

2.6 COUPP Vapour Exposure Hazard Analysis

Summary

The COUPP experiment at SNOLAB uses propylene glycol as a hydraulic fluid. This note describes the pertinent exposure limits to propylene as set by legislation, and the MSDS for propylene glycol from DOW chemical.

The exposure limits cited by these organizations are generally Time Weighted Averages (TWAs) averaged over an 8 hour shift. A Short-Term Exposure Limit (STEL) of 3 times TWA should not be exceeded for more than 30 minutes and a Ceiling limit (C) of 5 times the exposure limit should never be exceeded.

Ontario OSHA sets a TWA limit for propylene glycol vapour at 50ppm and the ceiling limit at 250ppm. The DOW MSDS for propylene glycol is slightly less restrictive but in the same spirit as than these regulations. At 25°C, the saturation vapour density is 300 ppm. Vapours from heated glycol, aerosolized glycol, or stale containers need to be avoided to stay under the ceiling limit. The TWA limit would only be exceeded in the case where one works next to a very large glycol spill for an extended period without cleaning it up.

Limits, Regulations, and Definitions

The Ontario Occupational Health and Safety Act of 1990, [Regulation 833, Control of Exposure to Biological or Chemical Agents](#), sets limits on the exposure to hazardous chemicals in the workplace. Quoting Paragraph 4,

Without limiting the generality of section 3, every employer shall take the measures required by that section to limit the exposure of workers to a hazardous biological or chemical agent in accordance with the following rules:

1. If the agent is listed in the Ontario Table, exposure shall not exceed the TWA, STEL, or C set out in the Ontario Table.
2. If the agent is not listed in the Ontario Table but is listed in the ACGIH Table, exposure shall not exceed the TWA, STEL, or C set out in the ACGIH Table.
3. If the Table that applies under paragraph 1 or 2 sets out a TWA for an agent but sets out neither a STEL nor a C for that agent, *exposure shall not exceed the following excursion limits:*
 - i. Three times the TWA for any period of 30 minutes.
 - ii. Five times the TWA at any time.
4. Paragraph 3 does not apply with respect to an agent that is prescribed as a designated substance under Ontario Regulation 490/09 (Designated Substances) made under the Act. O. Reg. 491/09, s. 4.

The 3 and 5 times multiplication factors are taken directly from [ACGIH](#).

Excursion Limits. For many substances with a TLV–TWA, there is no TLV–STEL. Nevertheless, excursions above the TLV–TWA should be controlled, even where the 8-hour TLV–TWA is within recommended limits. Excursion limits apply to those TLV–TWAs that do not have TLV–STELs.

Excursions in worker exposure levels may exceed 3 times the TLV–TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed 5 times the TLV–TWA, provided that the TLV–TWA is not exceeded.

ACGIH also carefully defines the units used in its [Introduction to BEIs and TLVs](#) .

TLV Units TLVs for gases and vapors are established in terms of parts of vapor or gas per million parts of contaminated air *by volume* (ppm), but may also be expressed in mg/m³. [...] Where 24.45 = molar volume of air in liters at NTP conditions (25 C and 760 torr), the conversion equations for gases and vapors [ppm ↔ mg/m³] are as follows:

$$\text{TLV in ppm} = (\text{TLV in mg/m}^3) (24.45)$$

2.6 COUPP Vapour Exposure Hazard Analysis

Document

$$\text{OR}$$

$$\text{TLV in mg/m}^3 = \frac{\frac{(\text{gram molecular weight of substance})}{24.45} (\text{TLV in ppm})}{24.45}$$

Applicable Limits

Propylene Glycol is listed under Paragraph 9, the Ontario Table, of Regulation 833 with

1. a TWA of 50ppm or 155mg/m³ of vapour or aerosol,
2. or a TWA of 10mg/m³ of aerosol for assessing the visibility in a work environment where 1,2-propylene glycol aerosol is present.

As no aerosol is expected to be formed, the first limit is legally applicable.

The DOW MSDS for propylene glycol lists an aerosol exposure limit, but no vapour limit. The MSDS does requires one to avoid breathing vapours from heated propylene glycol, which is equivalent to setting a 300ppm ceiling limit as described below.

Hazard Assessment

Glycol handling activities include being near open glycol containers or glycol spills, and the opening of glycol containers. Glycol filling is a reasonably lengthy process for which the TWA should not be exceeded. Spill glycol cleanup and the opening of glycol containers are quick procedures to which the Ceiling Limit would apply.

From the Dow MSDS, at 25°C, the vapour pressure of propylene glycol is 0.3 mbar or 300ppm, 1.2 times the Ceiling Limit. The only time it would be possible to exceed this limit is when breathing unmixed air from a glycol container, or when working with glycol warmer than 25°C. With procedures to inform personnel not to breath stale glycol vapours or to handle glycol warmer than 25°C, there is no further need to mitigate short-term exposure to glycol vapours.

Exposure to glycol over several hours from an open container may be required. A conservative assumption for vapour concentration assuming rapid evaporation of glycol into a quarter-sphere downstream of the glycol surface gives an exposure of

$$\rho_{glycol} = 300\text{ppm} \frac{r_{surf}^2}{(r_{surf} + r_{work})^2}$$

At a working distance of $r_{work} = 45\text{cm}$ from the edge of the glycol surface, the TWA would be exceeded only when working next to a surface 186cm in radius. This large a surface would only be caused by a spill, and needs to be cleaned up in a short time such that the TWA over 8 hours would not be breached.