Fumigation with CO2 for Stored Product Insect Control

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Controlled or Modified Atmospheres

- Controlled Atmosphere – atmospheric composition within the treatment is controlled or maintained with addition of gas to sustain desired gas levels
- Modified Atmosphere – the atmospheric composition within the treated enclosure may change over time and is controlled in an indirect fashion
Controlled Atmospheres Fumigation

Factors Affecting Required Exposure Time for CO2 fumigation

Depends On:
- Concentration of the atmosphere
- Grain temperature
- Moisture content of the grain
- Species and life stage
## CO2 Fumigation

<table>
<thead>
<tr>
<th>Grain Temp. C°</th>
<th>Concentration CO₂</th>
<th>Exposure Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>60 %</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>60 %</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>60%</td>
<td>14</td>
</tr>
<tr>
<td>10 – 20</td>
<td>60%</td>
<td>14 – 56</td>
</tr>
</tbody>
</table>

*At 25°C, 60% CO₂, all life stages succumb – Navarro et al. 2012*
CO2 Fumigation

Typical Installation

Grain Silo

CO2 injection

Flow control & analyzer panel

Bulk CO2 Tank
CO₂ Fumigation

Typical Installation

Bulk CO₂ Tank → LCO₂ Valve → Vaporizer → Solenoid Valve → Silo

Pressure Regulator

Control Panel

Probe (CO₂ Concentration 60-100%)

Flow meter
CO₂ Fumigation

Gas Tightness of Storage Bins

Before Using CO₂:

It is essential that the storage bins and any inter-connecting ductwork and fans be sealed to ensure to maintain the concentration within the desired treatment time.

Pressure testing to ensure gas tightness is recommended.
## CO₂ Fumigation

How much CO₂ is required to treat a typical grain silo?

<table>
<thead>
<tr>
<th>Volume needed (ft³)</th>
<th>Void Space</th>
<th>CO₂ Usage (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,260</td>
<td>0.4</td>
<td>560</td>
</tr>
<tr>
<td>24,530</td>
<td>0.4</td>
<td>1,120</td>
</tr>
<tr>
<td>36,800</td>
<td>0.4</td>
<td>1,680</td>
</tr>
</tbody>
</table>
CO$_2$ Fumigation

Present Situation

The two most commonly used chemicals approved for fumigation: PHOSPHINE and METHYL BROMIDE.

Methyl Bromide has been found to deplete the ozone, and its use is now restricted.
CO$_2$ Fumigation

Present Situation – cont’d

Grain handlers are therefore left with only one alternative: PHOSPHINE

- single selection pressure can result in insects overcoming the effect

- Future development of insect resistance to phosphine, could make it difficult to maintain the “zero tolerance” requirement unless alternative methods are found.
CO$_2$ Fumigation

An alternative to Phosphine.

The use of atmospheres with elevated CO$_2$ levels.

Elevated CO$_2$ atmospheres are desirable fumigants because they leave NO chemical residues on food and are safer to use.

CO$_2$ is less hazardous to handle and insects cannot develop resistance.
CO$_2$ Fumigation

Where can CO$_2$ be used?

Country elevators
Terminals
Shipholds

CO$_2$ is readily available in most parts of the country and is commonly used in many food related processes.
Ozone fumigation

- Alternative to other fumigants
- Used in many parts of the world for food and water sterilization
- Can cause insect, bacteria and fungal mortality – disrupts cell walls
- Used in a similar fashion to CO2 or gaseous PH3
- Registered in Canada for water treatment – grain project commencing early fall 2014
What happens inside an OMZ-5000-HFT Ozone Generator?

1. Air is pulled into the inlet of the ozone generator.
2. A 45 FPM (feet per minute) filter prevents dust & odors from entering the ozone mechanism & contaminating it.
3. A powerful 100 CPM (cubic foot per minute) fan accelerates air through the unit for ozone creation.
4. A high voltage corona mechanism converts the oxygen (O₂) to ozone (O₃).
5. A protective stainless steel grid ensures that people cannot touch the corona mechanism while it's operating.
6. Powerful ozone exits the machine. The ozone will oxidize odors, smoke & other harmful contaminants.

How does the OMZ-5000-HFT get its name?
OMZ = Ozone Solutions, line of residential & commercial ozone products
5000 = 5,000 cubic feet of ozone production
HFT = High Flow fan with a Discharge
Carbon Dioxide (CO2) for Grain Fumigation

June 2014