


Sulfuryl Fluoride ProFume* Gas Fumigant



Technical Update

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ProFume* Development

- Dow AgroSciences investigated sulfuryl fluoride as a MeBr alternative for postharvest insect control.
- Initial research focused on flour mills, food processing facilities, warehouses, and stored grains.
- Cooperative research since 1995 with researchers, food scientists, food commodity groups, industry consultants, and fumigators in Australia, Europe, Japan, and the United States.



More Similarities Between ProFume & MeBr Than Differences

Both are excellent fumigants that:

- have wide pest control spectrums
- are non-flammable and odorless
- have similar vapor density and molecular weights
- are non-corrosive in vapor phase
- utilize CT dosage relationship

$$\text{Dosage} = \text{Concentration} \times \text{Time}$$

Key Differences: Fumigant Properties

<u>Factor</u>	<u>SF</u>	<u>MeBr</u>
Ozone Depleter	No	Yes
Penetration	Rapid	Slow
Sorption	Low	High
Desorption	Rapid	Slow
Aeration	Rapid	Slow
Odor Potential	None	Sulfurous

Key Differences: Packaging & Use

<u>Factor</u>	<u>SF</u>	<u>MeBr</u>
Cylinder Weight (net)	125 lb	45-200 lb
Pressure @ 86°F	300 psi	25 psi
Heat Exchanger	No*	Depends
Volume Control	Hose Length/Dia	None
Shooting	Outside	Depends

- Introduction fans act to improve fumigant distribution and as an internal heat exchanger

Pests Controlled With ProFume



- Wide spectrum of insect and rodent (rats, mice) pests in postharvest cereal grain, dried fruit, and tree nuts.
- All life stages.
- Partial list of key pests includes:
 - ▣ Moths (IMM, MFM, CM, NOW, & AM)
 - ▣ Weevils (Granary, Rice, & Maize Weevil)
 - ▣ Beetles (RFB, CFB, STGB, LGB, & WHB)

ProFume Will Be Labeled For Use On:

Cereal Grains

Wheat
Rice

Corn
Sorghum
Barley
Oats

Dried Fruits

Raisins
Prunes

Figs
Apples
Apricots
Bananas
Dates
Other dried fruits

Tree Nuts

Walnuts

Almonds
Hazelnuts
Pecans
Other Tree Nuts

- Other commodities are being investigated.

ProFume Development 1997 - 2003

39 Fumigations at 25 Sites:

👉 California	11 mill fumes at 5 mill sites 5 chamber fumes at 2 mill sites
👉 U.S. Midwest	12 mill fumes at 8 mill sites
👉 Germany	4 mill fumes at 3 mill sites
👉 England	2 mill fume at 2 mill site
👉 Italy	1 mill fume at 1 mill site
👉 France	1 mill fume at 1 mill site
👉 Switzerland	3 mill fume at 3 mill site (Received Registration)

Sulfuryl Fluoride Effects: Mills and Equipment

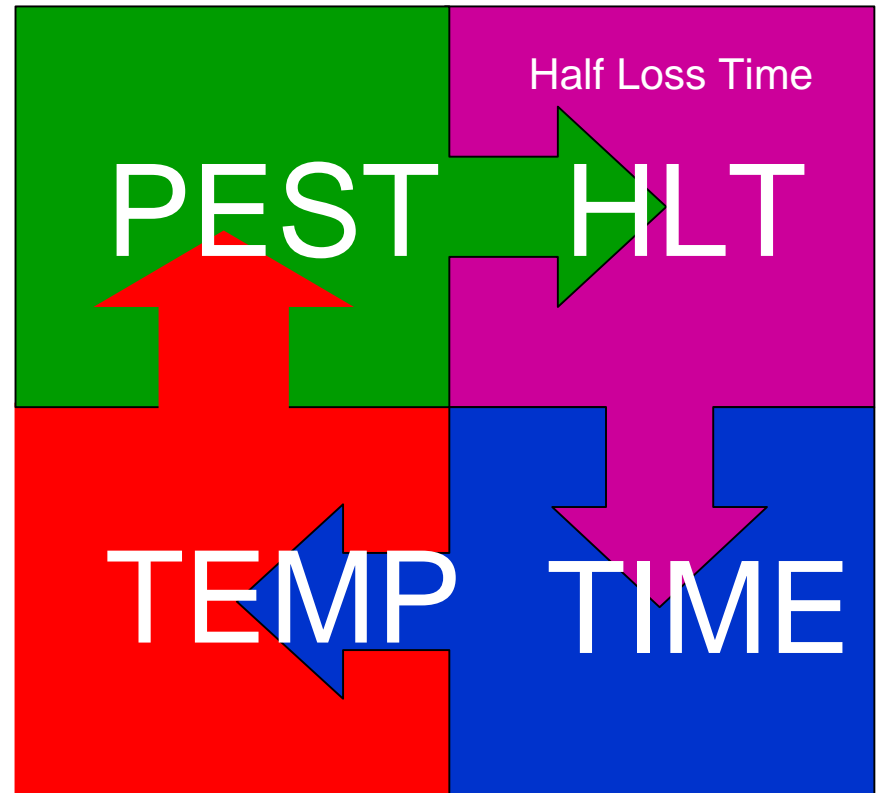


- Non-Flammable gas
- Not corrosive in gaseous phase
- Stable to 400°C, an inorganic gas
- Safe for use on sensitive electronic equipment and mechanical systems
- No complaints from fumigated facilities!
- Sulfuryl fluoride has been used in all sorts of structures for over 40 years!

Precision Fumigation Concept

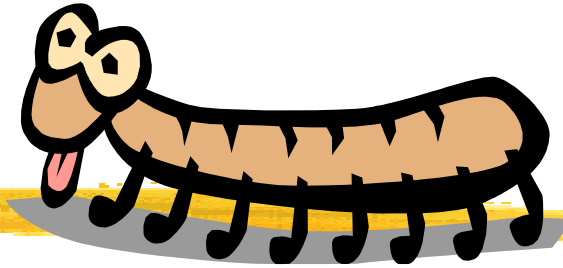
Precision Fumigation:

“Optimizing fumigant use to maximize efficiency and minimize risk.”



*Interrelated
Factors*

Pest Efficacy



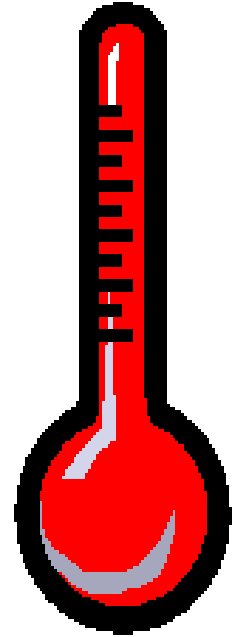
- Effective on all key stored product insect and rodent pests
- Dosage is species dependent
- ProFume* can control all life stages of insects including eggs and diapausing stages
- Postembryonic stages controlled with relatively low dosages
- Egg stage requires higher dosages



Red Flour Beetle Life Stages

Temperature Factor

- Key factor for successful fumigation
- Insects cold-blooded, so increasing TEMP increases metabolism
- Increasing insect metabolism greatly improves efficacy of ProFume*
- Increasing TEMP decreases exposure time and gas needed.

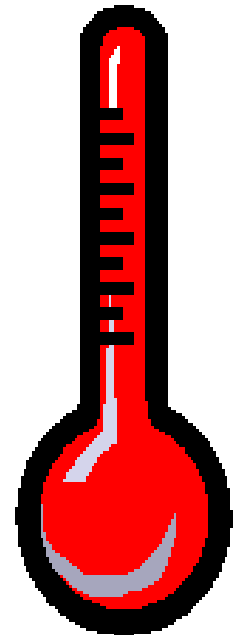


*Increasing TEMP from 75° to 85° F,
significantly decreases gas needed*

Temperature Factor

Methods for increasing temperature:

- Permanent / Built-in
 - hot water, steam, electric, fossil fuels, solar
- Temporary / Leased
 - gas, electric, other
- Time of Day
- Seasonal



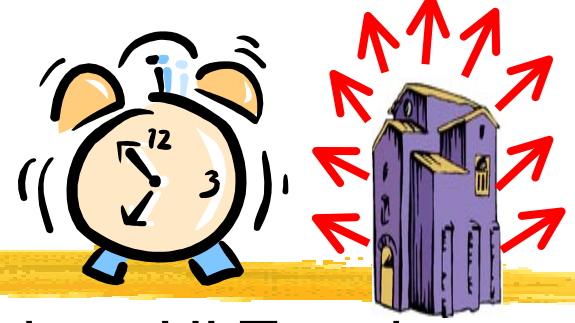
Exposure Time Factor (T)



- Key component of $C \times T = \text{Dosage}$
- Increased time = Decrease gas needed
- Decreased time = Increase gas needed
- If structure has good gas confinement, increasing fumigation time is most cost effective factor available
- Plan to maximize exposure time to minimize gas needed.

Doubling exposure time can decrease gas needed by up to 50%

Optimizing Time and HLT Factors



Amount Of Fumigant Needed With Various HLT and Exposures

<u>Exposure Time</u>	<u>HLT 5</u>	<u>HLT 10</u>	<u>HLT 15</u>
18 hrs	1.13X	0.69X	0.56X
24 hrs	1.00X	0.55X	0.44X
32 hrs	0.94X	0.47X	0.34X
48 hrs	0.90X	0.40X	0.27X

Doubling exposure time with good HLT decreased gas cost significantly

Dosage Determined with ProFume* Fumiguide* Calculator

- A MS-Windows based PC program
 - “Precision Fumigation” dosage tool
 - ↖ based on pest species, life stage, temp., exposure time, volume, and load factor
 - ↖ also gives gas introduction instructions
 - Allows “what if” scenarios to help fumigators and customers
 - Records fumigation data
 - Prints reports
- * TM Dow AgroSciences LLC





ProFume*

Stewardship

Commitment To Training & Stewardship



- Key to Long Term Success
- Required Fumigator Participation
- Basic to Dow AgroSciences Fumigant Offering:
 - ← Extensive Training Program
 - ← Continuous Improvement in Methods and Materials
 - ← Utilizing Precision Fumigation Techniques
 - ← Enhanced Support to Industry



ProFume*

Timelines

ProFume* Sites and Commodities

- Sites

- 📄 Flour Mills, DF&TN plants, Grain Storage

- 📄 Food Processing Plants

- Commodities

- 📄 Cereal Grains: Wheat, Rice, Corn, Sorghum, Barley, Oats and other

- 📄 Dried Fruits and Tree Nuts

- 📄 Processed Foods (complex products)


- 📄 Pet Food

Anticipated ProFume* Registration and Use Timelines



- 2003 - US Section 3 Label Cereal Grains,
and Dried Fruit & Tree Nuts
- 2003 - Limited Launch In Cereal & DF&TN markets
- 2004 - US Food Processing Registration
- 2004 - European Approval for Mills and Dried
Fruit/Tree Nuts

ProFume* Summary



- ✓ ProFume is a Viable Fumigant for Mill, Food Processing and Stored Grain Fumigation
- ✓ No Equipment Effects
- ✓ No Quality Effects at Label Proposed Dosages
- ✓ Mill Downtime Same as Now
- ✓ Fumiguide & Other Tools for *Precision Fumigation*
- ✓ Precision Fumigation Provides Flexibility to Fit Fumigation to Miller/Fumigator Needs and Budget