

CO₂ and O₂ scrubbers





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The CO₂ scrubber

Fruit 'breathes': it uses oxygen (O₂) and produces carbon dioxide (CO₂). If the concentration of carbon dioxide (carbonic acid) gets too high, the quality of the fruit deteriorates. A CO₂ scrubber can prevent this because it removes the carbon dioxide from your storage cells and ensures that the fruit retains its optimum quality.

The amount of carbon dioxide that must be removed or 'scrubbed' depends on various factors including the type of product, the dimensions of the storage area and the conditions under which the fruit is being stored. Once the required scrubbing capacity for the connected storage cells is known, the desired level of carbon dioxide can be maintained using the CO₂ scrubber. VA offers a range of standard CO₂ scrubbers with capacities of 50 to 900 kg per 24 hour period (at 3% CO₂).

Economical

The most important component of the CO₂ scrubber is a steel tank, with so-called active carbon, which binds carbon dioxide.

The CO₂ scrubber has a cycle of two activities:

- absorption: removal of the carbon dioxide by using an active carbon filter;
- regeneration: cleaning the active carbon filter.

As a rule, more time is required for regeneration than for absorption. The special single-tank-system from VA enables these times to be set independently of one another. This system only needs one pump and is, therefore, extremely efficient as well as being very economical.

Efficient

The VA-scrubber is also an excellent example of efficiency in another respect. When absorption is taking place, the carbon dioxide rich air is fed in one direction by the active carbon. During regeneration, the purified air goes through the tank in the opposite direction (see diagram 1).

This so-called 'counter flow principle' guarantees efficient purification, a shorter scrub cycle and an important increase in the capacity and effectiveness of the CO₂ scrubber. In addition, the active carbon is fully utilised by the unique air distribution system in the tank (see diagram 2 + 3) and VA therefore guarantees that the active carbon can continue to be effective for long periods because the filter cannot become soiled. This allows optimum usage to be gained from the materials and, as a result, costs can be reduced.

diagram 1

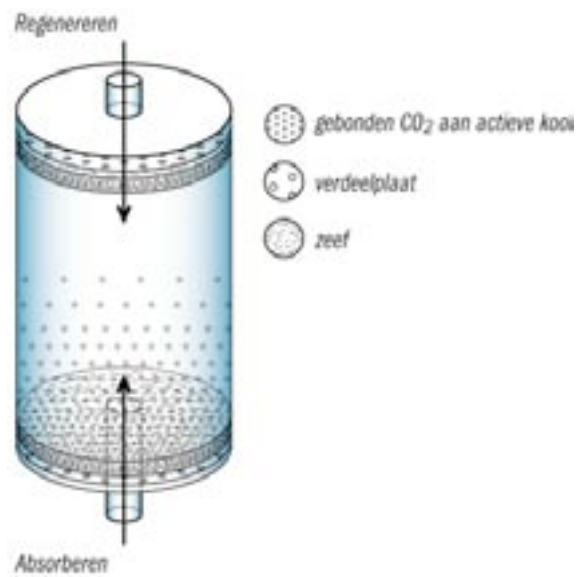


diagram 2

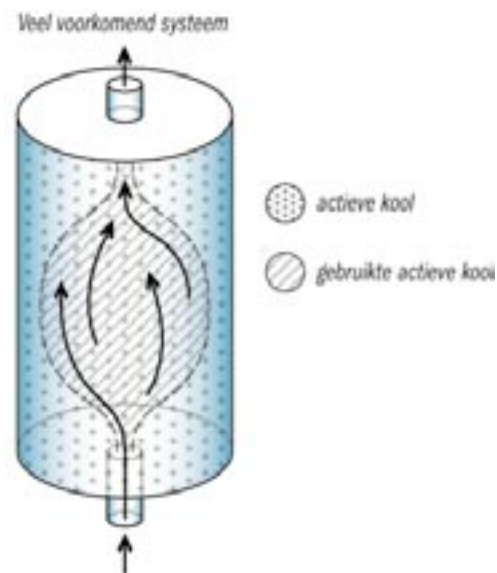
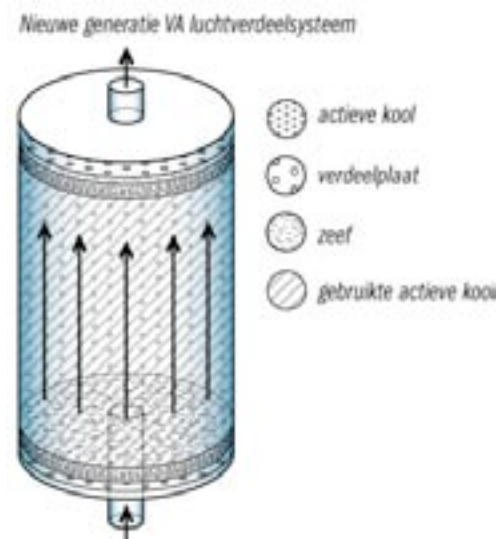


diagram 3



Unique lung system

The scrubber's active carbon filter takes up carbon dioxide up to its saturation point during absorption. The purified air goes back into the cold store. During the last phase of the CO₂ take-up, a small part of the purified air is stored in a flexible buffer – 'lung' – without this leading to under-pressure in the storage cell.

After cleansing with ambient air, and removing the carbon dioxide from the active carbon, the 'lung air' is used to reduce the oxygen level in the tank with the active carbon filter to the level in the storage cell. This unique system, guarantees that the undesirable inflow of oxygen into your cold store is minimised. The 'lung system' has been the most frequently used and reliable system for over 20 years.

The components:

CO₂ scrubber components:

- a steel tank with active carbon and air distribution system;
- a cabinet for internal process control, a minimum of S45 or S46 basic controls, built into the front of the machine;
- a flexible buffer made of PU film ('lung system'). The buffer enables extremely low (<0.5%) oxygen levels in the gas-tight storage cell.

A few plus points:

- energy-efficient as a result of the middle-pressure ventilator that reduces energy costs by 30%;
- low maintenance as a result of the minimum amount of moving parts;
- maximum life expectancy of the active carbon filter as a result of system optimisation;
- minimal temperature increases in cell air as a result of a considered ventilator choice.



Basic controls: S45 or S46

The S45 basic controls comprise a cabinet at the front of the CO₂ scrubber containing the following components:

- > a terminal strip;
- > an engine relay;
- > a master switch;
- > and a ventilator block for internal process controls.

In addition, the system gives the following alarms:

- > compressed air alarm;
- > thermal alarm;
- > pressure alarm.

This basic control always forms part of the CO₂ scrubber, irrespective of whether VA has supplied the controls for the CA-ULO system or a third party has provided this. The pneumatic valves in the CO₂ scrubber are not controlled by the basic controls. The S45 receives five so-called 'valve signals' from an internal or external CA-ULO control system. A sixth signal controls the engine relay.

The S46 is a basic control just like the S45. The most important difference is that the CO₂ scrubber valves are now controlled by a relay in the S46 cabinet. The internal or external CA-ULO control system, in this instance, provides a signal for:

- > absorption;
- > regeneration;
- > filling the lung;
- > emptying the lung.

Type	Absorption capacity (kg CO ₂ 24 hour ⁻¹ with 3%)	Power (kW)
VA50	50	1,1
VA100	70	1,1
VA150	100	1,1
VA200	150	1,1
VA350	200	1,1
VA500	250	2,6
VA600	325	2,6
VA900	450	2,6
VA1000	550	3,1
VA1200	650	3,1
VA2000	800	5,5
VA2500	900	5,5

Table 1 - Shortened specification summary for CO₂ scrubbers

The VPSA O₂-scrubber

The VPSA O₂ scrubber removes oxygen from the sucked out cell air (circulation) or external air (injection) so that almost pure nitrogen is what remains. The VPSA (Vacuum Pressure Swing Absorption) O₂ scrubber is, therefore, also referred to as a nitrogen generator. The VPSA reduces the oxygen level in the storage area after goods have been put into storage or after interim opening of the cell during the storage season. The VPSA O₂ scrub technology is based on an energy efficient, low pressure technique. The entry pressure is no higher than 1-1.5 bar and is produced with an oil-free blower. As a result, heavy air compressors are not required.

In addition, VSPA technology purifies the active carbon filter via an extremely effective vacuum technique, allowing the filter to remain completely free of dirt and moisture. Durability and energy efficiency are important core values for VA and these have been incorporated into the VPSA O₂ scrubber.

Residual oxygen concentration	
Input (from the cell)	Output O ₂ scrubber
21,0	3
10,0	2,0
5,0	1,5
1,5	0,8

Table 2 - Output VPSA in circulation mode

Circulation

A VPSA needs two PVC pipes for circulation to and from the cell (sucking and returning). The VPSA's output volume is constant. The residual oxygen level, however, reduces as the O₂ in the storage cell reduces. Circulation is the most energy efficient mode for lowering the oxygen level in a storage area. So-called pull-down time is an indication of the time necessary for circulation to bring your storage cells to the required levels.

Our quotes contain two values, as standard: the time necessary to reduce the oxygen concentration to 5% and to 1.5%. This calculation does not take cell leakage and respiration of the product into account.

Injection

During injection, the VPSA converts external air into nitrogen with a residual oxygen level of 1 or 3%. The type number of the VPSA indicates the capacity in m³. The capacity of a VPSA60, for example is 60 m³. When converting to 1% residual oxygen, the capacity is an average of 32% lower. In the case of a VPSA60, this is 39 m³.

During circulation, the VPSA reduces the oxygen concentration in the up to 32% quicker than when injecting. The advantage of injection is that a cell can be kept at slight over-pressure so that even ULO conditions (ultra low oxygen) are possible in a storage room with a leak. Only one PVC pipe is needed for injection. With the VPSA, you can switch between injecting and circulating and vice versa at any given moment.

Type	Capacity with 1/3% residual oxygen (m ³ hour ⁻¹)	Power (kW)
VPSA4	2,5	0,9
VPSA6	6,0/4,0	2,6
VPSA11	11,0/7,0	2,6
VPSA16	16/11,0	3,6
VPSA21	21/15,0	5,4
VPSA28	28/20	6,4
VPSA40	40/28	9,8
VPSA60	60/44	13,9
VPSA85	85/55	21

Table 3 - The VPSA O₂ scrubber is available in a range of capacities

Plus points

- development and production managed by VA;
- up to 50% less energy consumption than PSA or membrane generators;
- low pressure, so minimal wear and tear and limited maintenance costs;
- oil-free blower, giving maximum life expectancy and capacity retention of O₂ filter;
- circulation and injection modus in one machine;
- suitable for automatic or manual control (PLC).



The all-in-one system

In 2004, VA introduced the so-called All-in-one system. This compact system is particularly suitable for clients with a relatively small storage depot of up to 800 tons. The system can operate a maximum of seven storage cells. In this system, all the components of a CA/ULO installation are united on one frame: a CO₂ scrubber, a VPSA O₂ scrubber, all cell valves, an air compressor, a measurement and regulation system, gas measurement equipment, a calibration bottle and a printer. In addition, it is a 'plug and play' system and only the PVC pipes need to be attached after installation.

A complete system

The CO₂ scrubber and the VPSA O₂ scrubber are the most important components of this complete, all-in-one system. In addition the all-in-one system incorporates S950 Auto ULO controls as standard. But there is more. All cell valves are mounted on the back of the system in a valve manifold arrangement and no longer, therefore, need to be on the cell itself. The pipes to the individual cold stores are connected to this valve manifold arrangement. There are connections to both the CO₂ scrubber and the O₂ scrubber on the other side of the register.

Capacity

The all-in-one system is intended for a relatively small storage capacity. We regard the limit as 800 tons but this is very dependent on the type of product that is to be stored. The capacity of the machines is limited so as to prevent the system becoming top-heavy. The biggest all-in-one system houses a VA350 CO₂ scrubber (200 kg CO₂ per hour), combined with a VPSA16 O₂ scrubber (16 m³ N₂ with an oxygen level of 3%).

Type	Energy consumption		CO ₂ scrubber	O ₂ -scrubber in circulation
	CO ₂ scrubber (kW)	VPSA (kW)	Absorption kg CO ₂ 24 hour ⁻¹ with 3% CO ₂	Capacity in Nm ³ hour ⁻¹
VA50VPSA11	1,1	2,2	50	11
VA50VPSA16	1,1	3,6	50	16
VA100VPSA11	1,1	2,2	70	11
VA100VPSA16	1,1	3,6	70	16
VA150VPSA11	1,1	2,2	100	11
VA150VPSA16	1,1	3,6	100	16
VA200VPSA11	1,1	2,2	150	11
VA200VPSA16	1,1	3,6	150	16

Table 4 - Specification of various types of ORS

Plus points

- a price advantage of 15% compared to separate components;
- all-in-one, but all the advantages of separate components;
- no longer necessary to have wiring, measurement hoses or pressure hoses to individual cells;
- tested as ready-to-use system in our testing facility; even less chance of disruptions;
- remote service via modem;
- can be installed and connected by you.



Your dealer

