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CREMATORIA AND AIR QUALITY
FACT SHEET

In Canada, preference for cremation is increasing. The Cremation Association of North America (CANA) estimates that about 80% of human remains in Canada will be cremated by 2020. The increased demand for cremation services may result in construction of new crematoria or expansion of existing facilities. This could lead to a rise in inquiries about potential health risks to nearby communities. This fact sheet outlines the key facts about potential exposure to emissions from crematoria, and controls for reducing risks. Communication with the public about potential impacts and risk reduction strategies early in the development process can help to address concerns, and inform appropriate siting, operational controls and monitoring.

Types of emissions

- **Combustion gases:** carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and volatile organic compounds (VOC)
- **Particulate matter and fine dust:** PM_{10} and $PM_{2.5}$
- **Organic pollutants:** polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) and polycyclic aromatic hydrocarbons (PAH) and others resulting from incomplete combustion or formed when organic compounds react with chlorine in materials such as plastics
- **Heavy metals:** Mercury (Hg) arising from volatilization of Hg in dental amalgam in fillings and trace amounts of metals in tissues of the individual, or items in the casket
- **Radioactive substances:** arising from cremation of deceased patients treated with radioactive substances (e.g., cancer treatments)

Levels of emissions

- Crematoria are usually considered small-scale installations with relatively low total emissions compared to other types of incineration facilities such as municipal waste incinerators or industrial processes.
- Crematoria contribute approximately 5% of total PCDD/Fs, 6% of total Hg emissions and 0.25% of $PM_{2.5}$ emissions in Canada.

The pollutants of most concern are PCDD/Fs, Hg and fine particulate matter ($PM_{2.5}$). PCDD/Fs and Hg are known to be toxic to humans and can bioaccumulate in tissues. PCDD/Fs are classified as possible human carcinogens and Hg is a neurotoxin. Exposure to $PM_{2.5}$, which can reach deep into the lungs, can increase the risks of heart disease, lung cancer, asthma and adverse birth outcomes, and exacerbate other conditions such as diabetes. Care should be taken to limit exposure, particularly for vulnerable populations such as babies, children, pregnant women, and the elderly.

While these substances have been associated with a range of adverse health effects, no studies have been found that show causal links between crematoria emissions and adverse health effects. The absence of emissions data for crematoria and ambient air quality monitoring in the vicinity of installations limits the ability to fully assess exposures and health impacts. A precautionary approach could be adopted that includes following best practice recommendations for siting, design, operation, monitoring and maintenance of crematoria.

Table 1: Factors affecting the type and level of emissions from crematoria

The composition of the casket and remains	• The size of the corpse and number of cremations • The presence of dental amalgam fillings containing Hg • Plastics or polystyrene parts in the funeral casket or personal/memorial items (forming organic pollutants) • Burial caskets coated in insecticides or preservatives • The presence of radioactive substances within the remains
The design of the system	• The presence of two combustion chambers allowing for high temperature treatment of gases and particulate • Chimney height affects the distribution and dilution of emissions into the atmosphere and dispersion at ground level • Age of equipment; older equipment is less likely to have modern process controls and monitors, and is also more prone to failure
Operational parameters of the cremator	• Temperature at start-up and in the second chamber • Residence time for gases in the second chamber • O_2 available for combustion • Good operation and maintenance practices • Use of process controls and continuous monitoring
Emissions control measures	• Source control (restrictions on what is incinerated) • Presence of flue gas treatment, acid neutralization, activated carbon adsorption, dust collection or specific emissions control measures such as Hg-abatement equipment, scrubbers and technologies that bind or precipitate Hg

Standard practice for siting of crematorium in proximity to residential areas

Every site is unique with the type and levels of emissions affected by factors listed in Table 1 and local dispersion of air pollutants affected by prevailing wind direction and topography. There is no standard practice for setback distances between crematoria and residential areas in Canada but many regional and local permitting and zoning practices set out where crematoria are permitted or prohibited along with other specifications. For example, crematoria may be permitted in conjunction with a cemetery or in specified zones (Industrial) with minimum separation distances required between crematoria and sensitive receptors such as schools, daycares, libraries, or care facilities (e.g., 20-70m). Appropriate setback requirements may also take into account air dispersion modelling on a case-by-case basis.

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Key Recommendations

The Secretariat of the Stockholm Convention on Persistent Organic Pollutants has published best practice guidelines for crematoria, which align with recommendations cited throughout the literature. Table 2 lists the effectiveness of various control measures. The key recommendations include:

- Minimum furnace temperature (850 °C), residence time in the second chamber (2 s) and enough air (e.g., 6% O_2 by volume) to ensure efficient combustion;
- Suitable air pollution control equipment (e.g., temperature controls, dust control, carbon injection, fabric filtration, air tightness of cremators;
- Monitoring of gas temperature and flue gas O_2 and CO concentrations; use of relevant emission limit values and additional monitoring including ambient monitoring of soil and air in the proximity of crematoria;
- Avoidance of use of PVC, metals and chlorinated compounds in coffins and fittings;
- Operational controls, inspection and preventive maintenance.

Table 2. Effectiveness of various control measures on reducing pollutant release from crematoria*

	PCDD/Fs	Hg	$PM_{2.5}$	Radio-activity
Source control				
Removal of plastics, etc.	✓		✓	
Non-toxic and eco-friendly coatings or materials in caskets	✓			
Removal of Hg fillings		✓		
Removal of medical devices containing radioactive substances				✓
Operational controls				
Minimum 850°C (2nd chamber)	✓		✓	
Minimum residence time of 2 s (2nd chamber)	✓		✓	
Adequate O_2 in combustion chamber	✓		✓	
Monitoring CO releases	✓		✓	
Air tightness of combustion chambers and casings	✓	✓	✓	✓
Maintenance and inspection	✓	✓	✓	✓
Operator training	✓	✓	✓	✓
Emissions controls				
Dust control (filters and scrubbers)	✓		✓	
Activated carbon treatment	✓	✓		
Hg removal technology (binding, precipitation etc.)		✓		
Adequate chimney height	General dispersion and dilution of pollutants higher into atmosphere			

✓ indicates the measure can help reduce emissions
***See page 1 for description of pollutants**

This fact sheet presents the key messages from a field inquiry titled "Crematoria emissions and air quality impacts".
The full document and references can be found at: http://www.ncceh.ca/documents/field-inquiry/crematoria-emissions-and-air-quality-impacts

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