

# DISINFESTATION SYSTEMS FOR GRAINS AND DRY LEGUMES, IN BULK AND PACKAGED FORM USING NATURAL CARBON DIOXIDE

## KEY FACTS

- ▶ 90 MINUTE CYCLES THANKS TO THE 25 BAR PRESSURE AND THE 45 °C TEMPERATURE OF THE CO<sub>2</sub>
- ▶ USE OF NATURAL CARBON DIOXIDE
- ▶ LOW OPERATING COSTS THANKS TO RECOVERY OF THE PROCESS GAS
- ▶ VERTICAL AUTOCLAVES FOR BULK PRODUCT UP TO 60 T
- ▶ AUTOMATED HORIZONTAL AUTOCLAVES FOR BIG BAGS AND FOR PACKAGED MATERIAL UP TO 14 PALLETS
- ▶ CO-EXISTENCE OF THE TWO TYPES IN ONE SYSTEM
- ▶ AUTOMATED PROCESS CONTROL SYSTEM WITH REMOTE SUPPORT



---

## NEW SCENARIOS FOR BIOLOGICAL FUMIGATION

The banning of many chemical fumigants and pesticides in recent years has renewed interest in the use of modified atmosphere processes to eliminate and prevent insect and bacteria infestations in food products stored in warehouses.

The market and the end consumers are also increasingly oriented towards more natural products (organic), introducing a new factor in the analysis of the convenience of biological fumigation systems that use natural CO<sub>2</sub> gas.



## CO<sub>2</sub> AUTOCLAVE TREATMENT: ADVANTAGES

The use of CO<sub>2</sub> drastically lowers the mold and bacteria content present in the products subjected to treatment, dramatically reducing the risk of mycotoxin formation (reduction to approximately 1/1000 of the mold and TMC values).

The CO<sub>2</sub> validated for use in *atelo engineering's* systems is of natural and geological origin, certified for food use, and downstream of the treatment it leaves no residue on/in the treated product.

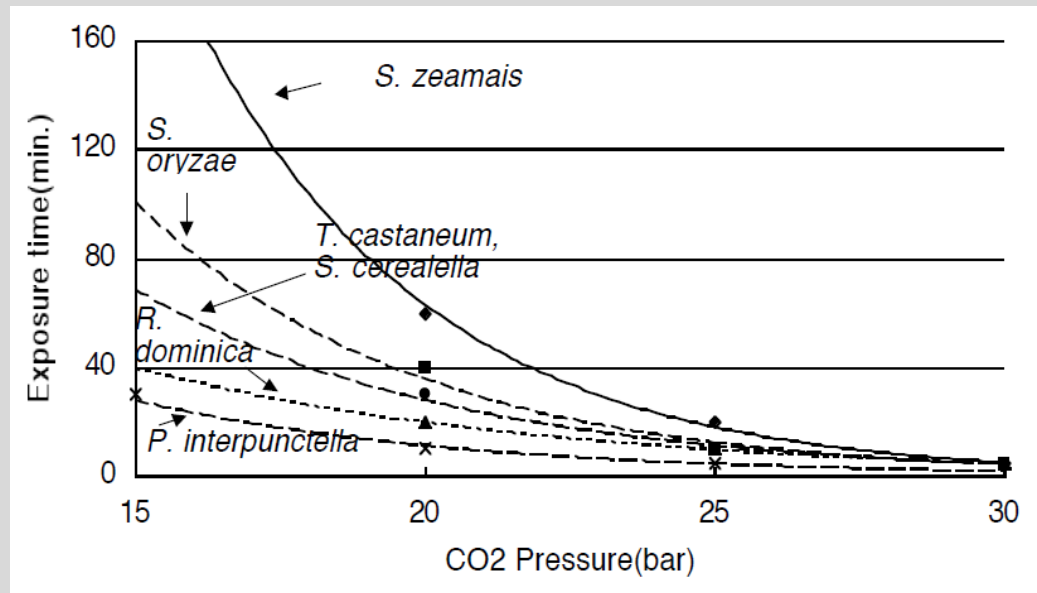
The disinfection process performed in an autoclave allows extremely fast treatment times, not exceeding three hours against the several days required for the standard air treatment.



## CO<sub>2</sub> AUTOCLAVE TREATMENT: EXPOSURE TIMES

The chart shows how the speed of treatment is given by the working pressure of the chamber, in relation to the infesting species to eliminate.

The graph is based on 100% mortality of the eggs and larvae of the individual infesting species, and clearly insects are eliminated after just a few minutes of treatment.



("Disinfestation of stored grains using high-pressure carbon dioxide", H. NAKAKITA, 2000)

---

## CO<sub>2</sub> AUTOCLAVE TREATMENT: ACTION

The release of CO<sub>2</sub> gas, at pressures of between 22 and 27 bar in an autoclave, in addition to having a toxic effect by impairing the oxygen transport capacity in their bodies, increases the metabolism of insects.

The lack of oxygen causes the insects to consume the moisture present in their body and causes their rapid dehydration.

Although minimal, the same aerobic behavior also applies to eggs, determining their total destruction.

The 'mechanical' effect due to sudden pressurization and de-pressurization of the treatment environment is also significant.



## CO<sub>2</sub> AUTOCLAVE TREATMENT: TYPES

We can produce plants based on vertical silo type autoclaves for treatment of bulk products, or horizontal units for treatment of packaged products and bulk products in big-bag containers, or a combination of the two types.



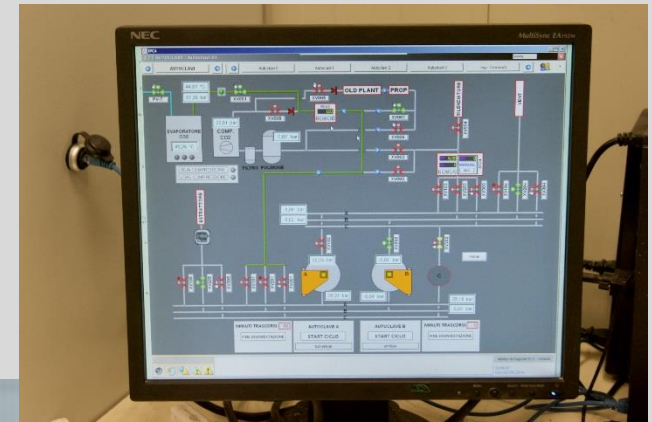
## CO<sub>2</sub> AUTOCLAVE TREATMENT: FLOW RATES

The horizontal autoclaves can be sized to be able to treat up to 15 pallets per load. The pallets are handled by automatic roller conveyors for loading and unloading.

The vertical autoclaves are sized according to requirements. Common flow rates are between 25 and 60 tonnes.

The combination of multiple autoclaves makes it possible to achieve significant continuous hourly treatment flow rates.

Using a set of six 35 t vertical autoclaves, a continuous hourly flow rate of 30 t/h can be achieved.



## CO<sub>2</sub> AUTOCLAVE TREATMENT: COSTS

Thanks to the use of a set of multiple autoclaves and to *atelo engineering's* exclusive technology that uses a reciprocating machine derived from the petrochemical industry to recover up to eighty percent of the process gas, it is possible to achieve costs under € 6 per tonne of product treated, for bulk product.

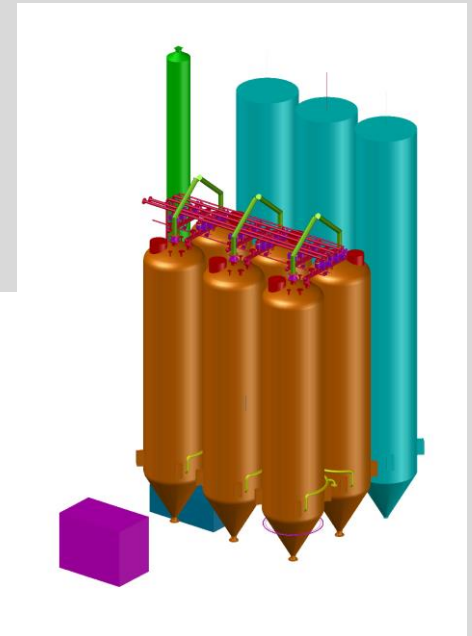
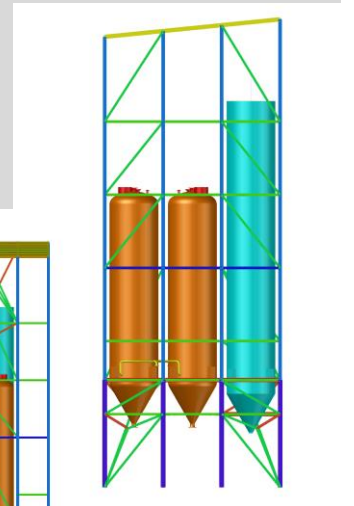
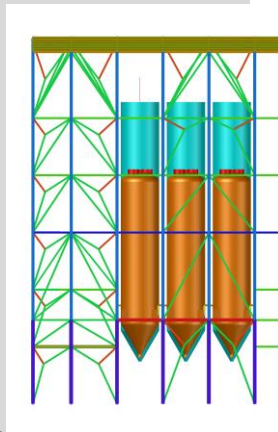
Due to a different empty-to-full ratio for horizontal autoclaves, the cost of treatment in this case is around € 9/tonne.





## CO<sub>2</sub> AUTOCLAVE TREATMENT: *atelo engineering*

Thanks to our now decades-long experience in the areas of plants for processing grains, especially rice and dried legumes, and in the design of systems for measurement, automation and transfer of petrochemicals, *atelo engineering* is able to design, supply and install fully custom CO<sub>2</sub> autoclave disinfestation systems, and act as an engineering company to build them.



design & development  
petrochemical & food plants  
industrial & process automation

**atelo engineering** s.r.l.

Via Ercolano 13 – 20900 Monza Italy

Tel: +39 039 8943095

info@atelosrl.eu