Occupational Health Clinics for Ontario Workers Inc.
Centres de santé des travailleurs (ses) de l'Ontario Inc.

1090 Don Mills Road, Suite 606
Toronto, ON M3C 3R6
Tel: (416) 510-8713
Fax: (613) 725-1719
ask@ohcow.on.ca
www.ohcow.on.ca

October 2, 2023

American Conference of Governmental Industrial Hygienists (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, Ohio 45240
Attention: Threshold Limit Values for Chemical Substances Committee

Re: Submission to the ACGIH TLV® and BEI® Committee

The Occupational Health Clinics for Ontario Workers Inc. (OHCOW) is a not-for-profit labour governed worker-based network with a team of dedicated health professionals committed to promoting the highest degree of physical, mental, and social well-being for workers and their communities. We strive to accomplish this through the identification of workplace factors which are detrimental to the health and well-being of workers; by empowering workplace parties to make positive occupational health changes in their workplaces. Our clients include workers, joint health and safety committees or representatives, unions, employers, health professionals, community groups, legal clinics, students, and members of the public.

At seven clinics in Ontario, Canada, an interdisciplinary team of client service coordinators, occupational health nurses, occupational hygienists, ergonomists, and contract physicians offer clinical and prevention services for both individual patient and larger cluster investigations providing an objective, evidence-based opinion on whether an illness or injury may be work-related, promote awareness of health safety issues, evaluate occupational exposures, and develop prevention strategies. OHCOW's unique experience, and vulnerable worker lens, provide a unique perspective on a full circle occupational illness/disease prevention approach (primary, secondary, and tertiary) and as such, continues to provide leadership to Ontario's Occupational Illness Prevention System Focus.

Please find attached our submission following your guidelines for: Metal Working Fluids (MWF).

Thank you for the opportunity on behalf of our team.

Sincerely,

Krista Thompson, MHSc, ROH, CRSP
Occupational Hygienist, OHCOW
kthompson@ohcow.on.ca

Comments regarding TLV and Recommendations

Comments must relate to perceived errors or omissions in the proposed TLV, BEI, or notations, or which provide new peer-reviewed information that was not included in the proposed TLV. Permission must be given for ACGIH to use any unpublished peer-reviewed materials sent for consideration. To ensure that your comments are directed to the appropriate committee, please use a separate form for each committee and substance you wish to address.

Instructions

Limit 10 pages, including references but excluding attached cited material.
Enumerate each recommendation requested as a separate item (more boxes may be added or removed).
Provide specific rationale for each recommendation as separate items directly below the action.
Include references and attach relevant cited material to substantiate rationale.
Any attached cited material must include a written authorization from the author or publisher to share the full-text material.
For full instructions, please visit Procedures for Commenting on TLVs and BEIs.

Date Submitted: October 2, 2023

Chemical Substance or Physical Agent: Metal Working Fluids (MWF)

Name of Group/Individual Submitting Comments: Occupational Health Clinics for Ontario Workers Inc. (OHCOW)
Authored by: Krista Thompson, M.H.Sc., ROH, CRSP
Reviewed by: John Oudyk, M.Sc., CIH, ROH

Contact Information

Address:

1090 Don Mills Road, Suite 606

Toronto, ON M3C 3R6 Canada

Telephone: 416-510-8713 Email: kthompson@ohcow.on.ca

Executive Summary *(limit 250 words):*

There is currently no TLV for metal working fluids (MWF).

There is a feasibility-based NIOSH (National Institute for Occupational Safety and Health) REL (Recommended Exposure Limit) of 0.4 mg/m^3 (thoracic) / 0.5 mg/m^3 (total) MWF based on 10 hours/day and/or 40 hours/week (NIOSH 1998a). NIOSH acknowledges health effects can occur below the REL for MWF (NIOSH 1998a, NIOSH 1998b).

There are TLVs for several common chemicals found in many MWFs, but not all; as a result, there are two outcomes. First, as not all MWFs have chemical components with TLVs, airborne monitoring for a chemical not in that specific MWF may lead to results being non-detectable. In reality, the chemical may not even be present in the MWF. Second, there is evidence that some industrial hygiene surveys are comparing MWF exposure to the feasibility-based NIOSH REL. It is likely not even realized that the NIOSH REL is not an evidence-based health exposure limit, though perhaps it is because there is no published evidence-based guideline outlining the level at which adverse health effects can occur. For these reasons, OHCOW is recommending a TLV for MWF.

A meta-analysis by Park (2019) forms the basis of this submission. Park's analysis for new-onset occupational asthma, hypersensitivity pneumonitis, and pulmonary function test losses indicates that there are adverse health effects occurring in 2–30 workers per 1,000 at 0.1 mg/m^3.

As such, this submission makes two recommendations:

1. Put MWF on the *Under Study List*.
2. Ultimately, implement a TLV-TWA of MWF of 0.10 mg/m^3.

Chemical Substance or Physical Agent: Metal Working Fluids (MWF)

Specific Recommendation

1. Put Metal Working Fluids (MWF) on the *Under Study List*.

2. Ultimately, implement a TLV-TWA for MWF of 0.10 mg/m^3.

Rationale

Introduction

From the ACGIH website: "TLVs and BEIs are health-based values established by committees that review existing published and peer-reviewed literature in various scientific disciplines" (ACGIH TLV/BEI Guidelines Overview). This submission will make the rationale that there is sufficient evidence for a health-based TLV for metal working fluids (MWF).

There is currently no TLV for MWF, though this has not always been the case. Currently, TLVs exist for some common, but not all, chemical components of MWF; such as ethanolamine, diethanolamine, and triethanolamine (ACGIH TLVs® and BEIs®, 2023). It is also noted that endotoxins were placed on the NIC (Notice of Intended Changes) in 2023. Endotoxins are an unintended exposure from some MWFs: uncontrolled or poorly controlled gram-negative bacteria in some types of MWF produce endotoxins, which can become airborne when MWFs are aerosolized. However, these aforementioned TLVs are not necessarily present in all MWF exposures.

There is a TLV for "mineral oil, excluding metal working fluids, pure, highly and severely refined" and a TLV for "mineral oil, excluding metal working fluids, poorly and mildly refined"; suggesting mixture-based TLVs have precedence. (Note that previously, ACGIH had a MWF TLV for oil mists, but it was withdrawn in 2008-2009 (Park, 2012)).

Finally, there are methods for monitoring MWF, including NMAM (NIOSH Manual of Analytical Methods) 5524. In unpublished results provided to OHCOW, it is noted that MWF is being monitored by industrial hygienists at the request of employers, with comparison made to the feasibility-based exposure levels on the assumption that it represented a health-based exposure level. A health-based TLV for MWF would provide trusted guidance to industrial hygienists with regards to evidence-based exposure levels; to encourage monitoring of MWF in cases where ethanolamine, diethanolamine, and triethanolamine levels are below TLVs or not present at detectable levels in the MWF - yet MWF exposure remains detectable and below the NIOSH REL.

There is a NIOSH (National Institute for Occupational Safety and Health) REL (Recommended Exposure Limit) of 0.4 mg/m^3 (thoracic) / 0.5 mg/m^3 (total) MWF based on 10 hours/day and/or 40 hours/week. This is the feasibility-based exposure level mentioned in the last paragraph: NIOSH reports the NIOSH REL is a feasibility-based limit (NIOSH 1998a); and NIOSH acknowledges that health effects can occur below the REL for MWF (NIOSH 1998a, NIOSH 1998b).

As previously mentioned, unpublished industrial hygiene surveys provided to OHCOW have compared MWF exposure to the NIOSH RELs. A TLV for MWF would provide a health-based, evidence-based guideline for comparisons among industrial hygienists who wish to ascertain the level that evidence indicates can cause adverse health effects. However, it is noted that published data indicates that many companies use an internal standard of 1.0 mg/m^3 (Cohen and White 2006).

MWF are coolants or lubricants used in machining processes. There are 4 classes of MWF (CCOHS 2019, Cohen and White 2006, Park 2012):

1. Straight oils, also called cutting oils or neat oils. Current straight oils are severely solvent refined or severely hydrotreated, but this was not always the case in the past, and unrefined straight oils led to hazardous health effects. The current oils in use may be petroleum (mineral), animal, marine, vegetable, or synthetic. Straight oils are not mixed with waters, whereas the next 3 classes of MWF are all intended to be mixed with some water.
2. Water-Soluble (emulsifiable) oils, which contain ~30-85% severely refined petroleum oils and emulsifiers to disperse the oil in water.
3. Semi-synthetic fluids, which contain ~5-30% severely refined petroleum oils, ~30-50% water, and a number of additives.
4. Synthetic fluids, which contain detergent-like components and other additives to wet the workpiece.

This submission will focus on two studies in particular identifying hazardous health effects in occupational exposures to MWF: a cross-sectional study published by Oudyk et al. (2003), and a systematic review published by Park (2019). Note that the study by Park (2019) cites the study by Oudyk et al. (2003), but the latter study is not included in the former study's meta-analysis due to different outcomes being measured.

Oudyk et al. (2003)

The study published by Oudyk et al. (2003) was a cross-sectional survey, which compared occupational exposures to reported symptoms using a questionnaire in an automotive machining facility. Area aerosol measurements were collected on a single day at all "I"-beams located every 20-40 feet. Three spot measurements were taken at each location for 20 seconds with the average measurement assigned to the location. Based on this information, the average departmental area aerosol concentrations were calculated using IHSTAT software. Average aerosol concentration in departments with MWF exposure ranged from 0.02–0.84 mg/m^3, with peak levels from 0.02–2.85 mg/m^3.

Two months after the area spots measurements were collected, all 2935 union-based employees were sent a questionnaire. The employees were divided into 63 distinct work units (departments), two of which did not have any MWF exposure. The questionnaire had three sections: work practices and exposures; health-related questions; past job changes. Work practices and exposures included: job title, department, line, or process; length of time in current job; length of time at plant. In addition, as many of the employees had previously worked at a nearby foundry that had since shut down, length of time at a foundry was also collected to eliminate any workers who had extensive work history and thus could have health effects from working there.

Health questions rated symptoms on a 5-point frequency scale (never, rarely, monthly, weekly, daily), and focused on respiratory symptoms. There was a telephone follow-up to those who did not respond to the survey by mail. Response rate was 81%. Symptom frequencies for symptoms reported as occurring daily or weekly were calculated.

Symptom frequencies' calculations were compared to MWF exposure levels' departmental averages. MWF, years in the plant, and smoking status, were regressed. Statistical analysis was performed using BMDP, with linear trend analyses performed using STATCALC in EPI-INFO for the relationship between MWF exposure and symptoms.

The highest tertile of exposures (0.25–0.84 mg/m^3) were statistically significantly associated with wheezing, chest tightness, sore throat, hoarse throat, and the upper respiratory symptom grouping (sore throat, hoarse throat, dry cough, sore or red eyes, runny or plugged nose, coughing up phlegm); when compared to the lowest tertile of exposures (0.02–0.09 mg/m^3). When peak exposure was included, it exerted a stronger effect than average exposure levels. These effects were independent of smoking status.

When using the lowest tertile exposures (0.02–0.09 mg/m^3) and never-smoker as the reference level, select results include:

- Wheezing middle-tertile exposure (0.10–0.19 mg/m^3): OR = 1.40, 95% CI 1.04-1.89;
- Wheezing highest-tertile exposure (0.25–0.84 mg/m^3): OR = 2.15, 95% CI 1.30-3.54;
- Chest tightness middle-tertile exposure (0.10–0.19 mg/m^3): OR = 1.17, 95% CI 0.86-1.59;
- Chest tightness highest-tertile exposure (0.25–0.84 mg/m^3): OR = 2.22, 95% CI 1.36-3.62.

The authors note that the results do not suggest a smoking-exposure interaction.

The authors note that this study added to the research suggesting MWF aerosol exposure is associated with upper and lower respiratory symptoms, and they include references to thirteen similar studies. What this study did that was novel was provide a health-based exposure level of an average exposure of 0.10 mg/m^3.

The authors acknowledge that personal sampling measurements were not taken, and their conclusions were based on average area measurements. For this reason, the exposure estimate is not as precise as it could have been. However, the decision to do area sampling was made based both on practicality and financial considerations, given the large size of the population being studied.

The authors also acknowledge that the monitoring did not identify which component of MWF was causing the health issues, such as endotoxin, biocide, or amines. However, they also note that these concerns are counterbalanced by the observation that a statistically significant exposure-symptom trend occurred for most of the symptoms evaluated, suggesting exposure measurements ranked health risks effectively in relation to symptom prevalence.

Park (2019)

Park performed a meta-analysis investigating risks of hypersensitivity pneumonitis (HP), new-onset occupational asthma (OA), and lower limit of normal (LLN) in pulmonary function testing (PFT) from MWF exposures. HP and new-onset OA were combined in the analysis. The meta-analysis searched for all literature through 2014 and found 13 published studies and 4 NIOSH Health Hazard Evaluations. Notably Park (2019) cited Oudyk et al. (2003) among the published data, but the data from Oudyk et al. was not included in the meta-analysis as the endpoints were not HP, new-onset OA, or LLN in PFT. From the available data, Park derived estimates of OA and HP for 28 groups of workers exposed to MWF. All cases of HP were assumed to be attributable to MWF due to being rare. For new-onset OA, the original investigators either determined MWF attribution based on interviews and history or based on comparison to a MWF-unexposed control group. There was additional analysis for pulmonary function test (PFT) losses.

The meta-analysis resulted in an excess lifetime risk of 30 per 1000 (3%) when MWF exposure was 0.10 mg/m^3. Tables in the study further quantify the excess risks for different exposures.

The meta-analysis demonstrates lifetime exposure at 0.10 mg/m^3 confirms a risk of adverse respiratory health effects, specifically OA/HP/PFT losses, ranging from 2–30 workers per 1,000 (Park, 2019).

Conclusions

The two specific actions recommended by OHCOW are:

1. Put Metal Working Fluids (MWF) on the *Under Study List*.
2. Ultimately, implement a TLV-TWA for MWF of 0.10 mg/m^3.

In other words, OHCOW recommends a health-based TLV-TWA for MWF of 0.10 mg/m^3 be adopted in the future.

Thank you for the opportunity to submit this document.

Disclosure

1. John Oudyk (the lead author of Oudyk et al., 2003) is an employee of OHCOW. Mr. Oudyk was one of the reviewers of this submission.

References *(specify if any are attached with permission to use):*

American Conference of Governmental Industrial Hygienists (ACGIH). TLVs® and BEIs®: Based on the Documentation of the Threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati (OH): ACGIH; 2023.

Canadian Centre for Occupational Health & Safety (CCOHS). Metalworking Fluids. Last updated 2019: https://www.ccohs.ca/oshanswers/chemicals/metalworking_fluids.html

Cohen H, White EM. Metalworking fluid mist occupational exposure limits: a discussion of alternative methods. J Occup Environ Hyg. 2006 Sep;3(9):501-7. https://pubmed.ncbi.nlm.nih.gov/16857649/

National Institute for Occupational Safety and Health (NIOSH). Criteria for a Recommended Standard: Occupational Exposure to Metalworking Fluids. DHEW (NIOSH) Publication No. 98-102. 1998a: https://www.cdc.gov/niosh/docs/98-102/pdfs/98-102.pdf

National Institute for Occupational Safety and Health (NIOSH). What You Need to Know about Occupational Exposure to Metalworking Fluids. DHHS (NIOSH) Publication 98-116. 1998b: https://www.cdc.gov/niosh/docs/98-116/pdfs/98-116.pdf

Oudyk J, Haines AT, D'Arcy J. Investigating respiratory responses to metalworking fluid exposure. Appl Occup Environ Hyg. 2003 Nov;18(11):939-46. https://pubmed.ncbi.nlm.nih.gov/14555447/

Park D. The occupational exposure limit for fluid aerosol generated in metalworking operations: limitations and recommendations. Saf Health Work. 2012 Mar;3(1):1-10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3430924/

Park RM. Risk Assessment for Metalworking Fluids and Respiratory Outcomes. Saf Health Work. 2019 Dec;10(4):428-436. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6933250/