms are destroyed on the surface and deep-down.
**Moderately effective:** 50 to 75% of microorganisms are eliminated, particularly on the surface.
**Ineffective:** surface treatment eliminating less than 50% of the microorganisms in the wood.

Chêne Développement
Z.A. de la Garosse - 250, rue des Droits de l'Homme
33240 Saint André de Cubzac - France
Tel. 33 (0)5 57 33 00 10
Fax 33 (0)5 57 33 00 11