# Methyl Bromide Consultation with the Secretaries' Science Advisory Board

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*Department of Environmental Quality*

# Methyl Bromide Log Fumigation Operations

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# Methyl Bromide Log Fumigation Operations

- **NC is experiencing an uptick in permit applications and inquiries from entities interested in using methyl bromide for fumigation of whole logs.**

- **Log export market primarily requires:**
  **1) fumigation with methyl bromide**
  **- or -**
  **2) debarking**

# Methyl Bromide Log Fumigation Operations

- **The process:**
  - **Logs placed in a shipping container. Doors closed.**
  - **Fumigation of logs inside container.**
  - **Residence time ~60-72 hours.**
  - **Aeration = Open doors and vent to atmosphere.**

**Label instructions that workers must follow.**

- **Buffer zones, buffer zone entry restrictions, respirator requirements, work time restrictions.**

# Methyl Bromide Log Fumigation Operations

**The Montreal Protocol banned most uses of methyl bromide due to its ozone depleting properties.**

**However, quarantine and pre-shipment (QPS) treatments are currently exempted.**

**NC has 5 permitted synthetic minor log fumigation facilities:**

- **Report 100% usage as emissions**
- **Reporting conditions & < 10 tpy limit to avoid major source classification.**

# Methyl Bromide Log Fumigation Operations

**DAQ's concerns:**

1. **Methyl Bromide is a Hazardous Air Pollutant (HAP).**
2. **The potential for acute (short-term) exposures: methyl bromide is highly toxic and studies in humans indicate that the lung may be severely injured by the acute inhalation exposures. Acute and chronic inhalation of methyl bromide can lead to neurological effects in humans.**
3. **There are no federal or state air quality regulations to protect the public from these emissions.**
4. **Unlike many agricultural uses, log fumigation facilities are more of an industrial point source where much greater quantities of methyl bromide are used and emitted in one spot.**

# Methyl Bromide Log Fumigation Operations

**New interest:**

- **2 new major source permit applications**
  - **60 ton per year operation (withdrew application)**
  - **100+ ton per year operation**

- **3 new synthetic minor permit applications received**

- **All on hold pending response to an information request sent to the applicants and rule-making**

# Methyl Bromide Log Fumigation Operations

## Multi-faceted strategy:

**Temporary and Permanent rule – Health-based approach. Establish an Acceptable Ambient Level (AAL) based on robust risk assessment data.**

– Consultation with Science Advisory Board (SAB) in October

- Draft AAL to Environmental Management Commission in November

**Existing facilities – 5 in NC. 60-day notice of intent to modify their air permit.**

-Put them on a path to comply with the temporary rule.

**New major source – Malec Brothers Transport: DAQ requested additional info.**

-Capture/control technology plan; Detailed monitoring plan; Operational limitations

**Other new permit applicants: DAQ requested additional info.**

-Capture/control technology plan; Detailed monitoring plan; Operational limitations

**Letter to USEPA requesting log fumigation be a listed category under Section 112(c) of the Clean Air Act.**

-MACT/GACT

# Methyl Bromide Assessment

Dr. Sandy Mort, Environmental Toxicologist, NC DEQ

# Methyl Bromide

- **Pesticide, fumigant**
- **Synonyms:  Bromomethane, Monobromomethane**
- **$CH_3Br$, CASN 74-83-9**
- **Odorless*, colorless gas at normal temperatures and pressure, 3.5°C**
- **Very water soluble, 15 g/L**
- **Degradation half-life in air – 11 months**

*** Poor olfactory warning properties**

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# Methyl Bromide Uptake Following Inhalation

Inhalation → Quickly distributed throughout the body → Tissue, Organs, Adipose

- Major elimination routes – lungs, urine (metabolites)

- Elimination half-life – 15-30 minutes (methyl bromide); 2-10 hours (metabolites)
- Slower release from some organs (brain, liver)
  - 25-35% remains in tissues >24-72 hours

- May cross blood-brain barrier
- Possible gender and genetic sensitivities

# Inhalation of Low Levels of Methyl Bromide

- **Headache**
- **Nausea**
- **Weakness**
- **Delayed on-set (hours)**

***Source: Toxicological Profile for Bromomethane (ATSDR 1995, 2018)***

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# Inhalation of Higher Levels or Over Longer Periods

- **Lung, respiratory tract effects**
  - **Irritation, burning**
  - **Lung edema, lesions**
  - **Olfactory epithelium degeneration**
- **Difficulty breathing**
- **Tremors**
- **Kidney, liver damage**
- **Nerve damage**

***Source: Toxicological Profile for Bromomethane (ATSDR 1995, 2018)***

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# Human Health Effects – Inhalation Exposure

**Effects noted in studies of workers exposed to methyl bromide**

- **Neurotoxicity**
  - **Headaches, dizziness, fainting, apathy, weakness, tiredness, giddiness, delirium, stupor, psychosis, loss of memory, mental confusion, speech impairment, visual effects, limb numbness, tremors, muscle twitching, paralysis, ataxia, seizures, convulsions, reduced hand dexterity, loss of full muscle control, and unconsciousness.**

- **Neurobehavioral**
  - **Cognitive function, reflexes, sensory and visual attribute deficits**

***Source:*** ***Chemical Assessment Summary – Bromomethane (IRIS U.S. EPA, 1992), Toxicological Profile for Bromomethane (ATSDR 1992, 2018)***

# Other Exposure Considerations

***Occupational studies reflect adverse effects to generally healthy adult workers. Other subpopulations may be more susceptible to the effects of methyl bromide, such as the young, the elderly, persons with pre-existing health conditions to organs impacted by methyl bromide exposure (lungs, neurological system).*** ***Source: ATSDR (1992, 2018)***

***More recent indications that large segments of the population may be pre-disposed to an enhanced sensitivity to neurotoxic effects associated with methyl bromide exposure***

- ***Result of variations in the levels of an enzyme that produces metabolites with increased neurotoxic effects***
- ***Enzyme system not present in rodents***

- ***Source: Schröder et al., 1992; Garnier et al.,1996; in Provisional Peer Reviewed Toxicity Values for Bromomethane, U.S. EPA (2007)***

# Additional Effects Reported in Animal Studies

- Decreased growth
- Neurotoxic - Decreased brain weight & brain degeneration, cellular necrosis
- Neuromuscular – Limb curling, twitching, loss of full muscle control
- Neurobehavioral - Decreased activity, increased startle response, decreased response to stimuli
- Hematological (blood) – Decreased red and white cell counts, decreased hemoglobin
- Nasal lesions, abnormal olfactory cell growth, epithelial cell degeneration
- Cardiac effects – cell & muscle degeneration, vascular effects/clot formation with decreased blood flow
- Bone tissue – abnormal cell growth, abnormal sternum development
- Testes – Cellular degeneration, decreased sperm count & motility, decreased testosterone
- Liver cell degeneration, generalized toxicity
- Adverse effects to the:  esophagus, kidneys, stomach

# Developmental and Reproductive Effects – Animal Studies

**Maternal effects**

- **Reduced body weight (BW)**
- **CNS toxicity**

**Off-spring deficits of embryonic development**

- **Gall bladder**
- **Sternum**

**2-Generation study**

- **Maternal effects – Decreased body weight, weight gain**
- **2nd Generation young – Reduced growth**

***Reduced BW or reduced weight gain may be an indicator of systemic effects***

# Proposed AAL

## Methyl Bromide 24-hour AAL = 0.005 mg/m$^3$

**Source: IRIS 1992**

- **Chronic RfC = 0.005 mg/m$^3$ methyl bromide = 1.3 ppbv**
- **29-month rat laboratory study, Inhalation exposure**
- **Critical effect - degenerative and proliferative lesions of the olfactory epithelium**
- **LOAEL = 2.08 mg/m$^3$ (0.48 mg/m$^3$ HEC), $\sum$UF = 100**
- **Reuzel et al., 1987, 1991**

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# Most Current Toxicological Review

**ATSDR *Bromomethane Toxicological Profile Draft for Public Review***

- **April 2018**

- **0.0039 mg/m$^3$ chronic inhalation MRL (0.001 ppm)**
  - **Most sensitive effect – Nasal lesions (basal cell hyperplasia of the olfactory epithelium)**
    - **HEC conversion (RGDR), Combined UF = 90**
    - **Reuzel et al., 1991, rats**

- **0.078 mg/m$^3$ intermediate inhalation MRL (0.02 ppm)**
  - **Most sensitive effect – Neurological endpoint (Decreased locomotor activity, M)**
    - **LOAEC, BMD, HEC conversion (RGDR), Combined UF = 90**
    - **NTP 1992, 13-week (sub-chronic) inhalation study, mice**

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# AAL Proposal Summary

**IRIS chronic inhalation RfC as the basis of the AAL**

- Most scientifically defensible health-based value for protection of public health
- Developed to be protective of the general population and sensitive sub-groups

**24-hour averaging time**

- Chronic exposure concern
- Protective of rapid uptake/distribution to target tissues
- Preventive of acute and sub-chronic exposures with potential for adverse health-effects
  - Olfactory system irritation and cell damage
  - Neurotoxicity and developmental concerns
- Added level of protection for large segment of population with Phase II metabolism GSH variant not captured in IRIS RfC

# Methyl Bromide AAL

**DAQ is requesting the Secretaries' Science Advisory Board review and affirm the IRIS RfC as the appropriate basis for the Acceptable Ambient Level (AAL) and the 24-hour chronic toxicant averaging time.**

# Contact info

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