CYANOGEN AND CARBONYL SULFIDE AS POTENTIAL QUARANTINE FUMIGANTS FOR TIMBER

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Environmental threats of imported timber

In all timber producing countries, the biotic complex associated with forests and forestry products is large, comprising several thousand species over a wide range of biotic groups. Included are:

- Several thousand species of fungi
- Several hundred species of insects
- Some nematodes
- Some molluscs
- Some bacteria
- Some mites

Many of these can be transferred on timber moving in international trade.

The biotic complex associated with forests and timber varies greatly from country to country. A significant proportion of the biota that is in balance with their home environment may pose a threat to natural forests and plantations in foreign countries. In addition to organisms associated with forest trees and timber, a number of organisms unrelated to trees or timber are readily transferred as hitchhikers on timber moving in international trade. Historically, the environmental impact of transferred organisms have been severe and often of long duration e.g. Dutch elm disease killed off virtually all elm trees in Europe, chestnut blight has killed off most chestnut trees in North America over more than 70 years and every year Asian gypsy moth severely damages maples in North America.

Chemical and physical properties of cyanogen and carbonyl sulfide compared to other fumigants

	Methyl bromide	Phosphine	Carbonyl sulfide	Cyanogen	Hydrogen cyanide
Formula	CH_3Br	PH_3	COS	C_2N_2	HCN
Molecular weight	95	34	60	52	27
Boiling point @1 atm	3.6°C	-87.74°C	-50.2°C	-21.17°C	25.7°C
Specific gravity (gas), air=1.0	3.3	1.2	2.1	1.82	0.9
Flammability limits in air, v/v %	13.5-14.5	>1.7	11.9-28.5	6-32	6-46
Solubility in water, v/v %	3.4	0.2	0.12	Highly soluble	Highly soluble
Conversion factor mg/L to ppm, v/v @ 1 atm	260	730	410	480	890

Range of activity in laboratory studies
Carbonyl sulfide is a good fumigant for insect and nematode control and a substantial amount of work has been done on stored product pests. In that application a dose of 60 g m^{-3} for 48 hour will control all life stages. A dose of 80 g m^{-3} controls or inhibits most grain fungi.

Carbonyl sulfide penetrates and diffuses through both hard and soft timber more quickly than does methyl bromide. The sorption is much less than methyl bromide so that effective internal concentrations may be attained. Desorption is very rapid; one day of airing post fumigation results in a headspace concentration less than the Australian experimental TLV of 10 ppm.

Cyanogen is a potent biocide that controls insects, nematodes, fungi and bacteria. It also kills seeds and therefore is not suitable for many grain applications. No existing timber fumigant has a comparable range of biocidal activity. Cyanogen therefore has the potential to be effective against the full range of organisms that may be associated with timber in international trade.

Cyanogen penetrates and diffuses through both hard and soft timber more quickly than does methyl bromide and also diffuses across the grain. Sorption on timber is similar to methyl bromide. Desorption is more rapid than other known fumigants.

What does carbonyl sulfide offer?
- Probably effective against all insect pests.
- Probably inexpensive, easy to use, likely to fit in well with normal trading activities, could be commercially viable as a fumigation service.
- Registration for use likely to be within 3 years.

What does cyanogen offer?
- Probably effective against all potential threats, including insects and pathogens.
- Probably inexpensive, easy to use, likely to fit in well with normal trading activities, could be commercially viable as a fumigation service.

Investigations currently underway at SGRL:
- Systematic studies on penetration, absorption, desorption and residues for treated wood.
- Systematic studies of efficacy against timber organisms.
- Development of formulation and application methods suitable for industrial use, particularly for quarantine treatment and including OH&S issues.