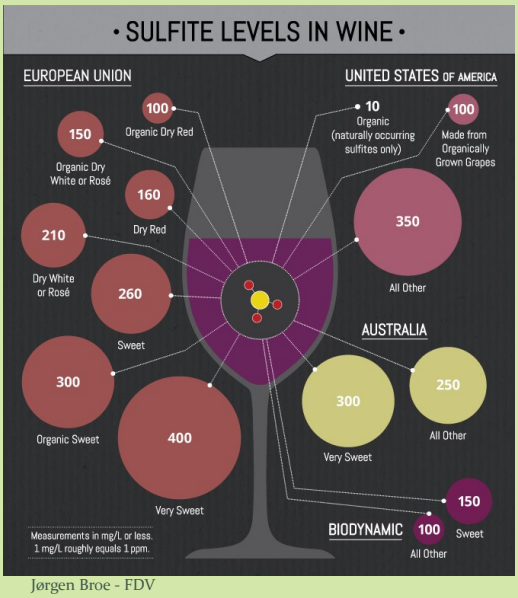
Sulfit et drilsk
- men nødvendigt onde ! (?)

1

Styring af sulfit i vin kræver:

- Viden/ indsigt
- Måling

2



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3

Hvorfor Sulfit/ SO_2 i vin ?

Sulfit tilsættes most/ vin for at:

- Hæmme uønskede mikro organismer (antimikrobiel)
- Hæmme oxidation (antioxidativ)
- Hæmme enzymatisk oxidation
- Binde uønskede stoffer (f. eks acetaldhyd)

- Tilsættes ofte i form af kaliummetabisulfit ($K_2S_2O_5$)

(Afbrænding af svovl (—> SO_2), gasning med SO_2, natriumsulfit mv.)

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Sulfit i vandige opløsninger

$SO_2(aq) + H_2O \leftrightarrows HSO_3^- + H^+$

$HSO_3^- \leftrightarrows SO_3^{2-} + H^+$

$HSO_3^- + HSO_3^- \leftrightarrows H_2O + S_2O_5^{2-}$ (disulfit/ bisulfit)

Total sulfit = fri sulfit + bunden sulfit

SO_2(aq) (ofte kaldet molekylært svovldioxid)

er den mest aktive komponent og kan dannes ud fra fri sulfit

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Sulfit pulver (kalium-metabisulfit – $K_2S_2O_5$)

- Ikke 100 % rent - Typisk 95%
- Hygroskopisk
- Labilt – afgiver SO2
- Let opløselig i vand - men ikke alkohol!

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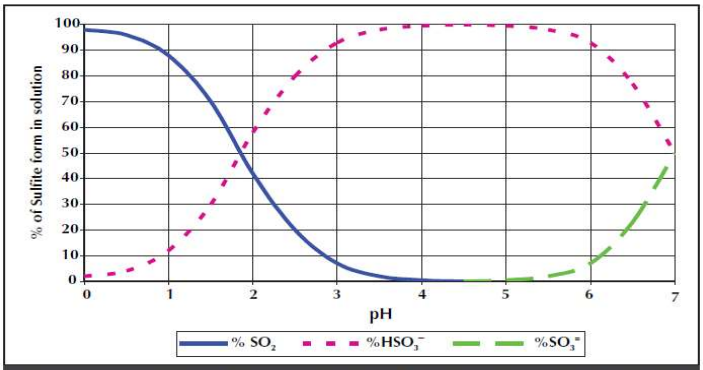

Figure I. The percentage of the different forms of free sulfite over the pH range (0 to 7). Wines usually range from pH 3 to 4, so bisulfite (HSO_3^-) is the dominant form of free sulfite in wine.

Total sulfur dioxide			
Free sulfur dioxide			Bound sulfur dioxide
Molecular SO_2	Bisulfite HSO_3^-	Sulfite $SO_3^=$	Sulfites attached to sugars, acetaldehyde and phenolic compounds

Figure II. Different forms of SO_2.

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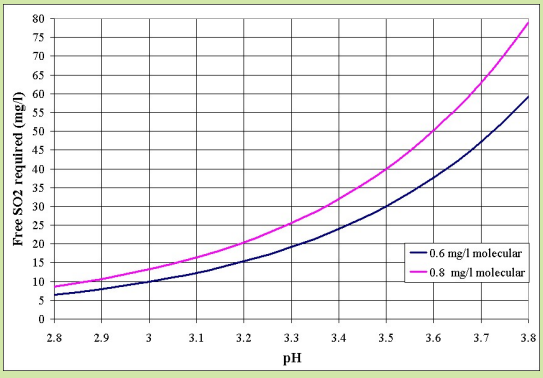
Fri SO_2 mellem 0,6 og 0,8 ppm er det optimale (generelt!)



pH	mg fri SO_2/ L
3,0	13
3,1	16
3,2	21
3,3	26
3,4	32
3,5	39
3,6	50

Hvad skal fri sulfit være for for at opnå beskyttelse af vinen?

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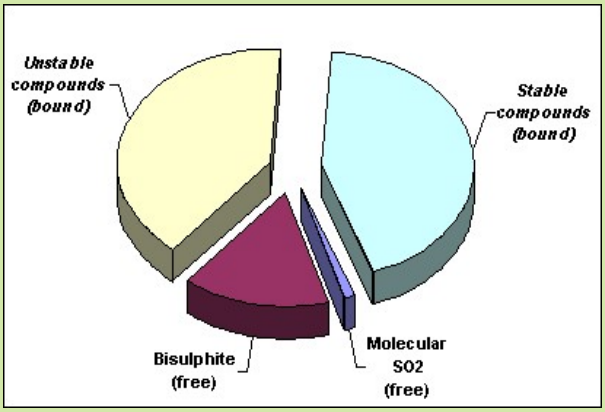
Sulfit former i vin



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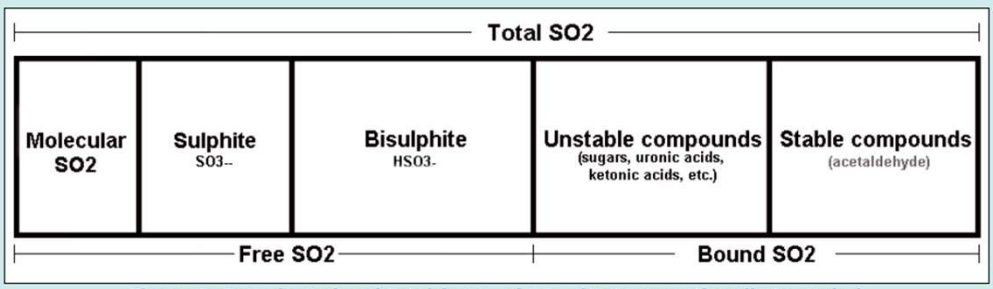

Figure 2. Free, bound and total forms of SO_2. (Not proportionally to scale.)

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"Tommelfinger regel" – den brede tommelfinger

- Hvis vin har været tilsat sulfit én gang (og ligevægte mellem sulfitformer har indstillet sig), så vil efterfølgende tilsætninger af sulfit, fordele sig således:

2/3 bliver til fri sulfit

1/3 bliver til bunden sulfit

Zoeklein et al: Wine anslysis and Production

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Sulfit henfald

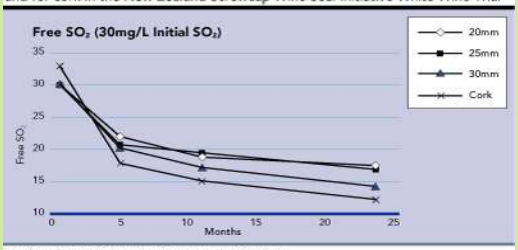
Oxygen permeation (mL of O_2 per day) measured approximately 36 months post bottling		
	Mean	Range
Screw Cap	0.0005	0.0002 to 0.0008
Technical Cork	0.0010	0.0007 to 0.0013
Natural Cork	0.0179	0.0001 to 0.1227

FROM: GODDEN ET AL.

1 mg O_2 forbruger 4 mg SO_2
dvs. hvis korklukning, forbruges
4 x 0,0179 x 365 = 26,1 mg SO_2 pr år!

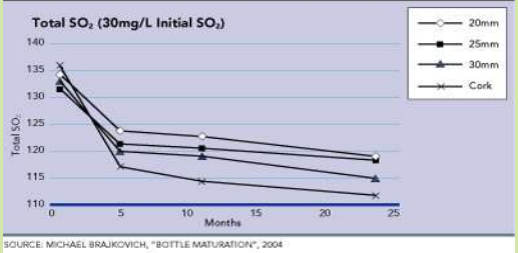
Jul 2005 Issue of Wine Business Monthly

CHART 1
Changes in free SO_2 for different headspace measurements (under screw cap) and for cork in the New Zealand Screwcap Wine Seal Initiative White Wine Trial



SOURCE: MICHAEL BRAJKOVICH, "BOTTLE MATURATION", 2004

CHART 2
Changes in total SO_2 for different headspace measurements (under screw cap) and for cork in the New Zealand Screwcap Wine Seal Initiative White Wine Trial



SOURCE: MICHAEL BRAJKOVICH, "BOTTLE MATURATION", 2004

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Oxygen i vin

- Stor betydning for omdannelser i vinen
- Store variationer i indhold i vin (headspace, beholder type etc.)
- Bruger af sulfit, hvis tilstede (størrelsesorden: 1 mg O_2 bruger 4 mg SO_2)
- Betydeligt og hurtigt optag af O_2 ved kontakt med luft (omstikning, pumpning, filtrering etc)
- MOX – Mikro oxididation - frivillig/ ufrivillig
- Hyperoxidation – "lad falde hvad ikke kan stå" - forsætlig oxidation fra start i vinifikation
- Oxygen indhold er inden for rækkevidde at måle (små 1000 kr)

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Kilder til oxygen.

- Dekantering/ omstikning
- Omrøring
- Headspace
- Filtrering
- MV

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”Safe zones”

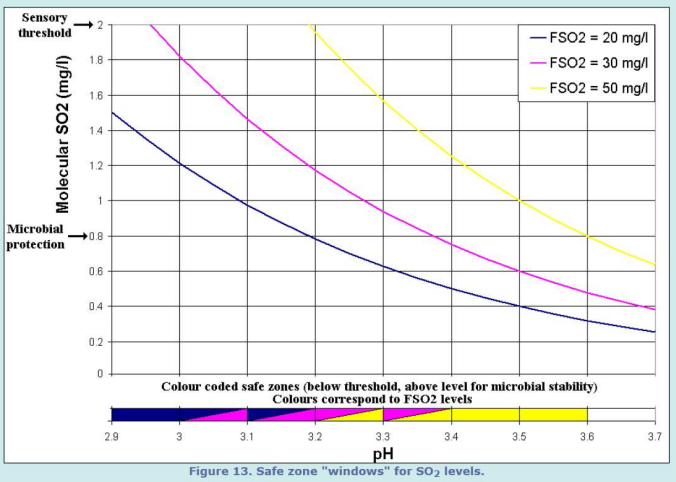

Figure 13. Safe zone "windows" for SO_2 levels.

Improve Winemaking – Sulphur Duioxide – Ben Rotter

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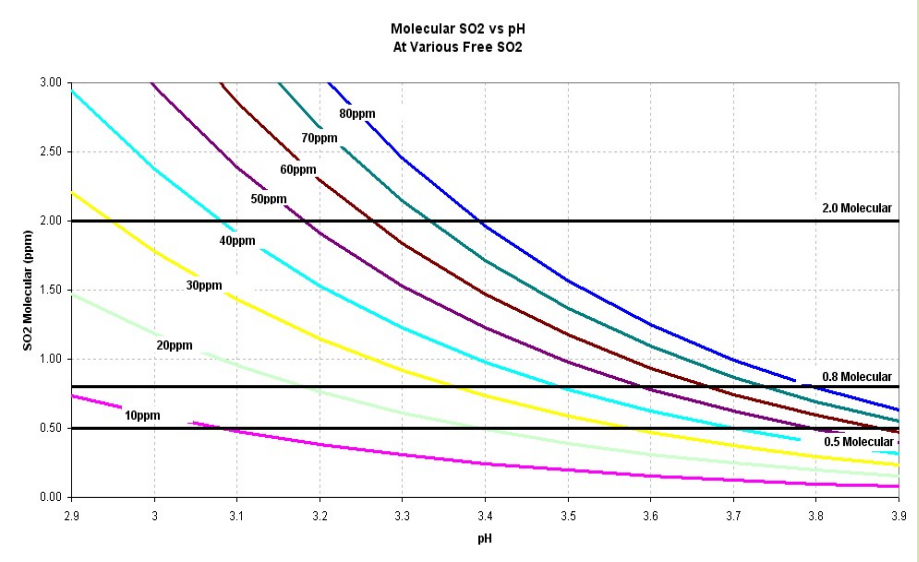
How Much to Use



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- With the slow absorption of oxygen in wine, free SO_2 is consumed and the level of free SO_2 decreases.
  - Lose around 5 mg/l per month in wines stored in large tanks in cool cellars with small headspaces.
  - Wines stored in warm cellars with large headspaces often lose 10-20 mg/l per month, or more.
  - In bottle depletion is no more than a few milligrams per year.
- SO_2 depletion increases with an increase in
  - Temperature
  - Headspace
  - Oxygen exposed surface area to volume ratio

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- Oxygen Saturation Level
  - The saturation level of dissolved oxygen in wine depends on temperature (it increases with a decrease in temperature) and the alcohol content of the wine (it increases with an increase in alcoholic content).
  - At 20 ^{o}C, 8 mg/l is the saturation level, whereas at 0 ^{o}C it is 11 mg/l.
  - Thus, the oxygen saturation range in wine is generally 7-11 mg/l.
- Typically takes several days to a week for SO_2 to consume all the oxygen in a saturated wine.

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- A partially filled container of wine with a surface area of 100 cm2 will absorb oxygen at 2 mg/l per hour.
  - A 19L carboy half full has a surface area of about 450 cm2 so you reach saturation in about 1 hour
  - Filled to the neck it is about 11 cm2 so it takes about 2 days to reach saturation
- **To react with 1 mg of oxygen, 4 mg of SO_2 is required**
  - Filled to the neck this is 22 ppm of SO_2 per day
- A solid bung, a carboy filled to the neck looses SO_2 very slowly (only a few ppm per month)

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- Racking
  - Gentle rackings often cause an oxygen uptake of 1-3 mg/l (loss of 4-12 ppm SO_2)
  - Those with more turbulence and air exposure might absorb 3-8 mg/l during each racking (loss of 12-32 ppm SO_2).
- Barrels
  - Penetration through oak wood itself is insignificant at 3-7 mg/l per year.
  - When barrels are often opened for testing/tasting, oxygen absorption may be around 40-53 mg/l per year.

Dennis Henry
Corkscrew Society Meeting
Feb. 20, 2007

Jørgen Broe - FDV

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- Kalium meta bi sulfit – karakteristika:
- https://en.wikipedia.org/wiki/Potassium_metabisulfite