# CARVEX – Pressurized Pest Disinfection with CARBO Carbon Dioxide

**Oliver Kik, Herbert Saal**

CARVEX Verfahrenstechnologie für Lebensmittel und Pharma GmbH, Sprudelstraße 1, 53557 Bad Hönningen, Germany, Okik.hgn@carbo.de
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## Abstract

**Keywords**: CARVEX, Carbon Dioxide, Pressure Fumigation, CARBO, Pest control.

## Introduction

Pest control with insecticides and toxic gases have polluting effects on persons and the environment. However, $CO_2$ pressurized pest control is a real revolution. It does not present any hazard either to nature or to persons. Benefit from an innovative, efficient and future-capable process for optimized hygiene results!

The entrainment of pests right to the stage of final packaging is an enormous source of danger for manufacturers. If the reputation of a brand is damaged by infected products, confidence can be restored with difficulty only. Politicians and consumers demand appetizing and hygienic foodstuffs which are equally uncompromising. CARVEX assists in assuring compliance with strict legal general conditions and provides for brand confidence and consumer protection.

The employment of insecticides or toxic gases, such as methyl bromide, phosphine or hydrocyanic acid, is still usual. However, they leave residues and are problematic, also from the viewpoint of environmental protection and occupational safety. This is being increasingly criticized publicly by consumers and associations. The solutions from CARVEX are now convincing in many ways, where they provide for "clean" products while avoiding harmful residues. In this way, the justified demands of consumers are optimally fulfilled - as well as possible damage to image avoided as early as in the initial stages.

CARVEX offers you perfect solutions so that your products reach end customers in an optimum condition hygienically. The charged nature of the issue is highlighted for example in that almost all harvest herbs, as well as tea products, are infected by harmful insects as well as by their larvae or eggs. In this case also, as with all other possible areas of application, the processes from CARVEX enable the best utilization capability and value-added utility of your products.

## Materials and Methods

Optimum pressurized pest control with carbo carbon dioxide

CARBO carbon dioxide has a side to it which is to a large extent unknown: Consumers hold natural products in high esteem where they provide a refreshing "sparkle" in mineral water, lemonade or beer. However, carbon dioxide because of its bacteriostatic and bactericide effects, is also increasingly used in the packaging of foodstuffs in inert gas. This tendency is increasing. The advantages are obvious: Complete disclaimer on the use of toxic gases. This follows the present Hazardous Material Ordinance (GefStoffV) which gives first priority to the health protection of persons.

Top hygiene without any losses in quality

With the proper selection of process parameters, the effects of $CO_2$ pressure processing on feedstock can be excluded. For example, a detailed study related to the $CO_2$ pressure processing of medication and herb teas indicates impressively that the amount of the material contents remains unchanged after pest control using the CARVEX process. Likewise, no negative impairments could be verified in the product quality of grain with the same processing method. As well as this, neither

the baking quality nor the germination characteristics were influenced in any way disadvantageously.

Three effects in perfect Interaction

In case of pressurized pest control, the exceptional effect of $CO_2$ results through the interaction of just three effects: Firstly, a forced dissolving of carbon dioxide in the bodily fluids of insects leads to an over-acidification of the cell fluid and hemoglobin, through which carbon dioxide is formed. In addition to this is the oxygen withdrawal effect and, a most important factor, the so-called pressure effect, which is also known to deep-sea divers as the bends.

The effect of pressure is particularly significant. Only the combination of CO2 and pressure allows the treatment to work well in a short period of exposure. For example, in the case of the dried fruit moth, treatment time increased from a few minutes at a pressure of 37 bars to 64 hours at a pressure of 3 bar

Neither a high nitrogen pressure, comparable with the pressurized CO2 process, nor high CO2 concentrations at atmospheric pressure, achieve the desired effect. To kill weevils using pressureless CO2 treatment an exposure time of around 28 days is required

Technical description

CARVEX systems are designed especially flexibly, where they are characterized by their quality as well as ease of operation and can also be re-equipped or retrofitted afterwards. In case of a large volume demand, the chamber number can be increased to three chambers, where the performance and cost-effectiveness are increased. Below on picture 1, you can see an example for a realized double chamber system.

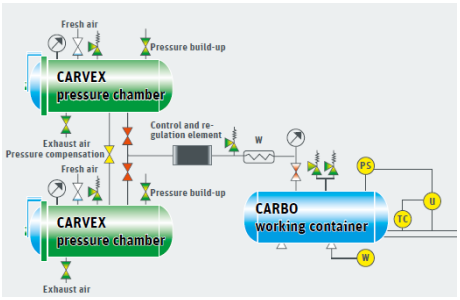
In addition, CARVEX offer different system lengths and diameters according to the area of application. With every system type, the number of pest control operations per shift is regulated by increasing pressure, which further increases throughput. Regardless of which solution you select, you can always choose whether the loading should be done manually, by lifting trolley or by roller conveyor.

The CO2 process for pressurized pest control works at ambient temperature above 15°C and pressures up to 30 bars. The material to be processed is inserted in bags in specially constructed pest disinfection chambers. After closure of the chamber, gaseous CO2 flows into the system until the required pressure has been reached. After the contact period, the pressure in the chamber is released and the material can be taken out.

The necessary CO2 is stored and refilled in a CARBO working container. The CO2 will be evaporated and tempered before entering in the chamber by heating. The pressure will be increased up to 30 bars by heating or by liquid pumping before heating.

The duration of the pressure treatment is varying depending on the chosen pressure (1-16 h), the product and the insect to be treated.

Picture 1: CARVEX Double Pressure Chamber




Picture 2: PID of a CARVEX Double Chamber

## Results

CARVEX pressurized pest control with harmless CARBO carbon dioxide is based on experience which has been acquired over decades in inventory protection and pest control. Thus, not only are harmful insects, such as the grain weevil, the cigarette beetle, the rice-meal beetle, the meal beetle or the flour moth, rendered harmless within the shortest time, but also their larvae and eggs. Currently there has been positive experience with more than 30 different pests from different areas of inventory protection. The CARBO carbon dioxide is approved as plant production product in Germany and Austria.

Following effects have influence on the CARVEX process.

Packaging and product density

The type of packaging, as well as the existing product density, represent important factors in determining the contact period. For example, compressed goods such as bales, flour sacks or sealed bulk materials in big bags significantly increase the respective contact period. The reason is that it requires some time before the necessary concentration is reached in the package middle. A further influence factor on the contact period is the pest type to be expected, as well as their stage of development. For example, eggs and pupae are generally the most resistant.

The role of temperature

Increased temperatures effectively decrease the contact periods. For example, with pressure-free CO2 processing, the contact period of 28 days at 10°C for the death of the grain weevil is shortened to only a few hours at 40°C. Of course, the temperatures
cannot be increased at will because this would lead to a decrease in the product qualities. On the other hand, the influence of the temperature is reduced with increasing pressure, which is why it is always recommended to implement the processing based on optimum parameters.

Optimum co2 concentration

The CARVEX process achieves optimum effectiveness with an atmosphere which includes at least 90% CO2. The CO2 content is of particular relevance in case of pressure-free application.

The pressure-effect

As a result of the interaction of CO2 and pressure, the CARVEX systems achieve an exceptional effect while at the same time providing for short processing times. Thus, in comparison with a system which works pressure-free, the processing time of the Indian meal moth at an adjusted pressure of approx. 30 bars is decreased from approx. 240 hours to only ½ an hour. The advantage of the pressurized pest control can be demonstrated even more efficiently in the example of the grain weevil. While conventional, pressure-free gas flushing takes approx. 28 days, only a few hours are required in a CARVEX system in order to achieve the same result.

## Discussion

## Acknowledgement

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# Fumigant toxicity of essential oils and their combinations on population buildup of three stored product coleoptera in stored wheat and effect on quality of wheat

**Ranjeet Kumar[1*], S. N. Tiwari[2], P. S. Pandey[3]**

[1] P. G. Department of Entomology, B.A.U Sabour, Bihar 813210, India,
[2] Department of Entomology, G.B.P.U.A.T, Pantnagar, Uttarakhand- 263145, India.
[3] A. D. G, I.C.A.R, New Delhi, India.
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*Corresponding author: rkipm06@gmail.com
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## Abstract

Experiments carried out to find the fumigant toxicity of three essential oils and their combinations from *Murraya koenigii*, *Citrus reticulata*, *Curcuma longa* on population buildup of *Sitophilus oryzae*, *Rhyzopertha dominica*, *Tribolium castaneum* in stored wheat at different days of infestation. The oil of *M. koenigii*, *C. reticulata* at 0.2% and *M. koenigii*+*C. reticulata*, *M. koenigii*+*C. longa* at 0.1% each were found highly effective against *S. oryzae* fumigated after 5, 10, 15 and 20 days. The oil of *M. koenigii* and *C. reticulata* at 0.2% *M. koenigii*+*C. reticulata*, *M. koenigii*+*C. longa*, *C. reticulata*+*C. longa* at 0.1% each and *M. koenigii*+*C. reticulata*+*C. longa* at 0.07% each were found highly effective against *R. dominica* fumigated after 5, 10, 15 and 20 days. Only *M. koenigii* at 0.2% was found highly effective against *T. castaneum* fumigated after 5, 10, 15 and 20 day. The fumigation of grain with *M. koenigii* at 0.2% completely suppress the infestation and weight loss when it was fumigated after 5, 10, 15 and 20 days while very low infestation and weight loss was observed in grain treated with *M. koenigii* +*C. reticulata* at 0.1% each and not affect the organoleptic properties and germination of wheat.

**Key words:** Fumigant toxicity, essential oils, Sitophilus oryzae, Rhyzopertha dominica, Tribolium castaneum

## Introduction

Stored commodities are infested by more than 600 species of beetles, 70 species of moths and about 355 species of mites causing quantitative and qualitative losses at different storage level (Rajendran and Srirajinia, 2008). Stored product insects cause 10 percent postharvest losses in developing countries, but they also contaminate the food products by presence of live insects, insect products such as chemical excretions or silk, dead insects and insect body fragments. In India, only aluminum phosphide and methyl bromide are available for fumigation of stored commodities. The use of aluminum phosphide is restricted while methyl bromide has been banned and their injudicious use during many years induced resistance development in stored grain insects.

Essential oils from more than seventy five plant species belonging to different families, such as Anacardiaceae, Apiaceae, Araceae, Asteraceae, Brassicaceae, Chenopodiaceae, Cupressaceae, Graminaceae, Lamiaceae, Lauraceae, Liliaceae, Myrtaceae, Pinaceae, Rutaceae and Zingiberaceae have been studied for fumigant toxicity against several insect pests of stored grain (Rajendran and Srirajinia, 2008). In several storage structures, fumigants are the most economical and convenient tools for managing stored grain insects due to their easy penetration in stored commodities and avaibility at cheaper rates (Azelmat *et al.,* 2006). Recently research has been focusing on the utilization of essential oils and their bioactive constituents as possible alternative to traditional fumigants (Negahban *et al.,* 2007, Ogendo *et al.,* 2008). *Sitophilus oryzae* (L), *Rhyzopertha dominica* (F), and *Tribolium castaneum* (Herbst) are one of the important stored product beetles and cause serious loses to stored commodities worldwide (Kumar, 2016). *Murraya koenigii* is an annual herb growing as medicinal plants and their leaves are used as some culinary and treatment of human disease. *Curcuma longa* is used as spice while peel of *Citrus reticulata* is wastage materials. The attempt has been made to study the fumigant toxicity of essential oils and their combinations on