

STERIGAS™ & COSMIC™: UPDATE ON PROPOSED NEW FUMIGANTS

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Introduction;

STERIGAS [EthanediNitrile, **EDN** = C₂N₂] is a new environmentally-safe fumigant with initial focus on control of pathogens, weeds and insects in soil; control of timber pests in export logs & timber and the devitalisation of imported grains (sterilisation of grain & weed seeds plus elimination of any pathogens). The basis for this initial **EDN** focus was the total consumption of methyl bromide in 2000 was estimated at 75,203 tonnes (TEAP Report, April 2001) and approximately 80% was used for soil and timber fumigation treatment. At low doses (~1g/m³) **STERIGAS** is effective against common stored product pests and is a potential methyl bromide alternative.

COSMIC [Carbonyl sulphide, **COS**] initial focus is a grain fumigant for use in phosphine resistance strategy. At economic doses (~30g/m³) **COSMIC** is effective against common stored product pests and is a potential methyl bromide alternative. CSIRO currently hold patents for use of **EDN** & **COS** as fumigants in the major worldwide markets. CSIRO and the international industrial gas company BOC Limited signed an agreement (2 September 2004) to globally market the patented **STERIGAS** & **COSMIC** fumigants. CSIRO is supplying BOC with efficacy and related data for to assist in the global registration of these new pesticides (pesticide registration application was submitted for **STERIGAS** & **COSMIC** to the Australian Pesticide and Veterinary Medicines Authority, June 2005).

STERIGAS [EDN]

EDN is a potential replacement for methyl bromide. Comparative Laboratory test toxicity examples (LC₉₅ mg/h/L) highlight the superior efficacy of **EDN**.

Soil insect (white fringed weevil):	50mg/h/L [C ₂ N ₂]; 135mg/h/L [CH ₃ Br]
Nematode	40mg/h/L [C ₂ N ₂]; 100mg/h/L [CH ₃ Br]
Fungus (<i>Rhizoctonia</i>)	8mg/h/L [C ₂ N ₂]; 55mg/h/L [CH ₃ Br]

Timber studies on the toxicity to five species of timber or wood related Coleoptera and Isoptera were reported by Dowsett & Ren (2002). In general, **EDN** showed high toxicity to all immature and adult stages tested and in this respect is more toxic than methyl bromide and sulfuryl fluoride. **EDN** is a very flammable liquefied gas with a flammability range of 6-32% by volume. While the flammable **STERIGAS 1000 Fumigant** [Active Constituent 1000g/kg Ethaneditrile] can be accommodated in the agricultural environment, there is a preference for non-flammable formulations in many industrial applications. To cater for this a non-flammable mixture of **EDN** in liquid carbon dioxide has been developed. This mixture has been conservatively set at 20 wt% **EDN** in CO₂ – hence the product: **STERIGAS 200 Non-Flammable Fumigant** [Active Constituent 200g/kg Ethaneditrile].

STERIGAS 1000 Draft Label Applications:

Devitalise grains & weed seeds + sterilise pathogens:	115g/m ³ for 5 d exposure
Timber and logs for export	50 g/m ³ , 6 h exposure
Strawberries runners and fruit growing	500 kg/ha for 24 h.

EDN Devitalisation of Grain:

The Meat & Livestock Association (MLA) membership are active in commercial feed lots where cattle are fed grain. The grain used in feedlots amount to 2.5 million tonne pa and during droughts there is a need to import grain. The requirements for importing are strict especially when grain needs to be transported into the countryside where the feedlots are located. The requirement is the devitalisation of grain & weed seeds and elimination of pathogens. MLA funded the R&D required to prove that this task can be performed using EDN. CSIRO Division of Entomology conducted this research and determined that devitalisation of grain & weed seeds and elimination of pathogens require a Ct of 13,800 g h/m³ or 115g/m³ in the grain store for 5 days.

EDN Commercial Issues:

There are a number of commercial issues including – Manufacture & Supply: Need to secure a supply of EDN as there is no known global tonnage plant manufacturer. BOC is currently negotiating a commercial deal with a large chemical manufacturer for the supply of tonnage quantities of EDN. There is some sensitivity in handling cyanides which resulted in adopting the IUPAC official name of Ethanedinitrile, EDN for cyanogen [C₂N₂].

COSMIC™1000 Fumigant [COS]:

Carbonyl sulfide (COS) is a new fumigant identified and developed by CSIRO. COS is present in range of raw and processed foodstuffs, including cereals and oilseeds. The natural levels of COS in grains and oilseeds were found to be ~0.05 mg/kg (Ren, 1997). Proposed dose rate for COS for all life stages of stored grain insects is **32g/m³ for 24 h.**

COS Commercial-scale trials

Field trials in grain storages up to 2,500 tonne showed COS has excellent physical, chemical and biological fumigant functions. COS kills all life stages of all test insects (*S. oryzae*, *R. dominica*, *T. castaneum*, *T. variabile*, *O. surinamensis*, *C. ferrugineus*, *E. cautella* and psocids) in all developmental stages with concentration x time product (Ct) of 1650-1950 mg h / L at grain temperatures of 10-35°C. After aeration COS left residues indistinguishable from levels in control samples (unfumigated) of wheat, barley, oats and canola. COS had no effect on the quality, such as quality of bread, noodles or sponge cakes made from the fumigated wheat; germination; seed colour and oil colour. In comparison with phosphine and methyl bromide, COS easily penetrated and diffused through the grain bulk. During application, fumigation and aeration, the levels of COS were < 10 ppm (TLV).

Keywords:

Gaseous fumigants; methyl bromide alternatives; stored product pests; pest-free & residue-free grain; commodity fumigants.