



Commentary on the Use of SO₂ in Winemaking and Typical Levels Found in Wines

Sulphur dioxide has been used in winemaking since Roman times and has shown to be an effective aid for production of quality wines. It has two main functions – as an antioxidant and a preservative/anti-microbial agent. However, it is important to recognise that wines also naturally contain SO₂, as yeast produce a small amount, about 10 mg/L (ppm), during fermentation. It would not be possible to produce a wine that was ‘SO₂ –free’.

Role of Sulphur Dioxide in Winemaking

Antioxidant

Sulphur dioxide is used by winemakers to prevent oxidation; however it does not act by directly removing oxygen from wines and musts, but by binding with the precursors involved in oxidative reactions thereby preventing them from reacting with oxygen, or by binding with compounds already oxidized to reverse oxygen’s effect.

Preservative

Sulphur dioxide has anti-microbial properties and can be used by winemakers to prevent spoilage by bacteria or spontaneous fermentation by ‘wild’ yeasts (i.e. yeast naturally present on the grapes or in the winery as opposed to the *Saccharomyces* yeast strains used by winemakers for alcoholic fermentation).

Free v Total sulphites

In solution in wine (typical pH of 3-4) sulphites are formed and react with other compounds such as sugars, acetaldehydes and phenolics, become **bound**, and no longer take part in any further reactions. A proportion of sulphites remains in solution and are described as **free**. The proportion of free SO₂ is also dependent on pH, temperature and alcoholic strength. Only the free SO₂ has oxidative and preservative properties. **Total** SO₂ is the sum of the free and bound sulphites.

Addition of SO₂

In general red wines have lower levels of SO₂ added as the tannins and phenolic compounds present provide an inherent protection against oxidation. Conversely sweet white wines may need higher doses of SO₂ as SO₂ reacts readily with sugars and becomes bound and therefore inactive (see Annex 1 for permitted maximum levels of SO₂ in national regulations).

SO₂ may be added to grapes at harvest or at the crushing stage to prevent oxidation and to suppress wild yeast. It is usually added in the form of the salt potassium metabisulphite, although it can also be applied as a gas. Careful control of grape health and quality, along with good hygiene in the winery has enabled winemakers to reduce the amount of SO₂ applied at this stage. However it is noted that as the vintage roll-over for sweet rosés and red wines approaches, oenologists may need to make full use of the SO₂ dosing available to them to compensate for the length of time the wine has been stored prior to bottling.

SO₂ is also key to protecting bulk wine that is transported across the world. Such transportation exposes the wine to extremes of temperature, increasing the likelihood of oxidation. Bulk wine accounts for a substantial volume of the wine imported into the UK (8 in ten of the bottles of Australian wine on sale in the UK were shipped in bulk and bottled in the UK) and it is essential that scope remains for the targeted use of SO₂ during this process.

Typical levels of Free and Total SO₂ at bottling

Winemakers also frequently add SO₂ to wines at bottling to help prevent oxidation during what can often be a turbulent process, particularly in 'bag-in-box' (BIB) products.

Wine makers aim for around 25-40 mg/L free SO₂ after bottling. Generally red wines will have lower levels and whites will be higher. As the fruit aroma and varietal character of wine can be masked at levels of free SO₂ above 40mg/L winemakers have no incentive to use greater levels of sulphites than necessary.

Data below in Table A has been provided by a major UK bottler and shows typical finished levels of SO₂ and is based on over 100 productions. It gives a clear indication of average packing levels of SO₂ taking into account different packaging performance of primary materials for varying end-market environmental conditions.

Table A

Product	FSO ₂ BIB	FSO ₂ Bottle	Total SO ₂ (BIB+Bottle)
White and Rosé wines (<5g/L sugar)	48	36	149
White and Rosé wines (>5g/L sugar)	48	35	183
Red wine (<5g/L sugar)	51	34	85
Red wine (>5g/L sugar)	52	32	106

Reduction in levels of Free and Total SO₂ after bottling

Bag-in Box (BIB)

Data provided by members indicates that BIB FSO₂ drops by about 10mg/L after the first month then 2-3 mg/L every month after that. Total SO₂ drops 10-15 mg/L after first month then 5-10 mg/L every month after that.

Bottled

In bottled wine, Free SO₂ drops within the first couple of months and then levels out. It is anticipated that Free SO₂ will drop to around 10-20mg/L by the end of its life and by about 10-30 mg/L from the original value.

Data below in Table B was provided by a major UK multiple-retailer and is based on a comprehensive analysis of their full range of wines. Samples were taken from bottles which were collected from shelf in store, and so represent what a customer is likely to be exposed to at home.

Table B.

Product	No of wines	Av FSO ₂	Av Total SO ₂
White and Rosé wines (<5g/L sugar)	87	26	119
White and Rosé wines (>5g/L sugar)	38	26	140
Red wine (<5g/L sugar)	86	23	104
Sparkling wine	36	11	99

Case for Bag in Box wines

Generally speaking BIB products may be subject to increased sulphite preservative usage over bottle when factors such as pack size, closure type, bag film composition and resulting oxygen transmission rates arising from local environmental conditions during transport and storage are taken into account. However, the principles of Good Manufacturing Practice still apply and any variations in additions are to be justified in accordance with shelf-life data evidence.

Alternatives to SO₂

There is a lot of research underway looking into an alternative to using SO₂, including a European funded study (SO2SAY) which is investigating plant-based extracts. Initial trials are promising, but to date there is no single, easily transferrable method which can offer the combined anti-oxidative and anti-microbial functions of SO₂.

Summary

Winemakers recognise that all wine benefits from minimal processing. Care is taken throughout the wine making process to minimise oxidation and manage levels of dissolved oxygen through Good Manufacturing Practice, and in combination with good hygiene and winery practices and careful handling of wine during transport and bottling. Accordingly winemakers routinely use SO₂ at the lowest possible levels to achieve a stable and long lasting product. Economic pressures also ensure that winemakers do not use processing aids or additives – including SO₂ – at levels greater than that needed to achieve the intended technological function in the wine.

While in practise winemakers use less than the maximum permitted SO₂, the current allowable levels are essential to ensure product quality can be maintained across the spectrum of wine styles and quality. Winemakers would struggle to produce commercially acceptable products if maximum permitted levels were cut significantly.

Exposure assessment

As shown above winemakers strive to add as little SO₂ as is technologically possible, and often add far less than the maximum levels allowable under national regulations (see Annex 1). Combined with the reduction in levels of free and total SO₂ after bottling and during storage prior to sale and consumption, it is vital that any assessment of the exposure to SO₂ from consumption of wine should therefore be based on levels of SO₂ in wine 'off the shelf' such as provided in Table B above.

[FIVS](#) is an international federation serving trade associations and companies in the alcohol beverage industry from around the world. It provides a forum for its members to work collaboratively on legal and policy issues and communicates Federation views to national governments and international organizations.

Annex 1. Maximum permitted levels of SO₂ in wines

Argentina	Red wine - <4 g/L sugar 130mg/L; >4g/L sugar 180mg/L White and Rosé wines - <4g/L sugar 180mg/L; >4g/L 210mg/L
Australia and New Zealand	Wine, sparkling wine and fortified wine - <35 g/L sugar 250mg/kg Wine, sparkling wine and fortified wine - >35g/L sugar 400 mg/kg
Canada	350 ppm bound SO ₂ or 70ppm free SO ₂
Chile	Red, rosé, white wines & sparkling wines - 250mg/L Sweet wines - >30g sugars 400mg/L
China	0.25g/L grape wines, 0.4g/L sweet wine
EU	Red wine <5g/L sugar 150 mg/L; Red wine >5g/L sugar 200 mg/L White and Rosé wines <5g/L sugar 200 mg/L;>5g/L sugar 250mg/L Wines specified in R606/2009 Annex 1B 2(c) 300-400mg/L Liqueur wines <5g/L sugar 150mg/L; >5g/L sugar 200mg/L Quality sparkling wines 185mg/L Other sparkling wines 235mg/L
EU Organic wines	The maximum SO ₂ content shall not exceed 100 mg/L for red wines with a residual sugar level lower than 2 g/L; The maximum SO ₂ content shall not exceed 150 mg/L for white and rosé wines with a residual sugar level lower than 2 g/L; For all other wines, the maximum SO ₂ content shall be reduced by 30 mg/L.
Georgia	Red wine - <5 g/L sugar 160mg/L; >5g/L sugar 210mg/L White and Rosé wines - <5g/L sugar 210mg/L; >5g/L 260mg/L Free SO ₂ content shall not exceed 30mg/L
Hong Kong	Grape wines 350 ppm; white wines 400 ppm; sparkling wines 200 ppm
India	Alcoholic wines - 450 ppm
Indonesia	50 mg/L for all wine styles
Japan	0.35g/Kg
Korea	350 mg/Kg
Malaysia	450 mg/Kg (wine including sweet wine)
Mexico	0.350 g/L
OIV	Red wine - <4g/L sugar 150mg/L; White wine, Rosé wines - <4 g/L sugar 200 mg/L Red, white, rosé wines >4g/L sugars 300mg/L Some sweet white wines 400mg/L
Papua New Guinea	Wine, sparkling wine and fortified wine >35g/L sugar 400mg/Kg
Peru	350 mg/Kg (wine from grapes)
Philippines	Wine – no defined limit
Russia	Dry wines 200mg/L Semi sec, semi doux and doux wines 300 mg/L Sparkling, high quality sparkling, pearl and liqueur wines, wine drinks 200mg/L
Singapore	300 ppm
South Africa	Wine produced after 31 Dec 1994 160mg/L; provided that: - noble late harvest wine + wine from naturally dried grapes 200mg/L - natural wine >5g sugar 200mg/L - max free SO₂ 60 mg/L (excluding red wine for bulk export during year of production) - min free SO₂ 30 mg/L wine for bulk export - red wine produced after 31 Dec 2002 <5g/L sugar 150 mg/L - wine in respect of which certification as a noble late harvest wine or as a wine from naturally dried grapes has been refused, may contain a maximum of 300mg/L SO₂
Chinese Taipei	0.4g/L (alcoholic beverages brewed from fermented fruit)
Thailand	No defined limits
Turkey	Red wine < 5 g/L 260mg/L; >5g/L sugar 160 mg/L White and Rosé wines <5g/L 235mg/L; >5g/L 210mg/L Sparkling wine 200mg/L Champagne 235 mg/L

US	350 ppm (mg/L) It is not permitted to add SO ₂ to Organic wines Wine made with organic grapes, SO ₂ to 100ppm (mg/L)
Vietnam	Red wine 150mg/L White and rosé wine, or red wine >5g/L glucose and fructose 200mg/L White wine and Rosé wines >5g/L glucose and fructose 250mg/L Quality sparkling wine 185mg/L Other sparkling wine 235mg/L

*Data kindly provided by FIVS from FIVS-Abridge database. Information should be confirmed directly with importing countries.