A Dimethyl Mercury Inhalation Risk Screening Concentration for Public Health Protection

**Abstract**
Dimethyl mercury (DMM), CASRN 599-74-8, is a small component of headspace gas in some waste storage tanks near the Hanford nuclear waste treatment plant. DMM vapor is also emitted by municipal landfills; is a trace gas in the global mercury cycle; and is sometimes detected in fish tissue along with monomethyl mercury (CH$_3$Hg$^+$$)$. Acute DMM exposures of as little as 5 mg/Kg body weight have caused delayed brain damage and death in humans. Fetal neurological development is likely the most sensitive effect at very low maternal exposures. Occupational exposure limits for all alkyl mercury compounds have been published; however, no reference inhalation limits such as an MRL or RIF for public exposure to any alkyl mercury compounds are available. This presentation shows how I derived a risk screening concentration for DMM of 0.14 µg/m$^3$ (daily time-weighted average) using published data and some assumptions about its absorption, distribution, metabolism, and elimination kinetics. The available literature suggests DMM is biologically inactive until it undergoes demethylation. Public exposure outside the Hanford area boundary from inhalation and ingestion of DMM emissions from the waste tank transfer ventilation systems is 6.0E-07 µg/Kg body weight per day or less. These emissions appear to pose no appreciable off-site health risks.

**Potential for Neurodevelopmental Effects**
- Subtle neurodevelopmental effects of DMM are unknown but likely
- Acute DMM symptoms resemble those observed in adult Minamata disease
- Fetal neurological development is likely the most sensitive effect
- In the Minamata outbreak, severe neurodevelopmental effects occurred from in utero exposure, even among asymptomatic mothers

**Metabolism**

\[ \text{HgCH}_3 + \text{H}_2\text{O} \rightarrow \text{Hg}^{2+} + 2\text{H}_2\text{O} \]

\[ \text{Hg}^{2+} + 2\text{H}_2\text{O} \rightarrow \text{Hg}^{2+} + 2\text{H}_2\text{O} \]

\[ \text{Hg}^{2+} + 2\text{H}_2\text{O} \rightarrow \text{Hg}^{2+} + 2\text{H}_2\text{O} \]

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**Dose by Inhalation**
- During pregnancy, women have higher daily ventilation volumes than prior to pregnancy (~55% increase)
- Overweight and obese women use higher volumes than normal and underweight ones do.
- Overweight and obese daily ventilation volumes during pregnancy:
  - Percentile
    - 50: 23 – 25
    - 95: 32 – 35
    - 99: 40 – 47

**Conclusions**
- 0.14 µg DMM/m$^3$ daily TWA should be sufficient to screen ambient air concentrations for in utero exposure neurodevelopmental hazards, even with steady exposure throughout a pregnancy
- Ingestion and inhalation exposures to DMM from waste tank transfer ventilation systems outside the Hanford area boundary has been estimated to be <6.9E-07 µg/Kg day (Runnum 2011). These emissions appear to pose no appreciable off-site risks
- Municipal landfill emissions also appear to pose no appreciable risk.