MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

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INTEROFFICE COMMUNICATION

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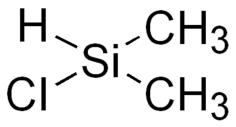
August 10, 2015

To: File for Chlorodimethylsilane (CAS No. 1066-35-9)

From: Michael Depa, Air Quality Division, Toxics Unit

Subject: Screening Level Update

The initial threshold screening levels (ITSLs) for chlorodimethylsilane (CDMS) are 5400 µg/m³ (1-hr averaging time) and 52 µg/m³ (annual averaging time).



In order to derive a screening level for CDMS, a review of standard toxicity references was searched for toxicity information. This literature search did not discover adequate chemical specific toxicological data to derive a screening level for CDMS.

The U.S. Environmental Protection Agency uses acute screening values for 26 chlorosilanes, including CDMS (EPA, 2015). The basis of these screening levels comes from methodology developed by the National Advisory Committee (NAC) on Acute Exposure Guideline Levels (AEGLs) for Hazardous Substances (NRC, 2012). The NAC derived AEGLs for 26 chlorosilane based on the molar equivalent of hydrochloric acid (HCl) released when chlorosilanes are exposed to air:

> Chlorosilanes react rapidly with water, steam, or moisture; hydrolysis yields hydrogen chloride (HCl) gas along with silanols and other condensation products. [T]he acute toxicity of chlorosilanes is largely explained by the HCl hydrolysis product; acute toxicity of these chlorosilanes is qualitatively (based on clinical signs) and quantitatively (based on molar equivalents of HCl) similar to that of HCl (Jean et al. 2006). On the basis of these data, and in the absence of appropriate chemical specific data for the chlorosilanes considered in this document, the AEGLs for HCl were used to derive AEGLs for the chlorosilanes. For each class of chlorosilanes (mono-, di-, tri-, and tetra-chlorosilanes), the molar ratio (moles of HCl released per mole of chlorosilane, assuming complete hydrolysis) was used to adjust the AEGL values for HCl to the equivalent concentration of chlorosilane.

Since the literature review did not find adequate chemical specific data to derive a screening level for CDMS, it was concluded that the NAC's methodology should be used to derive a screening value for CDMS. However, instead of using the AEGLs for HCl as the basis for the screening levels for CDMS, it was reasoned that the chronic and acute ITSLs for CDMS should be based on the acute and chronic ITSLs for HCl. AEGLs[1] allow for transient discomfort, whereas the Michigan Department of Environmental Quality Air

[1] "…susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects." (NRC, 2012. AEGL-1 definition on page 106)

Quality Division's ITSLs are protective for all effects, and are designed such that even the most sensitive individual will not experience adverse effects over the specified time period.

The MDEQ (2014) ITSLs for HCl are:

HCl Acute ITSL: 2100 µg/m³ (1-hour)[2]
HCl Chronic ITSL: 20 µg/m³ (annual)[3]

The ITSLs for CDMS were derived based on the following:

$$\underset{\substack{\text{HSi-Cl}\\ \text{1 mole}\\ \text{94.6g}}}{(CH_3)_2} + 2H_2O \rightarrow \underset{\text{HSi-OH}}{(CH_3)_2} + \underset{\text{1 mole}\\ \text{36.5g}}{HCl}$$

$$\text{ITSL for CDMS} = \text{ITSL for HCl} \times \frac{\text{1 mole CDMS}}{\text{1 mole HCl}}$$

$$\text{Acute ITSL for CDMS} = 2100\ \mu g/m^3 \times \frac{94.6g}{36.5g} = 5443\ \mu g/m^3 \approx 5400\ \mu g/m^3\ \text{(1-hr)}$$

$$\text{Chronic ITSL for CDMS} = 20\ \mu g/m^3 \times \frac{94.6g}{36.5g} = 52\ \mu g/m^3\ \text{(annual)}$$

References

EPA. 2012. Reference Concentration for Hydrochloric Acid. U.S. Environmental Protection Agency, Integrated Risk Information System (IRIS) on-line database. http://www.epa.gov/iris/subst/0396.htm

EPA. 2015. AEGL Program (website). Acute Exposure Guideline Levels (AEGLs). Office of Pollution Prevention and Toxics (OPPT). U.S. Environmental Protection Agency. Accessed 7-28-2015. http://www.epa.gov/oppt/aegl/

California OEHHA. 2008. Acute Toxicity Summary for Hydrogen Chloride. TSD for Noncancer RELs June 2008. Air Toxicology and Epidemiology Branch, Office of Environmental Health Hazard Assessment (OEHHA). Appendix D2. Pages 112-118. http://oehha.ca.gov/air/hot_spots/2008/NoncancerTSD_final.pdf

Jean, P.A., R.H. Gallavan, G.B. Kolesar, W.H. Siddiqui, J.A. Oxley, and R.G. Meeks. 2006. Chlorosilane acute inhalation toxicity and development of an LC50 prediction model. Inhal. Toxicol. 18(8):515-522.

[2] California Office of Environmental Health Hazard Assessment (OEHHA) acute Recommended Exposure Level (REL) (OEHHA. 2008)
[3] US EPA Reference Concentration (RfC) (EPA, 2012)

MDEQ, 2014. File for Hydrogen Chloride (CAS No. 7647-01-0). Development of the Screening Level. Interoffice communication. By Michael Depa, Toxics Unit, Air Quality Division. April 8, 2014. 7647-01-0_annual_1hr_ITSL.pdf

NRC (2012) Acute Exposure Guideline Levels for Selected Airborne Chemicals: Volume 11. Committee on Acute Exposure Guideline Levels; Committee on Toxicology; Washington, DC: National Academies Press. National Research Council. ISBN 978-0-309-25481-6, 356 pages. Document was prepared by the AEGL Development Team composed of Chery Bast (Oak Ridge National Laboratory), Julie M. Klotzbach (Syracuse Research Corporation), and Chemical Manager Ernest V. Falke (National Advisory Committee [NAC] on Acute Exposure Guideline Levels for Hazardous Substances).

NRC (National Research Council). 2004. Hydrogen chloride. Pp. 77-122 in Acute Exposure Guideline Levels for Selected Airborne Chemicals. Volume 4. Committee on Toxicology, Washington, DC: National Academies Press.