SILICA

Crystalline silica is one of the most common minerals on earth, naturally found in soil, sand, and rocks. Quartz is the most prevalent form and along with cristobalite (1). While silica is present in industries such as smelting and refining and glass manufacturing, exposure can occur in a variety of settings, from mines to dental offices (1).

Health Effects

Crystalline silica is carcinogenic to humans according to IARC (Group 1) (2). In addition to lung cancer, crystalline silica causes silicosis and chronic obstructive pulmonary disease.

Worker Exposure

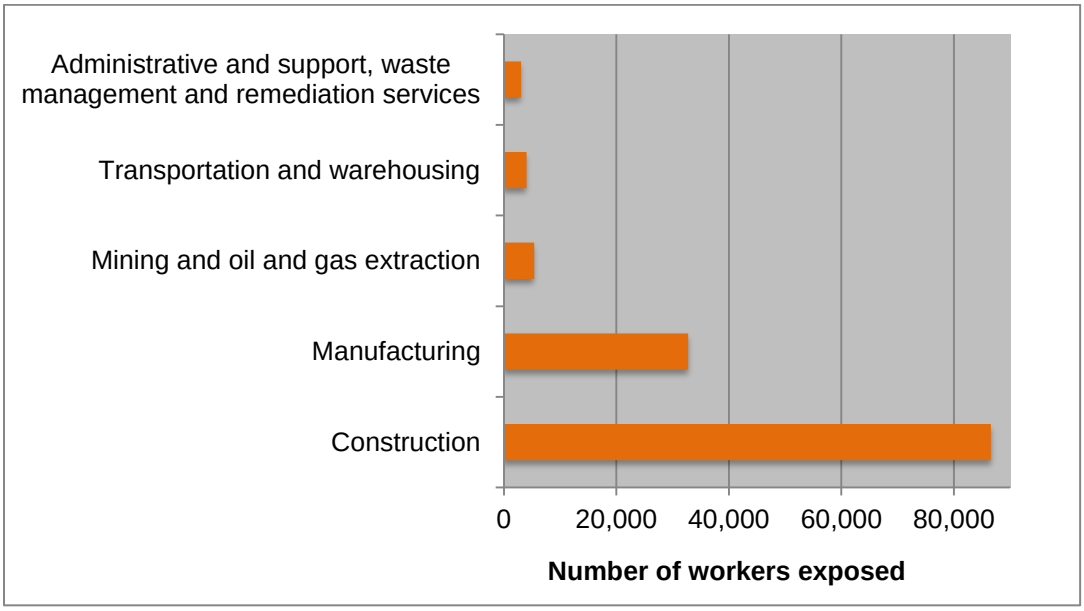

Figure 1: Workers exposed to silica in Ontario, by industry

CAREX Canada estimates that approximately 140,000 workers are exposed to this substance in Ontario; most employed in the construction or manufacturing industries (Figure 1) (3). The construction and manufacturing industries also have the greatest numbers of workers in the high exposure category (3).

Limits

The following limits are for the respirable fraction, referring the inhaled particles that can reach deep into the lungs, and are measured in milligrams per cubic meter (mg/m^3). For two forms of crystalline silica, cristobalite and quartz, the Ontario 8-hour OELs are 2 and 4 times the ACGIH value, respectively. A number of other provinces have adopted the ACGIH's recommendations. All exposure limits are expressed in terms of respirable dust.

	8 hour OEL (mg/m^3)
ON: Cristobalite	0.05
Quartz & Tripoli	0.1
ACGIH: Cristobalite and Quartz	0.025
MB, NL, PE, BC, NS, AB: Crystalline silica	0.025
NB: Crystalline silica	0.1
SK: Cristobalite	0.05
Quartz & Tripoli	0.1
QC: Cristobalite & Tridymite	0.05
Quartz & Tripoli	0.1

Ontario's current limits for quartz and cristobalite represent values proposed by ACGIH in the 1980s, before a reduction to 0.025 mg/m^3 in 2005 (4). There is an immediate need to change the province's OELs for both quartz and cristobalite, considering the large number of those exposed and the number of health consequences.

Recommendation

Ontario's OELs for all forms of crystalline silica should be lowered to 0.025 mg/m^3 (respirable), to reduce the risk of occupational cancer and silicosis.

WOOD DUST

Wood dust is generated by the processing of wood in the natural resource industries, in sawmills and other wood processing facilities, in the manufacture of wood products, and in the construction and maintenance of buildings. Wood dust from different tree species are broadly classified into two groups: hardwood and softwood (5).

Health Effects

Wood dust is a human carcinogen according to IARC (Group 1), a prominent risk factor for sinonasal cancer (2). However, wood dust can also cause other respiratory health effects, such as chronic obstructive lung disease and asthma. In particular, Western red cedar (found on the West Coast) is a potent allergen and a cause of occupational asthma (5). Eastern white cedar, found throughout Ontario, has also been linked to occupational asthma (6,7)

Worker Exposure

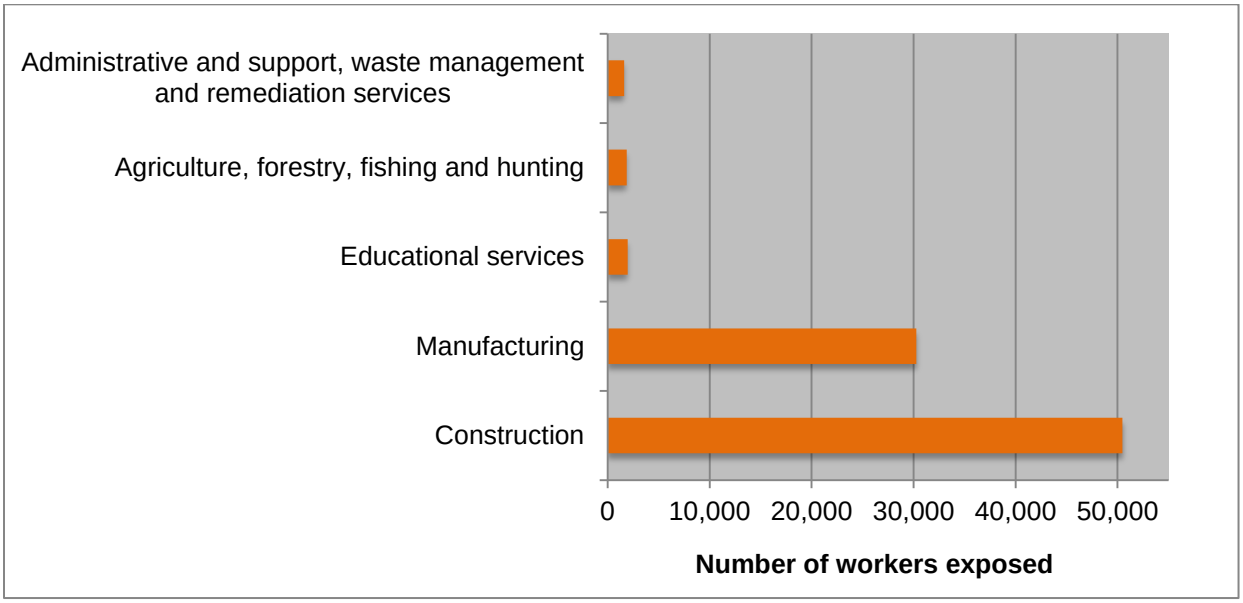

Figure 2: Workers exposed to wood dust in Ontario, by industry

According to CAREX Canada estimates, approximately 92,000 workers are exposed to wood dust in Ontario, mainly from work in construction and in the manufacturing of wood products (Figure 2) (3). The construction and manufacturing industries have the greatest numbers of workers that fall into the high exposure category.

Limits

The ACGIH limits here pertain to inhalable dust, particles that get trapped in the throat, nose, and upper respiratory region when inhaled (4). Ontario has 8-hour and 15-minute limits for wood dust, but no mention of what fraction of dust is being collected. While the Ontario OEL for softwood appears to be five times the ACGIH recommendation (for species other than Western red cedar), the actual ratio could be much higher is the dust is collected using old methods. Most provinces also have a specific limit for Western red cedar, in line with the ACGIH recommendation.

	OEL (mg/m^3)
ON: Softwood	5.0 (8-hour)* 10.0 (15-min)*
Certain Hardwood	1.0 (8-hour)*
ACGIH: Western red cedar	0.5 (8-hour)**
All other wood species	1.0 (8-hour)**
MB, NL, PE, NS: Western red cedar	0.5 (8-hour)**
All other wood species	1 (8-hour)**
BC: Softwood	2.5 (8-hour)
Allergenic or hardwood species	1 (8-hour)
AB: Western red cedar	0.5 (8-hour)
All other wood species	5 (8-hour)
SK* Softwood**	5 (8-hour) 10 (15-min)
Hardwood	1(8-hour) 3 (15-min)
QC Western red cedar	2.5 (8-hour)****
All other wood species	5 (8-hour)****
NB: Softwood	5.0 (8-hour) 10.0 (15-min)
Certain Hardwood	1.0 (8-hour)

***There is no specification of the collected fraction of dust in ON**
****ACGIH and these provinces have OELs for inhalable dust**
*****SK has noted wood dust as a potential sensitization agent**
******The Quebec OELs are for total dust**

The current wood dust OELs in Ontario are equal to those developed by ACGIH in 1981 (4). Adverse health effects can occur amongst workers exposed at levels that are much lower than the present Ontario limits (4).

Recommendation

Ontario should reduce limits for both softwood and hardwood dusts to 1 mg/m^3 (of inhalable dust) to reduce the risk of respiratory disease and cancer and implement a lower limit of 0.5 mg/m^3 (of inhalable dust) for Western red cedar and other allergenic species. If the 8-hour OEL is lowered to 1 mg/m^3, the ceiling could be eliminated.

FORMALDEHYDE

Formaldehyde is a flammable and colourless gas with a strong odour. Formaldehyde is used in chemical production and as a disinfectant in hospitals, nursing homes and funeral homes (8). Painters who apply paint with spray nozzles can also be exposed (8).

Health Effects

Formaldehyde is a known cancer-causing agent (IARC Group 1 carcinogen) that can cause nasopharyngeal cancer and leukemia (9). It is also an eye and respiratory irritant, as well as an allergen and can result in contact dermatitis.

Worker Exposure

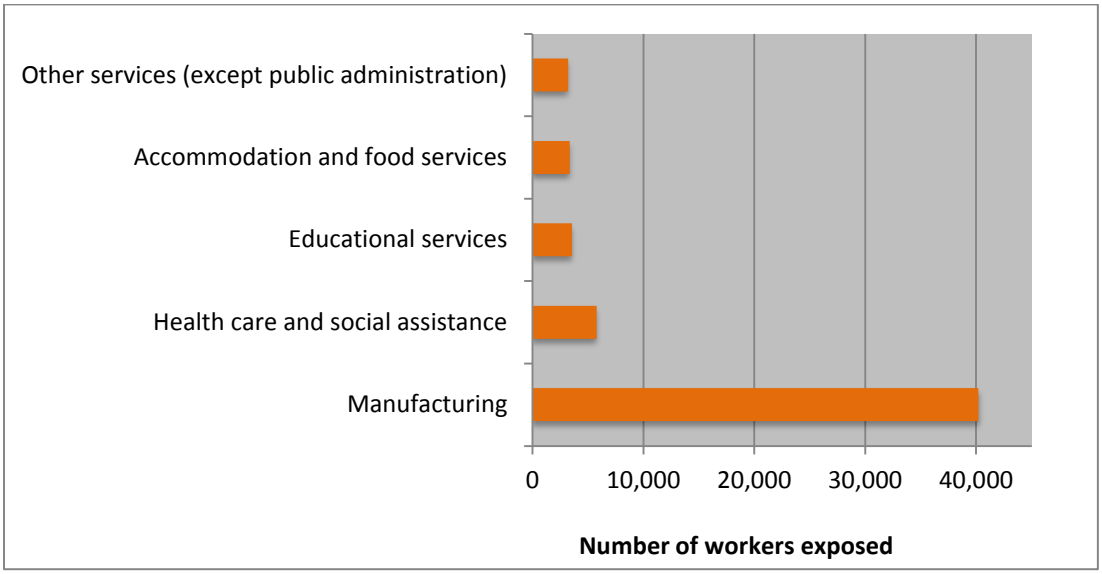

Figure 3: Workers exposed to formaldehyde in Ontario, by industry

According to CAREX Canada estimates, approximately 63,000 workers are exposed to this substance in Ontario, mostly employed in the manufacturing sector (Figure 3) (3). The construction, manufacturing and retail trade sectors have the greatest numbers of workers that fall into the high exposure category.

Limits

Ontario currently has two types of OELs for formaldehyde, a short term exposure limit, and a ceiling limit (a maximum level of exposure a worker should be exposed at any time), both of which are above the ACGIH ceiling limit (4). The current ACGIH limit for formaldehyde is 0.3 parts per million (ppm) and is a ceiling value. Most provinces have followed the ACGIH ceiling value recommendation.

	OEL (ppm)
ON: Formaldehyde	1.0 (15-min) 1.5 (Ceiling)
ACGIH*	0.3 (Ceiling)
MB, NL, PE, NS, NB	0.3 (Ceiling)
SK*	0.3 (Ceiling)
BC*	0.3 (8-hour) 1 (Ceiling)
AB	0.75 (8-hour) 1 (Ceiling)
QC	2 (Ceiling)

*Noted as a potential sensitization agent in these regions

Ontario's ceiling limit is the value developed by the ACGIH in the 1970s to early 1980s (4). The ACGIH recommended a ceiling limit of 0.3 ppm in 1992 because of the potential of formaldehyde to cause eye and upper respiratory tract irritation, even at very brief exposure to low levels (4).

Recommendation

Ontario should lower its ceiling limit for formaldehyde to 0.3 ppm to prevent eye and respiratory irritation. If the ceiling is lowered, the 15 minute OEL should also be substantially lowered, but could also be eliminated.

REFRACTORY CERAMIC FIBRES

Refractory ceramic fibres are a type of synthetic (man-made) fibres used in high-temperature applications, such as linings of catalytic converters and kilns, because of their insulating qualities (10).

Health Effects

This substance is considered a possible cancer causing agent for humans, classified as an IARC group 2B carcinogen (11). Other possible health effects include respiratory irritation and contact dermatitis (11). This substance has also been linked to decreased respiratory capacities in exposed workers (12).

Worker Exposure

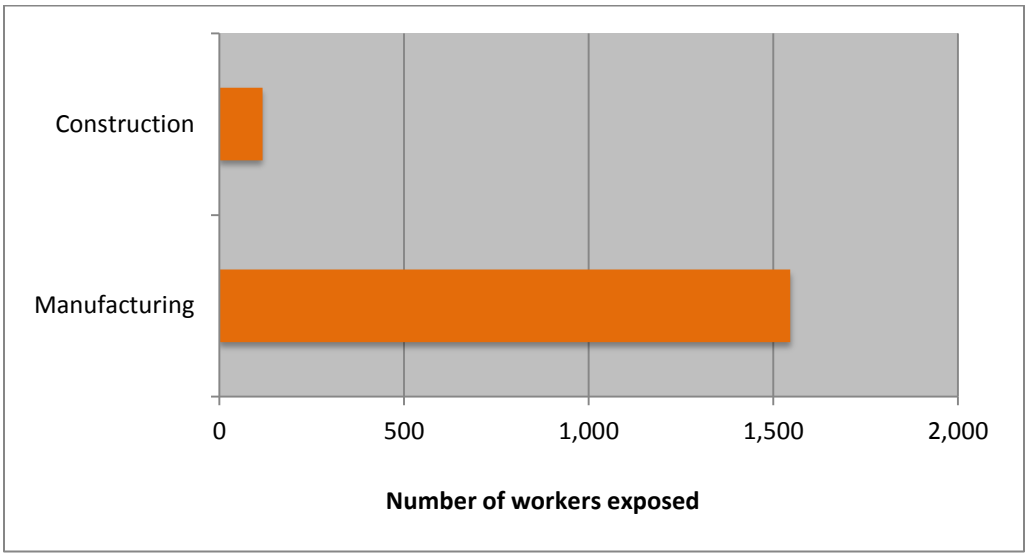

Figure 4: Workers exposed to refractory ceramic fibres in Ontario, by industry

According to CAREX Canada estimates, approximately 1500 workers are exposed to this substance in Ontario with the majority employed in the manufacturing industry (Figure 4) (3).

Limits

The current Ontario OEL of 0.5 f/cc (measured in fibres per cubic centimeter, f/cc) is more than double the ACGIH value of 0.2 f/cc. Most provinces have followed the ACGIH recommendation.

	8-hour OEL (f/cc)
ON	0.5
ACGIH	0.2
BC, AB, SK*, MB, NB, NL, PE, NS	0.2
QC	1

*This is a designated substance in SK

It is likely that Ontario's OEL is derived from the ACGIH value proposed in 1996 (4). Since then, a 2011 Scientific Committee on Occupational Exposure Limits (SCOEL) report highlighted research on the adverse respiratory effects of exposed workers (12). The Ministry of Labour should also be aware that IARC periodically updates carcinogen classifications, and an update to the classification of this substance may result in an upgrade to a more carcinogenic category.

Recommendation

Ontario should lower its OEL for refractory ceramic fibres to 0.2 f/cc to protect against adverse respiratory effects.

DIESEL ENGINE EXHAUST

Diesel engine exhaust is a complex mixture of gases and other particulate matter resulting from the combustion of diesel fuel in engines (13). Some of the gases in diesel engine exhaust include carbon dioxide, water vapour, oxygen, and nitrogen compounds (13).

Diesel particulate matter is made up of elemental carbon, organic compounds (including polycyclic aromatic hydrocarbons, or PAHs), metals, and other substances present in smaller amounts (13). The particulate is very small, and nearly all of the particulate is respirable (13).

Health Effects

Diesel engine exhaust can have an intense odour with short term effects including nasal and eye irritation (14). In 1989 IARC classified diesel engine exhaust as a "probable" human carcinogen (Group 2A) (15). In 2012, IARC re-evaluated the carcinogenicity of diesel engine exhaust and classified it as a "known" human carcinogen (Group 1) (15).

Worker Exposure

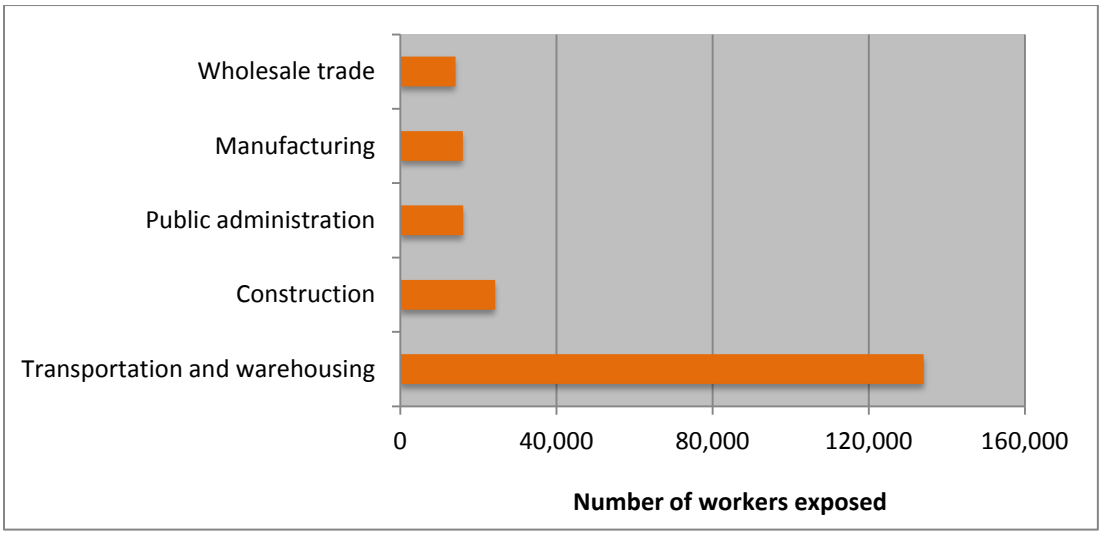

Figure 5: Workers exposed to diesel engine exhaust in Ontario, by industry

Diesel engine exhaust is a significant cause for concern for Ontario workers. CAREX Canada estimates that approximately 260,000 workers are exposed in Ontario, most of whom are employed in the transportation industry (Figure 5) (3).

Limits

Exposure to diesel engine exhaust is measured through individual markers. Currently, these markers include total carbon and elemental carbon (16). Research on diesel exhaust and health outcomes primarily uses elemental carbon as a marker of diesel engine exhaust (17). We would suggest that when the Ministry proposes a diesel engine exhaust limit, they also use elemental carbon as the measured marker of diesel engine exhaust.

While there is no diesel OEL in Ontario, in Regulation 833 (Control Of Exposure to Biological or Chemical Agents), there is mention of diesel particulate matter in section 183.1 of Regulation 854 (Mines and Mining Plants). In section 183.1, the regulation addresses ventilation for underground mines where diesel equipment is operating. According to this section the maximum acceptable exposure is 400 $\mu g/m^3$ measured as total carbon (approximately 307 $\mu g/m^3$ elemental carbon).

Standards have been developed in other jurisdictions and include:

- United States Mine Safety and Health Administration: 160 $\mu g/m^3$ (total carbon)
- Australian Institute of Occupational Hygienists: 100 $\mu g/m^3$ (elemental carbon)
- Finnish Institute of Occupational Health: 5 $\mu g/m^3$ for general workplaces and 20 $\mu g/m^3$ as an underground mining-specific target level (both based on elemental carbon)

The Finnish recommended OEL comes closest to representing the current state of knowledge regarding the health effects of diesel engine exhaust. Recent research suggests that at an average elemental carbon exposure over a working lifetime of 25 $\mu g/m^3$–years would result in 689 excess deaths (per 10,000 exposed workers) due to lung cancer (17). Importantly, a cancer risk can still persist even at exposure levels below 20 $\mu g/m^3$.

Recommendation

Ontario should develop a new OEL for diesel engine exhaust to reduce exposure and reduce the risk of lung cancer. We would recommend the target level of 20 $\mu g/m^3$ put forth by the Finnish Institute of Occupational Health for mining, with a target of 5 $\mu g/m^3$ for other workplaces, both to be measured as elemental carbon.

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