IMPROVED TREATMENT TIMES FOR CONTROLLED ATMOSPHERES IN STORED PRODUCT PEST CONTROL

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Introduction

Controlled Atmospheres are based on the establishment of a low-oxygen environment which kills pests. The Dutch company EcO_2 BV is using Controlled Atmospheres to control all stages of insects, rats and mice in food, associated products, artefacts, silos, food (processing) facilities, airplanes and barges.

Controlled Atmospheres designed by EcO_2 are established by means of an oxygen burner system or a nitrogen generator. Low oxygen levels vary between 0% and 2%. It can be applied in airtight environments ranging form $1M^3$ to 1000 M^3. Insects in all stages are eliminated (99,9% Lt) because of the lack of oxygen which causes the insect to dry out and suffocate.

The use of Controlled Atmospheres on post-harvest durables is growing rapidly and replacing Methyl Bromide and Phosphine more and more. EcO_2 has managed to take away the disadvantages normally inherent with Controlled Atmospheres; above average price, longer treatment times, not fool proof and no availability.

The phase out of Methyl Bromide pushed the increase of world-wide Phosphine use. The product is easy to use and affordable although this product takes long exposure times to be effective. Unfortunately the product is meeting increased levels op pest resistance and requires more investments to be applied on an acceptable level. This is in line with chemicals such as Sulfuryl Fluoride that can not guarantee an effectiveness level of 99,9% Lt , take long treatment times, need elevated temperatures and considerable investments in fumigation rooms and information technology.

Improvements

Controlled Atmospheres where always seen as an average alternative because of disadvantages in exposure time, price, usability and availability. EcO_2 has changed this reality completely.

Exposure time

EcO_2 has managed to decrease treatment times for stored products pest to a very acceptable level because of new mechanical developments in the technique. The treatment times now vary between 3 and 5 days instead of 8 to 12 days. The treatment time depends on the type of product (density level) and type of insect (exposure level). These treatment times are faster than chemical alternatives for Methyl Bromide.

The decrease in treatment time (also named the EcO_2 Rapid Treatment Option)has been caused by shortening the time needed to heat up the goods and because of improvements in airflow in the airtight room and in the products themselves. A test conducted in our test centre in Ridderkerk (The Netherlands) on dried organic peaches from South Africa gave very positive results. In figure 1 the increase in temperature has been visualised by the different lines which represent the different monitoring devices between the products. The increase in temperature is equally throughout the cargo. In figure 2 the old situation when heating up was slow can be seen.

The insects that were tested have been killed with the following parameters (table 1);

Insect	**Stage**	**Type**	**Parameters**
Carpoglyphus lactis	All stages	CA	CA, 38C, 24hrs
Acarus spp.	All stages	CA	CA, 32C, 24hrs
Carpophilus dimidiatus	All stages	CA	CA, 40C, 16hrs
Ephestia elutella	All stages	CA	CA, 35C, 10hrs
Ephestia Cautella	All stages	CA	CA, 35C, 10hrs
Plodia interpunctella	All stages	CA	CA, 34C, 16 hrs
Oryzaephilus mercator	All stages	CA	CA, 36C, 16hrs
Oryzaephilus surinamensis	All stages	CA	CA, 30C, 24hrs
Sitophilus oryzae	All stages	CA	CA, 35C, 48hrs
Sitophilus granarius	All stages	CA	CA, 30C, 4days
Stegobium paniceum	All stages	CA	CA, 32C, 24hrs
Tribolium castaneum	All stages	CA	CA, 34C, 24hrs
Bruchus ssp.	All stages	CA	CA, 32C, 2days
Rhizopertha dominica	All stages	CA	CA, 32C, 3days
Sitotroga cerealella	All stages	CA	CA, 30C, 3days
Tribolium confusum	All stages	CA	CA, 30C, 36hrs

Stage; insect, larvae and eggs.
Type; means EcO_2 Controlled Atmosphere.
Parameters; treatment type, temperature in Celsius and time in hours/days.

Price
Normally Controlled Atmospheres are most efficiently applied in airtight cells made of isolated panels. This required a considerable investment and a vast amount of space. EcO_2 managed to implement a converter based system in a 20ft or 40ft isolated container. This caused the price of the system to drop towards far more expectable levels. Systems can even be rented, so switching from chemicals to the Controlled Atmosphere is a less big of a shock.

Usability
Using an isolated container gives the customer for more flexibility. The treatment system can be transported from one location to another. Also expanding the system is far easier. With a few electro technical adaptations up to five isolated containers can be linked to the central container with the EcO_2 system in it. The system can also be monitored online via the internet software. This means that operators can be monitored by the EcO_2 control centre in The Netherlands. Via this way the system is foul proof.

Availability
Companies can now test the system in several locations in the world. There are seven treatment centres in The Netherlands, one in Belgium, one in The United Kingdom, one in Turkey, one in Greece, one in Vietnam and one in India. This means that the barrier to test the system has been significantly lowered.

Types of commodities

The products are exposed to the Controlled Atmosphere in the airtight environment and the systems are equipped to handle variable sorts and quantities of products. The system can be applied on (table 2):

Examples of Commodities Treated

Cereals:	Barley, Buckwheat, Cereals, Soya Flour, Grain, (Basmati) Rice, Maize, Organic Barley, White Sorghum etc.
Pulses:	Chick Peas, Lentils
Nuts:	Almonds, Ground nuts, Hazelnuts, Pistachio, Walnuts, Brazil nuts, Cashew nuts, Pecan nuts etc.
Spices:	Pepper, Cinnamon, Coriander, Broken Mace, Ginger, Marjoram, Nutmeg, Anise, Hibiscus leaves, Onion flakes, Onion powder etc.
Dried fruits:	Apples, Apricots, Desiccated coconut, Grapes, Peaches, Plumps, Tomatoes, Figs, Raisins, Sultanas etc.
Seeds:	Sunflower seed, Radish seed, Sesame seed, Onion seed, Mustard seed, Lettuce seed, Fennel seed, Grass seed, Clover seed, Cabbage seed, cardi seed, Perilla seed
Various:	Cocoa beans, coffee, beans, Soya beans, Soup additives, Pet feed, Dried shrimps, Flour,

Note: all these commodities are treated in the EcO_2 facilities around the world

Conclusion

Controlled Atmospheres are far more competitive than a few years ago. Barriers of treatment time price, usability and availability have been lowered. The conventional food products market will choose for this alternative more often because of the growing trend in awareness of food safety. Chemical alternatives for Methyl Bromide can not only cause residues and a negative image; they become less competitive in comparison to natural alternatives.

Figure 1: Decreased heat-up times with the EcO_2 Rapid treatment Option

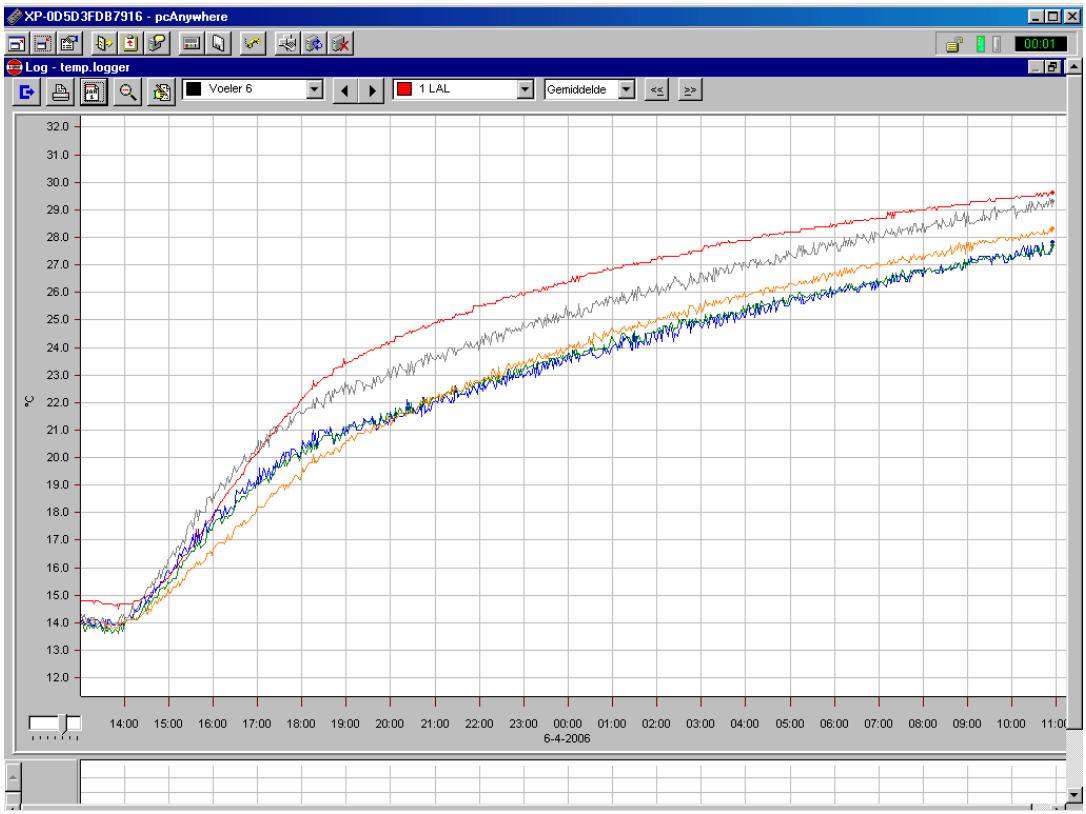

Figure 2: Standard heat-up times without the EcO_2 Rapid treatment Option