Dimethyl Disulfide (DMDS)

A Methyl-Bromide Replacement Candidate

Current Important Industrial Uses of DMDS

- **Important agent used in hydrodesulfurisation processes in the petrochemical industry**
- **Coke inhibiting agent used in ethylene furnaces**
- **Used as an FDA registered food additive**
- **ARKEMA, a world leading producer of DMDS**

DMDS Atmospheric Effects

DMDS physical-chemical properties

Molecular formula: $C_2S_2H_6$
Molecular weight: 94.201
Appearance: yellow liquid
Odor: garlic-like smell

Boiling point: 109.8° C
Flash point: 16° C (TCC)
Henry's law constant: 1.21 E-3 (20° C)
Octanol/water partition: log Pow 1.77
Vapor pressure: 28.7 mm Hg (25° C)
Water solubility: 3 g/L (25° C)

DMDS: Naturally Occurring in the Environment

DMDS Residues in the Environment: Biological Sources

in Procaryotes

- bacteria (*Pseudomonas fluorescens, Proteus vulgaris, Sarcina lutea*)
- fungi (*Rhizopus nigricans, Aspergillus oryzae, Fusarium culmorum*)
- algae (blue-green, green)

in Plants

- crops (alfalfa, brussels sprouts, cabbage, cassava, cauliflower, cocoa, filberts, garlic, onion, pea, peanut, potato, rutabaga, tea, tomato)
- aquatic plants
- terrestrial plants (oak, pine)

in Animals

- humans (expired air, urine), cattle (milk, manure), poultry/ sheep/ swine (manure), shellfish (oyster meat)

DMDS Residues in the Environment: Anthropogenic Sources

in Food Processed Commodities

- coffee, bread, fish processing, whiskey, beer, water treatment

in Substances from Industrial Processes

- previously described industrial uses, sulfur dioxide scrubbing, wood pulping, gasoline engine exhaust, food refuse, starch manufacturing, pesticides[1]

[1/] terminal residues of acephate and methamidophos

In *Brassicacea* from thiomethyl glucosinolates

From S-methyl-cysteine sulfoxide in crucifers and *Allium spp*.

DMDS Formation from Natural Processes

Methionine Degradation Pathway

DMDS Formation from Natural Processes

Dimethylsulfoniopropianate (DMSP) Degradation Pathway

DMDS Formation from Natural Processes

Biogenic Atmospheric Sulfur Cycle

DMDS Natural Background Concentrations

- Anthropogenic[1]
  - Wastewater effluent (45 µg/l)

- Biological[1]
  - Human expired air: max. 0.6 µg/hr)
  - Human expired air: max. 7ng/l)
  - Poultry manure: 85 µg/kg

[1/] low levels are maintained due to flux

DMDS Efficacy

- Effective against
  - Nematodes (e.g.-Root-knot, Cyst?)
  - Soil pathogens (e.g.-Rhizoctonia, Sclerotinia, Verticillium?)
  - Weed species (e.g.-Purple Nutsedge, others)
- Efficacy influenced by
  - Dosage applied
  - Product combinations
  - Barrier permeability

DMDS Registration

- Registration submission on schedule for
  - 1st quarter, 2007

DMDS: Summary

- DMDS is a ubiquitous, simple, and natural product, being associated with such processes as methionine catabolism and dimethylsulfoniopropianate degradation.
- It is also key component of the biogenic atmospheric sulfur cycle.
- DMDS is registered with FDA as a food additive.
- As with any fumigant product, the development of appropriate

commercial uses to maximize efficacy and ensure operator and bystander exposure are required and are in progress.