Environment and Climate Change Canada
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RELEASES OF LEAD FROM CONSTRUCTION SHEETING USED IN THE CANADIAN BUILDING INDUSTRY

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Canada

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Purpose

The purpose of this document is to present findings and conclusions on Environment and Climate Change Canada's commitment to study lead construction sheeting in the Canadian building industry as identified in the Risk Management Strategy for Lead published in 2013.

Environmental and health effects associated with lead

Lead is a naturally-occurring element found in rock and soil, yet widespread anthropogenic use has resulted in an increase of exposure to Canadians. Lead is a highly toxic metal found in air, soil and water, as well as in food, drinking water and some products including lead construction sheeting. It is listed on the List of Toxic Substances of the Canadian Environmental Protection Act, 1999 (CEPA 1999) and is currently subject to numerous federal, provincial, territorial and industrial regulatory and non-regulatory initiatives.

Human health risk associated with lead include adverse developmental, neurodevelopmental, neurodegenerative, cardiovascular, renal and reproductive effects. Known environmental hazards include toxicity to birds, fish, crustaceans, benthic invertebrates as well as plants and earthworms. An assessment of the most current scientific information was undertaken by Health Canada and published as the Final Human Health State of the Science Report on Lead, in February 2013. This report determined that although lead levels in blood have declined significantly over the last 30 years, lead is still widely detected in Canadians and the health effects are observed at levels below the current Canadian blood intervention level of 10 micrograms/deciliter.

Risk management strategy for lead

In February 2013, the Government of Canada published the Risk Management Strategy for Lead, which outlined the current and planned control actions for lead. Under this strategy, the Government of Canada committed to investigate releases of lead in order to determine the key areas where exposure could be further reduced to the greatest extent possible.

One of the priority areas identified for assessment is the release of lead from construction sheeting in the Canadian building industry.

Overview of the lead construction sheeting industry in Canada

Lead is one of the most malleable metals used for construction products. It can easily be shaped, formed, bent and cut to suit all applications including a variety of structures such as walls, floors, doors, window frames and cabinetry. Lead is also very resistant to corrosion (e.g., atmosphere, salt water, and most industrial chemicals) and is an effective waterproof and sound barrier. Lead sheets are usually sold by weight and are available as rolls or sheets[1].

In Canada, lead sheets are mainly used for radiation protection and to a lesser extent in building applications such as flashing, cladding and roofing. The three Canadian lead sheet manufacturers produced approximately 738 tonnes of lead sheets in 2011, mostly for the domestic market.

[1] Natural Resources Canada. (2009). Canadian Mineral yearbook. 2009.

There were also approximately 124 tonnes (i.e., 14% of the total demand) of lead sheets imported into Canada.[2]

Radiation protection

Lead remains the most effective material that meets the conditions and specifications set out in various construction and safety codes for radiation protection. Its high density and high mass attenuation coefficient make lead sheets the most common material used for radiation shielding applications including: [3]

- facilities with X-ray machines (e.g., hospitals doctor and dentist offices);
- nuclear, industrial and research facilities;
- security scanners; and
- low-level nuclear waste storages.

It estimated that the Canadian demand for new lead constructions sheeting in radiation protection applications is about 574 tonnes per year. These applications are necessary to protect Canadians from radiation exposure. The total stock in use for this application was about 17,480 tonnes in 2011. The Government of Canada has developed safety codes and guidelines for installing, operating and dismantling X-ray equipment and addresses lead sheeting. For more information: http://www.hc-sc.gc.ca/ewh-semt/radiation/clini/xray/index-eng.php.

Alternatives to lead radiation protection

Alternatives to lead sheets and other lead products (e.g., lead bricks, lead glass, lead acrylic) which are used for radiation shielding may include various bricks, glass, acrylic, concrete blocks, barium plaster, gypsum wallboard, steel and wood materials. However, these alternatives are determined to be less effective and provide inconsistent levels of protection. The choice of material used depends on the level of shielding required and whether it is practical to install it. Certain alternatives such as bricks and concrete have internal voids which reduce their effectiveness. In general, alternatives require more material to obtain the equivalent shielding protection compared to lead sheets, which would likely result in additional costs (see table below).

Table 1: Lead sheet equivalent thickness for alternative materials used in radiation protection

Lead thickness (mm)	Steel (mm)	Barium plaster (mm)	Concrete (2350 kg/m^3) (mm)	Plate glass (mm)	Brick (Oxford clay, 1650 kg/m3) (mm)	Gypsum (mm)	Wood (mm)
2	15	21	181	191	228	491	1454
3	23	31	278	279	332	717	2024
4	31	41	375	367	435	943	2592

Source: Based on Radiological Protection Institue of Ireland (RPII). The Design of Diagnostic Medical Facilities where Ionising Radiation is used. A Code of Practice issued by RPII in June 2009

[2] Environment Canada. (2013a). Background Study and Use Pattern for Lead Sheeting used in Construction in Canada. Final Report. ToxEcology Environmental Consulting Ltd

[3] Lead Industry Association Ltd. (undated). Fabricated Products Subcommittee of Lead Industry Association Ltd. 292 Madison Avenue, New York, NY 10017

Flashing, roofing and cladding

Historically, lead sheets were widely used for building flashing, cladding and roofing and continues to be used on heritage buildings (e.g., some churches). These uses are much less common in Canada compared to Europe. In Canada, about 26% of lead construction sheeting is used in flashing, cladding and roofing) compared to 90% in Europe. This is mainly due to differences in architectural style, climatic conditions and traditional use. [4]

Alternatives to lead flashing, roofing and cladding

Many alternatives to flashing roofing and cladding are already widely used in Canada including:

- metals (e.g., aluminum, steel, copper)
- polymers (e.g., ethylene propylene diene monomer (EPDM), thermoplastic elastomer, polyolefin, polyvinyl chloride (PVC) and polyisobutylene)
- modified bitumen membranes (e.g., aluminum-reinforced styrene ethylene/butylenes styrene and atactic polypropylene)
- fibre composites (e.g., glass reinforced polyester) and
- other traditional materials (e.g., asphalt shingles, cedar, slate, concrete tiles, clay roofing tiles).

The choice of material depends on the budget, desired performance, climate, design choices, aesthetics, building codes and structural requirements. Metal materials are very durable, long lasting and are highly recyclable. On the other hand, non-metal materials can be cheaper to install but have a shorter lifespan, lower scrap value and require more effort and time to recycle.

Other lead sheeting applications

Lead sheeting can also be used in chemical industry applications for corrosion-resistant gaskets and lead-lined tanks, for soundproof barriers in home theatres, studios and isolation equipment to limit mechanical vibration, and in plumbing applications (e.g., lead stacks, caps and stubs). [5] However, the demands for these other applications are marginal in Canada.

Lead releases and human exposure from construction sheeting material

Environmental releases

Releases to the environment can occur throughout the entire lifecycle of lead sheeting products but are generally associated with leaching during use and disposal when recycled after a building is demolished.

Fortunately, most lead sheets used in Canada are encased in interior building walls for radiation protection and sound proofing application, therefore, remain there for the life of the building.

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[4] Environment Canada. (2013a). Background Study and Use Pattern for Lead Sheeting used in Construction in Canada. Final Report. ToxEcology Environmental Consulting Ltd.

[5] Lead Industry Association Ltd. (undated). Fabricated Products Subcommittee of Lead Industry Association Ltd. 292 Madison Avenue, New York, NY 10017.

Since the lead sheeting is not exposed to the elements, lead is not released into the environment when used this way.

Conversely, lead used in flashing, roofing and cladding applications can slowly leach out of the sheeting when exposed to the elements. In 2011, it is estimated that about 5 grams per square meter per year (g/m^2/year) (or approximately 0.5 tonnes/year) was released in Canada during the service life of these applications.[6]

Due to the high market value of lead, lead sheets are normally recovered when renovating or demolishing buildings. In 2011, approximately 766 tonnes of lead sheeting was sent to secondary smelters for recycling.[7] Since 1991, this source of release has been controlled under the Secondary Lead Smelter Release Regulations. They limit the concentration of particulate matter containing lead emitted into the ambient air from defined sources within secondary lead smelting facilities.

Since lead can be found in a wide range of products, other lead products may be disposed of in landfills. Based on landfill monitoring data 2013, it is estimated that less than 0.360 tonnes of lead per year is released to surface water from landfills in Canada. It is impossible to differentiate between lead sheeting and other lead products that may contribute to the landfill leachate.[8]

Human exposure

Lead exposure from construction sheeting primarily occurs during the installation, recovery and disposal of the sheeting products. Exposure may also occur under certain conditions when it is used for balconies and verandas because oxidation can result in lead oxides and carbonates to be physically transferred upon contact. However, installed lead sheets used in flashing, cladding and roofing are not expected to be associated with frequent or sustained human contact. Exposure to lead may also occur during regular maintenance and repair work on buildings that contain lead sheeting products, or from rainwater runoff when lead sheeting products are used for architectural purposes.[9]

Existing risk management controls

Canada

There are no federal regulations restricting the use of lead sheeting in Canada. However, a number of building standards and codes promote its use due to its physical and chemical properties which meet the conditions and specifications set out in construction and safety codes (such as corrosion resistant, density, shielding protection and attenuation coefficient).

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[6] Environment Canada. (2013a). Background Study and Use Pattern for Lead Sheeting used in Construction in Canada. Final Report. ToxEcology Environmental Consulting Ltd.
[7] Ibid.
[8] Environment Canada. (2013b). Landfill Monitoring Data - Correlation, Trends, and Perspectives. Conestoga-Rovers & Associates,
[9] National Building Code of Canada. (2015). Volume 1. Issued by theCanadian Commission on Building and Fire Codes. National Research Council Canada, 2015.

- The National Building Code of Canada provides guidelines on the types of materials suitable for flashings and their recommended thickness. Recommended materials include lead, galvanized steel, copper, zinc and aluminum metals as well as polyethylene.

- The Canadian Nuclear Safety Commission's GD-52: Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms specifies the requirement for appropriate shielding in its design guide for nuclear substance laboratories and nuclear medicine rooms which are typically shielded using lead sheeting from 0.8 mm to 3.2 mm in thickness.

Through the ongoing work of the Canadian Council for Ministers of the Environment (CCME), federal, provincial and territorial governments have indicated their intentions in addressing construction and demolition materials to support efforts to enhance resource recovery and foster environmentally sound management. This includes lead-containing products. Specifically, in 2009, under the CCME Canada-wide Action Plan for Extended Producer Responsibility (EPR), jurisdictions committed to working towards incorporating certain construction and demolition materials into operational EPR programs by 2017. The CCME is also exploring a vision and strategy to support continued work on waste, which is anticipated to include linkages to the management of construction, and demolition waste.

International

The European Lead Sheet Industry Association has developed an industry code of practice to manage lead sheets installed as a building or construction product to limit where individuals may come into physical contact with lead such as balconies, rain water/soak-aways, and lead sheet fitted at low levels.

The International Green Construction Code has provisions that prohibit the use of various materials including lead flashing when the collected water is to be treated to potable water standards.

Denmark is the only country that has National legislation banning the use of lead flashing and roofing for new buildings. However, the ban does not apply to the renovation or repair of existing buildings.

Recently, lead sheets were established as a "green" building material by a UK-based research institute. Lead sheets used in lead roofing and vertical cladding installations received a rating of A or A+ in the Building Research Establishment - Green Guide to Specification. It specifies that lead used in these applications has a carbon footprint of between 30 and 76 kg of carbon dioxide (CO_2) per kg of material, considerably lower than similar installations using copper, zinc and stainless steel. Lead sheet on timber produced 4.5 kg of CO_2 equivalent, whereas comparable Polyvinyl chloride (PVC) systems were found to produce 31 kg of CO_2.

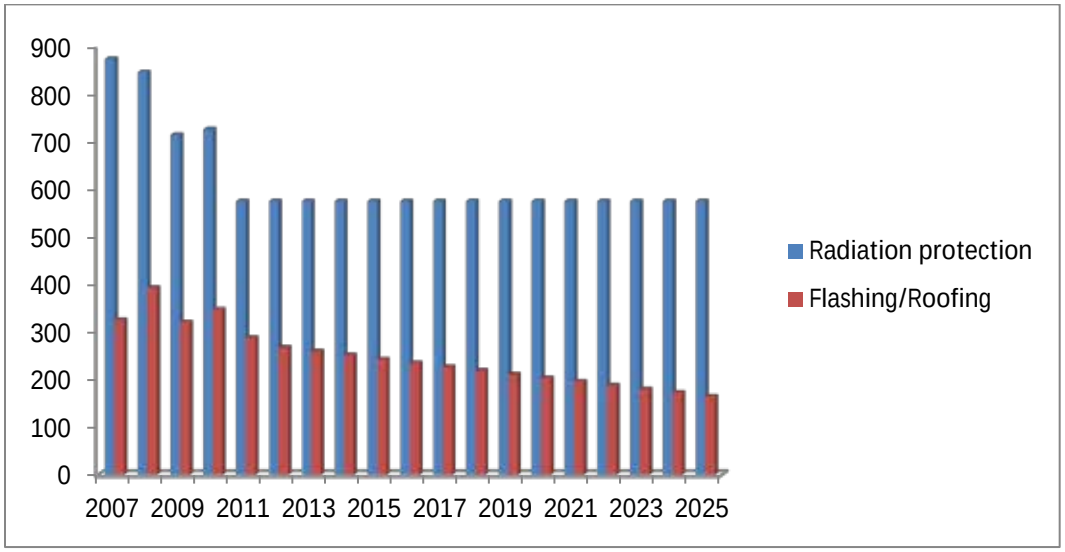
The use of lead sheet for industrial radiography purposes is recommended by several American national standards in order to minimize worker exposure to radiation.

Forecast of lead sheeting demand in Canada

Based on current market information, it is anticipated that the demand for lead in radiation shielding applications will stay relatively stable over the next 5 to10 years at approximately 575 tonnes per year in Canada. The use of lead in flashing, cladding and roofing applications is anticipated

to gradually decline over the same period, with a projected demand estimated to be approximately 165 tonnes by 2025. [10]

Figure 1: Demand for lead construction sheeting in Canada 2007 to 2025 (tonnes per year)



Note: This graph assumes uses in radiation protection to remain stable and flashing/roofing applications to gradually decline by 1% per year based on industry consultations

Conclusion

For radiation protection applications, lead sheeting remains the most economical and effective material to meet the standards set in various building and safety codes when compared to existing alternatives. The lead used for these applications is generally recovered and recycled. Due to health and safety requirements, it is expected that lead sheeting will continue to be the predominant material for radiation protection applications and the demand is forecasted to remain constant over the next five to ten years.

With respect to lead sheeting used for flashing, cladding and roofing applications, alternatives are already available in the Canadian market and industry has demonstrated efforts to move towards greater use of these alternatives, where it is technically and economically feasible. The total demand in Canada for lead sheeting in these applications is projected to continue to decline over the next ten years.

Given the small quantities and the limited exposure potential in the current Canadian context, the Government of Canada proposes to take no further action at this time on lead construction sheeting in the building industry. The market will continue to be monitored and new information relating to alternatives and releases in Canada will be evaluated as warranted.

[10] Environment Canada. (2013a). *Background Study and Use Pattern for Lead Sheeting used in Construction in Canada*. Final Report. ToxEcology Environmental Consulting Ltd.

Contact information

For more information, please send an email to ec.produits-products.ec@canada.ca use “Lead construction sheeting” in the subject line of your message.

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