



**Gases in oenology**  
**tell me more**

# Introduction

The use of gases in oenology or winemaking is not new. The Romans burned sulphur to improve wine preservation. Nowadays food-grade gases such as sulphur dioxide, carbon dioxide, nitrogen, oxygen, argon, dry ice and gas mixtures are used during the entire process of wine production and storage.

Each gas, either used as a single gas or in mixture form, has a specific function which can significantly improve the final product quality.

Air Products offers advanced technologies for all gas-based applications. Moreover, Air Products owns various plants for the production and packaging of high purity gases and has a distribution network that guarantees availability of its products and services in a wide number of countries.



# Nitrogen

The use of nitrogen in the production and storage of wine is considered one of the most important steps forward for oenology.

Its main objective is to extend the shelf-life of wine, in the following ways:

- **Eliminating oxidation reactions in the wine by displacing the oxygen**
- **Inhibition of microbiological growth during storage**
- **Reduction of the use of SO<sub>2</sub>**

The physicochemical characteristics of nitrogen (colourless, tasteless, inert and insoluble) make it specifically suitable for use in most processes in the production and storage of wine.

**Crushing** of the grapes can be carried out using pressurization with nitrogen and sudden depressurizing. The wine that results is more aromatic and fruity, since the breakage of seeds and absorption of polyphenols of the grape-skin are minimized.

Liquid nitrogen produces the condensation of the flavoring volatiles and generates gaseous nitrogen which can be used in other processes.

- **Pigeage and/or homogenization** of must or wine by the injection of pressurized nitrogen helps to improve the clarification process and helps to obtain a homogeneous mixture.
- **Storage** under a nitrogen atmosphere (blanketing) in order to avoid the exposure of wine to ambient oxygen. In some cases mixtures of nitrogen and CO<sub>2</sub> can be used. The concentration of oxygen in the deposit has to be kept below 1%. Our control systems enable the automatic dosage of nitrogen, upon detection of a decrease in pressure (for example, caused by emptying the silo or by presence of a leak), and also release pressure excesses that might occur during packaging.

- **Deoxygenating** of wine can be performed by the injection of nitrogen through a sintered stainless steel micro-diffuser (Sparger, or Inyecvin) directly into the tubes that lead the wine to the bottling plant or storage tanks. Nitrogen can also be used to perform racking without oxygen (emptying and filling of tanks, sweeping of pipelines and tanks, etc.).

- **Bottling** wine in a nitrogen atmosphere or using a mixture of nitrogen/CO<sub>2</sub> helps to avoid oxygen contact during the bottle shelf-life.

- **Blanketing** storage tanks with inert gas. Nitrogen is injected in the storage tanks to avoid the contact between wine and oxygen, and thus eliminate unwanted oxidation reactions. It is recommended that the amount of oxygen in the deposits is always kept below 1%.

# Sulphur dioxide (SO<sub>2</sub>)

Only part of the SO<sub>2</sub> that is added to the must or wine remains as free SO<sub>2</sub>, which is needed for oenological purposes. This free SO<sub>2</sub> consists of molecular SO<sub>2</sub> and bisulphite, although only the former of these is really active. The concentration of SO<sub>2</sub> needed depends on the conditions of the vintage, the degree of maturation of the wine to be produced, and pH (see graph 1).

The main applications of SO<sub>2</sub> in oenology are as follows:

- **Protection against oxidation** caused by the grape's own enzymes
- **Reducing the growth of bacteria and unwanted yeasts**, while enabling the desired yeasts to develop. This will limit unwanted fermentation reactions and enhance the desired fermentation.
- **SO<sub>2</sub> influences the taste**; helps to conserve the aromas; contributes to the development of the bouquet of reserve wines; and improves the production for over-ripe vintages.

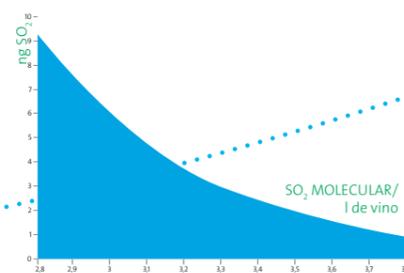
## Recommended SO<sub>2</sub> doses (grams SO<sub>2</sub>/hl must)

Type of vintage	White wine/ Rose wine	Red wine
Normal maturation	5-8 g/hl	3-5 g/hl
<i>Strong acidity</i>		
Very ripe	8-10 g/hl	5-10 g/hl
<i>Weak acidity</i>		
With deterioration	10-12 g/hl	10-15 g/hl
Maximum levels allowed in the EU	21 g/hl	16 g/hl

• SO<sub>2</sub> enhances the dissolution of colours in the grape skin. Sulphur dioxide is therefore added to the grapes after crushing in production of red wines and to the pressed must in the production of white wines.

The amount of SO<sub>2</sub> added can vary, depending on the type of wine to be produced and the initial characteristics of the vintage (see table below).

Apart from conventional gas cylinders, we also offer **cylinders with a probe** which enable SO<sub>2</sub> to be added depending on the specific application in wine making.



Graph 1: concentration of molecular SO<sub>2</sub> as function of pH for 100mg of total SO<sub>2</sub> added

Conventional gas cylinder



Safety indications  
Instructions

Date of hydraulic test

Seal  
Product code

Traceability information  
Safety indications

Botella seccionada



SO<sub>2</sub> feeding device

Valve

Ring

Rectilinear probe

When using an Air Products SO<sub>2</sub> cylinder with a rectilinear probe, the whole contents can be used, while maintaining the cylinder in a vertical position. The main advantages of the rectilinear probe (longitudinal along the full length of the cylinder) are:

- Safety: cylinders designed to be in vertical position avoid breakages, leaks, shocks, and generally incur less handling incidents than cylinders that are stored horizontally or are put upside down.
- Comfort: working with these cylinders is more ergonomical and comfortable, avoiding possible injury during handling.
- Savings: when using the rectilinear probe one can use 100% of the product without handling and one avoids the risk of breaking the measuring equipment.

## Other advantages:

- Each cylinder is traceable as required in food industry
- Each cylinder has passed a hydraulic test required legally every five years
- Safety seal on the valve
- Information on safety regulations on each cylinder
- Cylinders always clearly identified, painted and in good condition

# Carbon dioxide (CO<sub>2</sub>)

During must fermentation, a large amount of CO<sub>2</sub> is produced and then lost later on in the classical mechanical processes used in wine making (pigeage, pumping, racking, blanketing, etc). Therefore it is recommended to correct the level of CO<sub>2</sub> by adding this gas directly into the final product and thus standardising the level of CO<sub>2</sub> across the various wine tanks.

The addition of CO<sub>2</sub> to wine has different effects, depending on the production stage at which it is applied.

- Cooling the grapes during transport to the winery or during crushing and pressing, through the use of solid CO<sub>2</sub> (dry ice), is useful to prevent oxidation and early uncontrolled fermentation.
- Carbonic maceration in the production of red wines. By adding CO<sub>2</sub>, production times are reduced, mould growth is prevented, and the wines are obtained are more fruity, light, fresh and with a more stable colour, so that they are more appreciated by the consumer.

- Gasification of wine by the injection of CO<sub>2</sub> helps to obtain wines which are lively and fresh, with gas bubbles and increased aroma intensity.

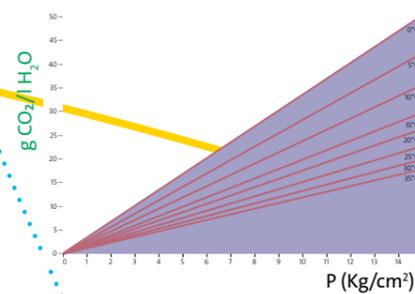
The solubility of CO<sub>2</sub> in wine depends primarily on temperature, pressure and composition (see graphs 2 and 3). In gasification of wine one can also retrieve the optimum level of CO<sub>2</sub> lost during the process, especially for young wines.

The degree of solubility of CO<sub>2</sub> at saturation in a wine stabilized at 20°C and 1 atm is 1.60 to 1.69g CO<sub>2</sub>/l. These values can be increased if working at a lower temperature and increased pressure using the corresponding equipment.

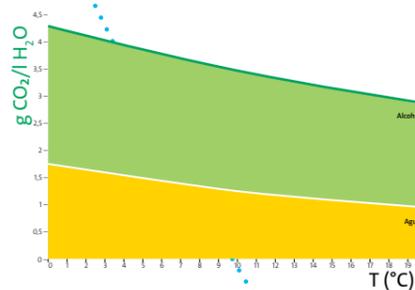
Dry ice is used for two purposes: to obtain a decrease in temperature of the grape during the harvest or



during reception at the winery, and/or to prevent oxidation and early uncontrolled fermentation of the grapes. Another application of dry ice is the inerting of fermentation tanks, before fermentation commences.



Graph 2: Solubility of CO<sub>2</sub> in water



Graph 3: Absorption of CO<sub>2</sub> in water and alcohol at 760 mmHg (1 atm)

# Oxygen

The must needs a specific level of oxygen so that fermentation proceeds correctly. However, the presence of this gas in the wine can cause oxidation and growth of harmful micro-organisms. Oxidation of wine can lead to a loss of colour, flavour and aroma, increased acidity, and excessive levels of acetic acid.

One of the technologies used in the production of white wines is the hyper-oxygenation of must before fermentation, without applying SO<sub>2</sub>. Another noteworthy application is the use of oxygen during the biological treatment of waste water in the wine-making industry, which can increase the plant capacity of existing installations and enable the design of new installations with smaller foot-print, without noise or contaminant emissions.



# Argon

The use of argon and argon mixtures (Ar +CO<sub>2</sub>) as alternatives to nitrogen and its mixtures (N<sub>2</sub>+CO<sub>2</sub>) in wine conservation is a relatively new development. Argon shows improved effectiveness in protecting the wine and extending its shelf-life by displacing oxygen and thus eliminating oxidation reactions and inhibition of microbial growth during storage.

Argon's physio-chemical characteristics, especially its density which is significantly higher than air, make it particularly useful for blanketing of storage tanks. This is because it forms a protective blanket on the surface of the wine from the first contact, preventing exposure with the oxygen from the air. This leads to a reduction in the amount of gas needed to displace the air.

## Food-grade gases

All gases supplied by Air Products meet the safety and hygiene regulations stipulated by national and international legislation.

## Safety and hygiene

All gas cylinders are subjected to periodic pressure tests to detect the units that need to be replaced. Each cylinder is labeled with the year in which this hydraulic test was last performed.

The cylinders are supplied with a protector that protects the valves from shocks while enabling easy handling. In the specific case of CO<sub>2</sub>, the cylinder also contains a rupture disc (burst disc), which will break and relieve the pressure in case of pressure build-up above set limits due to temperature increases for example.

Food-grade gas cylinders contain a label that indicates the batch number of the gas, guaranteeing traceability of the product. Our gas cylinders are sealed after filling to guarantee the highest level of hygiene and safety.



# Equipment for the oenology industry

Air Products offers the latest technology and equipment to meet various needs in the oenology industry.

## Injection lance

This equipment, designed by Air Products, is made to dose gases in liquid tanks. It is used both in must and in wine, for example in pigeage with nitrogen, the dosing of SO<sub>2</sub> and CO<sub>2</sub>, and in the hyperoxygenation of must with oxygen.

The injection lance is made of stainless steel and does not need a permanent installation. It is easy to use and very versatile, as it can be moved from one tank to the other with minimal loss of product. Its length varies with the diameter of the tank and it can be connected either to the top of the tank or to the bottom, depending on the application.

## Inyecvin

Inyecvin is a system for the gasification of wines, which provides the possibility of a controlled dosage of CO<sub>2</sub> in order to obtain young, fruity, and lively wines, with enhanced flavour and aroma which can give added value to the wine.

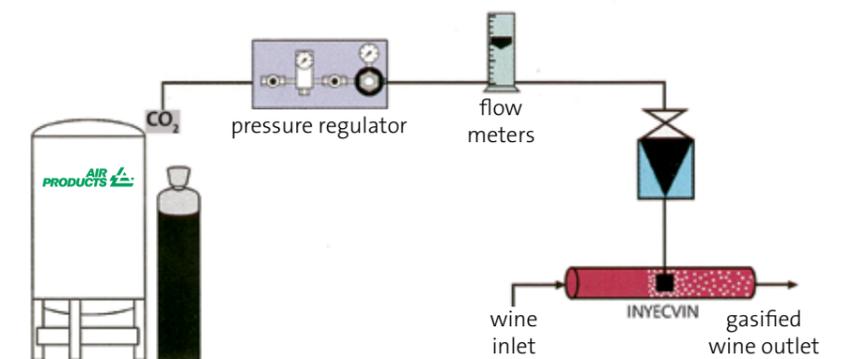
Inyecvin contains a distributor of sintered steel with pores of 16 µm that produce micro bubbles without creating foaming or boiling of the liquid. In this way a homogeneous distribution of CO<sub>2</sub> in the wine is obtained.

To enable the dissolution of CO<sub>2</sub> in the wine, it is necessary to work at low temperatures and at above atmospheric pressures.

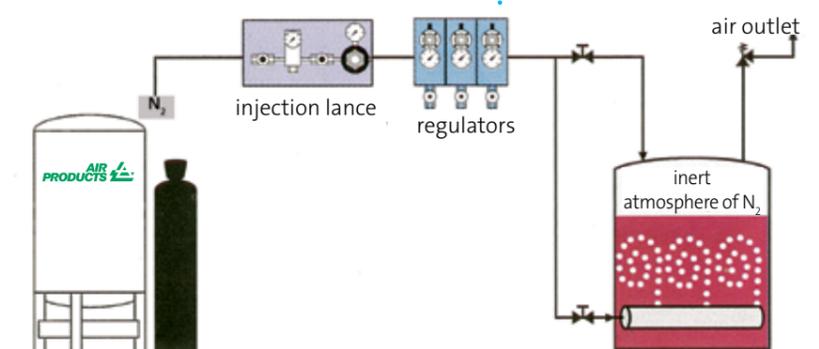
change of the gas cylinder connected to the equipment is used.

Inyecvin can be used at a wide range of dosing levels. The injection of CO<sub>2</sub> in the wine is regulated accurately by an automated control box. To ensure complete autonomy of the process, a regulator panel for automatic

## Process scheme for inertization and homogenization.



## Injection lance



# SO<sub>2</sub> dosing

## SO<sub>2</sub> feeding device

Air Product offers a manual volumetric dosing device for SO<sub>2</sub> with a capacity of 1kg. The SO<sub>2</sub> feeding device can be connected directly to the gas cylinder, using the cylinder's valve to open or close the inlet of SO<sub>2</sub> to the feeding device. It is made of stainless steel and contains a glass level meter, graduated in grams, to enable accurate dosing.

## SO<sub>2</sub> dosing

We provide SO<sub>2</sub> dosing equipment that adapts to the different needs of the various processes when producing must and wines.

### • Sulfidox

This is a device for the automatic dosing and homogenizing of SO<sub>2</sub> in liquids in storage tanks, in order to adjust the SO<sub>2</sub> concentration. It works in a discontinuous mode and can add SO<sub>2</sub> in concentrations between 0.1 and 15 kg. This concentration is controlled by a scale and once finished, the system switches automatically to the dosing of nitrogen to sweep the line and homogenize the tank.



### • Dosiven Plus

This is an automatic SO<sub>2</sub> dosing station for paste pumps. There are two models: one to work with two paste pumps and one to work with four paste pumps. This device can dose between 500 g/h and 7000 g/h for each pump.

### • SO<sub>2</sub> dosing panel for barrel wash stations

With this dosing panel the dose of SO<sub>2</sub> can be adjusted for barrel wash stations, as an alternative to the traditional burning of sulphur sticks.

### • Dosimatic 2010

This is an automatic SO<sub>2</sub> dosing device that can be used either continuously or batch-wise. With this equipment one can adjust both the total amount that is to be dosed (between 1 and 1000kg) and the dosing-rate (between 30 and 200 kg/h).

## Pressure-vacuum safety valves

These valves are designed to relieve excess pressure and/or the vacuum that may occur during tank filling and emptying. They are suitable for tanks with inert atmospheres as they provide an air-tight sealing. Moreover, their specifications and properties (construction materials used, set points for maximum pressure/maximum vacuum, accuracy in valve opening, flow rates, ease of disassembly for easy cleaning, etc) make these valves particularly suitable for the food industry, for example in storage of wine, oils, cereals and nuts.

### Characteristics

Pressure-vacuum safety valve (1)		Pressure-vacuum safety valve (2)	
Materials	PVC exterior Stainless steel interior Silicone disc	Materials	Stainless steel exterior Stainless steel and PVC interior Silicone seals
Connection	R 2" F	Connection	R 1 1/4" M
Pressure	35 g/cm <sup>2</sup> , -5 g/cm <sup>2</sup>	Pressure	35 g/cm <sup>2</sup> , -5 g/cm <sup>2</sup>
Flow rate	100 Nm <sup>3</sup> /hora	Flow rate	100 Nm <sup>3</sup> /hora

# Other applications

We can offer a wide range of welding shielding gases, with gas mixtures specifically designed for welding stainless steel. These include pure argon, our Protar and Astec product lines, and our Maxx® shielding gases range. Moreover, these gases can be packaged in our Integra® gas cylinders which are filled at 300 bar and include a built-in regulator with a quick connection at the outlet for more comfortable and safer welding.

As well as our Integra® cylinders, we can also offer our Xtralite®



cylinders for argon which combine the advantages of the Integra® cylinder with a lighter and easier to handle package.

Air Products can offer a wide range of welding equipment and consumables for MMA, MIG and TIG welding of own brands (such as Platinum and CM), or for a variety of renowned brands, such as Kemppi, T-PUT, Hyundai or Koike.

Our team of welding specialists can offer advice on the best technical solution for the different welding processes to maintain optimum performance.



We can also offer a wide range of refrigerant gases, either pure or in mixture form, including HFCs which are most widely used at the moment, as well as natural alternatives such as CO<sub>2</sub> and ammonia (NH<sub>3</sub>), and new generation HFO products.



For more information,  
please contact:

#### **België**

Air Products NV  
J.F. Willemsstraat 100  
1800 Vilvoorde  
T +32 02 255 28 95  
beinfo@airproducts.com  
airproducts.be

#### **Belgique**

Air Products SA  
J.F. Willemsstraat 100  
1800 Vilvoorde  
T +32 02 255 28 95  
beinfo@airproducts.com  
airproducts.be/fr

#### **Česká republika**

AIR PRODUCTS spol. s r.o.  
Ústecká 30  
405 02 Děčín  
T +420 800 100 700  
infocz@airproducts.com  
airproducts.cz

#### **Deutschland**

Air Products GmbH  
Rensingstraße 15  
44807 Bochum  
T +49 0 234 6105 6300  
F +49 0234 6105 6371  
apginfo@airproducts.com  
airproducts.de

#### **España**

Carbueros Metálicos S.A.  
c/ Aragón, 300  
08009 Barcelona  
T +34 902 13 02 02  
F +34 93 290 26 09  
oferta@carbueros.com  
carbueros.com

#### **France**

Air Products SAS  
Parc des Portes de Paris  
Bâtiment 270  
45 avenue Victor Hugo  
93300 Aubervilliers  
T +33 0800 480 030  
frinfo@airproducts.com  
airproducts.fr

#### **United Kingdom**

Air Products PLC  
2 Millennium Gate  
Westmere Drive  
Crewe CW1 6AP  
T +44 0800 389 0202  
F +44 01932 258 652  
apukinfo@airproducts.com  
airproducts.co.uk

#### **Ireland**

Air Products Ireland Ltd.  
Unit 950  
Western Industrial Estate  
Killeen Road  
Dublin 12  
T +353 1800 99 50 29  
ieinfo@airproducts.com  
airproducts.ie

#### **Italia**

SAPIO Produzione Idrogeno Ossigeno S.r.l.  
Via Silvio Pellico, 48  
20900 MONZA  
T +39 039 8398286  
F +39 039 836068  
gtm@sapio.it  
grupposapio.it

#### **Nederland**

Air Products Nederland BV  
Klaprozenweg 101  
1033 NN Amsterdam  
T +31 020-435 3535  
F +31 020-435 4035  
nlinfo@airproducts.com  
airproducts.nl

#### **Polska**

Air Products Sp. z o.o.  
ul. 17 Stycznia 48  
02-146 Warszawa  
T (BULK) +48 0801 081 122  
T (PG) +48 0801 100 801  
infopl@airproducts.com  
airproducts.com.pl

#### **Portugal**

GASIN – Grupo Air Products  
Rua do Progresso, 53 – Perafita  
Apartado 3051  
4451-801 Leça da Palmeira  
T +351 229 998 300  
F +351 229 998 301  
proposta@gasin.com  
gasin.com

#### **Россия**

ООО «Эйр Продактс»  
125047, Москва  
1-я Тверская-Ямская ул., д.23,  
стр.1, подъезд 1, этаж 5  
Тел.: +7 (495) 258-04-21  
Факс: +7 (495) 258-04-22  
Отдел маркетинга и продаж Эл.  
адрес: Russia@airproducts.com  
airproducts.ru

#### **Slovenská republika**

Air Products Slovakia s.r.o.  
Mlynské Nivy 74  
821 05 Bratislava  
T +421 0800 100 700  
infosk@airproducts.com  
airproducts.sk



tell me more