Update On The Development Of Sulfuryl Fluoride As An Alternative To Methyl Bromide

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Sulfuryl Fluoride (SO_2F_2)

- **Early 1950's - Research initiated by Dow to develop an alternative structural fumigant without the mercaptan odors associated with methyl bromide**
- **1955 - First field tests with sulfuryl fluoride for control of DWT**
- **1959 - Patent received for fumigation with sulfuryl fluoride (#2,875,127)**
- **1961 - First marketed in US under trade name Vikane* gas fumigant**
- **1974 - Sulfuryl Fluoride production initiated at Dow Chemical facility at Pittsburgh, CA.**

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Sulfuryl Fluoride (SO_2F_2)

- **Currently sold under global trade name Vikane* gas fumigant**
- **Primary use: Structural Fumigation to control Drywood Termites**
- **Secondary uses: Railcars, Shipping Containers, Artifacts, Beetles**
- **Currently registered in:**
  - **USA**
  - **Caribbean**
  - **Sweden**
  - **Germany (use permit)**

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More Similarities Between SF & MeBr than Differences

Both are excellent fumigants that:

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

Dosage = Concentration X Time

Key Differences: Physical/Chemical Properties

Factor	SF	MeBr
Formula	SO_2F_2	CH_3Br
Nature	Inorganic	Organic
B.P. (°C)	-55.2	3.6
V.P. (kPa)	1700	190
Solubility Water (ppm)	750	17,500
Solubility Organics(ppm)	Low	High

Key Differences: Fumigant Properties

Factor	SF	MeBr
Effect on Ozone	No	Yes (?)
Penetration	Rapid	Slow
Sorption	Low	High
Desorption	Rapid	Slow
Aeration	Rapid	Slow
Odor Potential	None	Sulfurous

Key Differences: Biological Activity

- **Relative Insect Control**

Stage	SF	MeBr
Adult	X	X
Pupal	X	X*
Larval	X	X
Egg	X*	X

* **May Require Higher Dosages**

Key Differences: Packaging and Use

Factor	SF	MeBr
• Cylinder wt	90 kg	20-90 kg
• Pressure(kPa)	2078	172
• Heat Exchanger	No*	Depends
• Vol. Contrl.	Hose len/dia.	None
• Shooting	Outside	Depends

* *Shooting fans necessary as internal heat exchanger and for improved fumigant equilibrium*

ProFume Gas Fumigant Development*

- **Biology efforts to define effective dosages**
  - **Laboratory efficacy trails (1995-2001)**
  - **Target six key SPIP (IMM, MFM, CFB, RFB, WB, STGB)**
    - **CSL in UK**
    - **DFA in CA**
    - **BBA in Germany**
    - **USDA-ARS in CA**
  - **Validate CT concept for SPIP**
  - **Field validation of laboratory results**
    - **Germany**
    - **UK**
    - **US**
  - **Translation of data into label rates based on targeted level of control**
  - **Development of ProFume* Fumiguide Calculator**

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ProFume is not available for sale. EPA registration pending.

ProFume Gas Fumigant Development*

- **Development of "Best Practices" to optimize efficient use of sulfuryl fluoride**
  - **Improved structure sealing techniques**
  - **Optimizing gas retention**
  - **Increased HLT**
  - **Shorter time to reach equilibrium**
  - **Maintenance of fumigant equilibrium**
  - **Improved monitoring techniques**

- **Goal: Use of less fumigant to reach desired level of insect control**
  - **Minimize downtime**
  - **Ensure safety**
  - **Avoid damage**

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ProFume Gas Fumigant Development*

- **Taste and Quality Effects**
  - **Validate that fumigation of DF & TN and Cereal Grains does not affect taste and quality**
    - **Completed two DF & TN trails**
      - **9 commodities**
      - **In cooperation with DFA and USDA-ARS**
    - **Coordinating taste and quality tests on wheat, rice and corn with:**
      - **Kansas State University**
      - **HGCA / CSL**
    - **Fumigating kernels, processed products (flour) and finished products**

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ProFume Gas Fumigant Development*

- **Population Modeling**
  - **Better understanding of economic thresholds and action levels**
  - **Population rebound rates**
  - **Potential for development of resistance**
  - **Determination of economical dosages**
  - **Help determine success of pervious fumigations**
  - **Predict when future fumigations will be required**

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ProFume Gas Fumigant Development*

- **Residue Research**
  - **DF & TN**
    - **Commodity Fumigation / Analysis - Completed 1999**
  - **Cereal Grains (Wheat, Rice, Corn)**
    - **Fumigation of grain and process functions currently underway**
    - **Residue analysis/risk assessment**

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ProFume Gas Fumigant Development*

- **Regulatory Timeline**
  - **2001**
    - **Dried Fruit and Tree Nut EUP (Walnuts, Raisins)**
  - **2002**
    - **Section 3 Registration Approval DF&TN**
    - **Product Launch DF&TN**
  - **2003**
    - **Section 3 Registration Approval Cereal Grains (US)**
    - **Product Launch Cereal Grains (US)**
  - **2004**
    - **Product Launch Cereal Grains (Europe)**
    - **Section 3 Approval Food Processing (US)**
    - **Product Launch Food Processing (US)**

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Product Stewardship

It is a Dow AgroSciences expectation that an effective Product Stewardship Program will be a primary requirement in any area where sulfuryl fluoride business currently exists or where new uses are being developed.

Conclusions

- **Dow AgroSciences is committed to supporting sulfuryl fluoride in the existing Vikane* markets as well as new use patterns**
- **Sulfuryl fluoride (ProFume*) will be a viable alternative for methyl bromide in many commodity fumigation markets**
- **Dow AgroSciences is demonstrating confidence and commitment in ProFume* through our investments in product development**
- **Developing technical foundation for long term use of sulfuryl fluoride**
- **Cooperating with researchers, fumigators and the food industry to development practical sulfuryl fluoride fumigation options**

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Thank You

Questions?