EACO
Vermiculite Guideline
January 2015

Foreword

This guideline has been prepared to assist building owners, building managers, homeowners, constructors, contractors, subcontractors and trade workers who may encounter vermiculite and vermiculite attic insulation (VAI) during the course of various activities in residential and commercial buildings. Vermiculite is a naturally occurring mineral composed of shiny flakes, resembling mica and has the unusual property of expanding into worm-like accordion shaped pieces when heated. The expanded vermiculite, a light-weight, fire-resistant, chemical resistant, and odorless material is present in numerous products, including insulation for attics and walls.

Prior to its close in 1990, much of the world's supply of vermiculite came from a mine near Libby, Montana, USA. This mine unfortunately also contained a natural deposit of asbestos which resulted in contamination of the vermiculite product. Attic insulation and other products produced using vermiculite, particularly vermiculite that originated from the Libby mine, may contain asbestos fibres. Vermiculite from Libby represents the majority of vermiculite insulation in Canada and was often sold under the trademarked name "Zonolite". However, some of the vermiculite insulation sold in Canada came from deposits without significant asbestos contamination[1], mainly in South Africa.

Asbestos has been shown to cause lung cancer and other respiratory diseases. Asbestos fibres must be airborne to cause a health risk through inhalation. Therefore, the removal or disturbance of asbestos contaminated vermiculite insulation should be performed with caution. Proper sampling, testing and removal procedures are essential to properly identify and safely mitigate the hazard associated with asbestos contaminated vermiculite in buildings. The Environmental Abatement Council of Ontario (EACO) developed this guideline to address this important health hazard.

Disclaimer

EACO disclaims any liability or risk resulting from the use of the work practices and recommendations discussed in the guideline. It is the user's responsibility to ensure that these apply to the specific workplaces and to ensure compliance with all other applicable federal, provincial and local acts and regulations.

[1] Vermiculite from deposits in South Carolina or South Africa is often referred to as "non-asbestos" or "asbestos-free". This is subject to the limitations of the analytical methods used and it is possible that asbestos can be detected in these vermiculites, but at insignificant quantities

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1. GENERAL INFORMATION ON VERMICULITE

1.1 What is Vermiculite

Vermiculite is a hydrated laminar magnesium-aluminum-iron silicate resembling mica. Vermiculite is mined around the world and used in a variety of commercial and consumer products because it is fire-resistant and has good insulation qualities.

When heated to a high temperature, flakes of vermiculite expand as much as 8-30 times their original size. The expanded vermiculite is a light-weight, fire-resistant, and odourless material and has been used in numerous products, including insulation for attics and walls. Sizes of vermiculite products range from very fine particles to large (coarse) pieces.

As with most geological formations, the vermiculite ores contain a number of other minerals that were formed with the vermiculite.

1.2 Why is Vermiculite an Issue

Vermiculite ores from some sources are associated with the presence of some asbestiform minerals, however, asbestos though is not intrinsic to vermiculite.

A mine near Libby, Montana, was a major source of vermiculite sold in the U.S. and Canada from approximately the 1920's to 1990. There was a very large deposit of asbestiform minerals at that mine.

1.3 Zonolite

Vermiculite from Libby, Montana was used in the majority of vermiculite insulation in the U.S. and Canada and was sold under the brand name Zonolite ® or Zonolite ® Attic Insulation (ZAI).

2. VERMICULITE AND ASBESTOS

2.1 Types of Asbestos

Asbestos is a general term used to describe 6 different types of commercially used asbestos fibres, the first type being Chrysotile, from the Serpentine group. Amphibole minerals classified as asbestos include;

- Amosite
- Crocidolite
- Tremolite
- Actinolite
- Anthophyllite

Libby amphibole is NOT unique. Libby amphibole mostly includes Winchite (84%), Richterite (11%), and Tremolite (6%) among other amphiboles[2]. Therefore, Libby amphibole is defined as its own type of asbestiform mineral outside the six listed above; however it is most similar to Actinolite/tremolite.

2.2 Health Canada

Health Canada states

"Vermiculite is a mica-like mineral mined around the world and used in a variety of commercial and consumer products because it is fire-resistant and has good insulation qualities. Of concern is vermiculite ore produced by the Libby Mine in Montana from the 1920's to 1990. It was sold as Zonolite® Attic Insulation and possibly other brands in Canada during that time. Vermiculite from the Libby Mine may contain amphibole asbestos. The Libby Mine supplied the majority of the world market in vermiculite-based insulation."

"Not all vermiculite produced before 1990 contains amphibole asbestos fibres. However, to be safe and in the absence of evidence to the contrary, it is reasonable to assume that if your building has older vermiculite-based insulation, it may contain some amphibole asbestos."
As stated above, Health Canada has defined the fibre in the Libby Vermiculite and ZAI ® as *amphibole asbestos*.[3]

2.3 Libby Amphibole

Since Libby amphibole asbestos does not fall under the definition of one of the 6 main commercially sold types of asbestos, instead of just being referred to as "asbestos", it is widely referred to as either:

- Libby amphibole
- Libby amphibole asbestos

[2] The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana G.P. Meeker1,* A.M. BERN,1 I.K. BROWNFIELD,1 H.A. LOWERS,1,2 S.J. SUTLEY,1 T.M. HOEFEN AND J.S.VANCE3

[3] Health Canada - It's Your Health - Vermiculite Insulation Containing Amphibole Asbestos. http://www.hc-sc.gc.ca/hl-vs/alt_formats/pacrb-dgapcr/pdf/iyh-vsv/prod/insulation-isolant-eng.pdf

- Amphibole asbestos (Health Canada)
- Actinolite/Tremolite
- Non-Regulated Amphibole
- Non-Regulated Fibre

There are many more amphibole minerals that have similar properties to the "asbestos" minerals but are not "regulated" as one of the 6 types, since they were not used commercially.

EACO will refer to the asbestiform mineral from Libby as *amphibole asbestos* in this document, deferring to the Health Canada description. However, any of the above descriptions should prove adequate to describe the material or convey its description in reports or analytical results.

2.4 Health Risks

Although the overall percentage of amphibole asbestos in Libby vermiculite can be low, the airborne fibre concentration can become high, depending on the type of disturbance. Asbestos in vermiculite is very often not distributed homogeneously. The concentration of amphibole asbestos varies from bag to bag, within a building, and can even vary depending on the method used to collect a sample. The Industry average concentration is approximately 1-5%

Since the amphibole asbestos is not bound within a material like it is with virtually every other type of asbestos-containing building material, it can become airborne very easily if disturbed. Vermiculite is also hydrophobic - meaning that it does not easily absorb water, thus making it difficult to wet. However, the dust or fines present with the vermiculite, should be able to be wetted which is the main objective.

It is EACO's belief that Libby amphibole asbestos can cause asbestos-related diseases and may pose a health risk **if** made airborne/disturbed. Generally, asbestos-related diseases are developed as a result of occupational exposure to asbestos or frequent disturbance/exposure.

3. VERMICULITE PRODUCTS

3.1 Products with Vermiculite bound within

It is not the intention of EACO, by way of this guideline, to infer that materials that contain Libby vermiculite are also a hazard. For example, if sprayed fireproofing were to contain 20% Libby vermiculite within it, it could contain possibly 0.1% Libby Amphibole (0.5% x 20% = 0.1%). At this level, the asbestos

content is less than 0.5%[4], the regulated level in Ontario and it is *bound* within a material. The primary concern with Libby amphibole in vermiculite insulation is that it is NOT bound within a material and therefore can create a much larger airborne dust hazard (depending on method of disturbance).

3.2 Zonolite Attic Insulation

The majority of vermiculite attic insulation (VAI) present in Canada is Zonolite. Approximately 60-70% of the vermiculite in homes is Zonolite (or similar) which contains amphibole asbestos.

Largely, the non-asbestos vermiculite attic insulation comes from South Africa. This is somewhat larger in size than Zonolite. There were also attic insulation products sold that included a mix of Zonolite and South African Vermiculite.

In some instances, the vermiculite was poured between the joists and filled to the top of the joist level. In other cases it was installed below or above fibreglass insulation (or other insulation). This unfortunately results in the other insulation also being effectively contaminated with amphibole asbestos.

Depending on the type of house construction, sometimes the vermiculite was poured down into the wall cavities on the exterior walls when the attic was filled. This is a relatively rare condition in Canada however.

3.3 Vermiculite Masonry Block Fill

Vermiculite was used as block-fill insulation in concrete block wall construction.

[4] Quebec sets this level at 0.1% and, Saskatchewan and Manitoba set this at 0.1% for friable materials, BC states “any asbestos” detected using the US EPA method 600/R-04/004, dated January 2004 for vermiculite insulation (absence/presence).

This has only been found by EACO members in non-residential construction. Generally a series of blocks were laid (2 - 4 courses high) and bags of vermiculite were poured into the webs of the blocks until they were full.

Then another series of blocks were laid and more vermiculite poured - until the wall was completed.

3.4 Incinerators and Commercial Ovens

Vermiculite was sometimes poured on top of incinerators and industrial ovens that were used in assembly line type manufacturing (This typically does NOT include residential ovens or stoves).

3.5 Chimneys

Vermiculite was sometimes poured down chimneys within flues during retrofit applications that made use of the chimney space to vent/exhaust new mechanical equipment (retrofit boilers or hot water tanks for example). This seems to be a rare application. It should only become an issue upon building demolition or demolition of the chimney.

4. VERMICULITE ASSESSMENT AND SAMPLING IN ATTIC SPACES

When conducted as part of an asbestos assessment to meet the requirements of Ontario Regulation 278/05 or Section 30 of the Ontario Occupational Health and Safety Act, an assessment for vermiculite should be conducted by a trained and competent worker. There is an exception that homeowners can perform an assessment in their **own** home, if given and following proper instruction.

Any firm that is hired should have the proper errors and omissions insurance – more commonly known as professional liability insurance (if a consultant) or pollution liability insurance (if a contractor) for conducting this work with no exclusions regarding asbestos.

A minimum of three (3) separate samples of vermiculite attic insulation should be collected for analysis from 3 different areas and submitted for analysis.

Analysis of multiple samples may identify conditions of mixed asbestos and non-asbestos vermiculite that a single sample may miss. Also, provincial occupational health and safety law for Ontario requires a minimum of three samples from any single material of uniform appearance to conclude it is not an asbestos-containing material.
The following instructions should be followed while sampling;

- Place a drop sheet at the entrance to the attic or directly below the attic hatch
- Wear a half face air purifying respirator equipped with HEPA-filtered (P100) cartridges during sampling
- Use safety glasses during sampling
- Close all windows and doors to minimize cross ventilation before opening access to the attic
- Carefully access the attic through the attic hatch or access panel
- Avoid creating and breathing any more dust than necessary during this collection and do not remain in the area longer than necessary. The U.S. EPA and Health Canada recommend that you use a respirator to reduce the dust you breathe during this collection. A "NIOSH approved half-face respirator with P100 filters" can be purchased from most safety supply companies or hardware stores. Follow the respirator instructions regarding fitting and maintenance.
    - This respirator should not be used for major disturbance of vermiculite which would be encountered during renovations in the attic or for removal of the material.
- Collect a litre of insulation for each of the three (3) samples (each in its own re-sealable zipper storage bag) taken from the bottom half of the insulation in the attic or wall cavity (the asbestos tends to settle to the bottom). **Ensure the "fines" or dust on the top of the ceiling is included with each sample.**
- Using a dust pan is the simplest way to ensure the fines are included.
- Avoid tracking the insulation or dust into the living space of the house.
- Wash your hands, face, tools and wet wipe the respirator.
- Mist the drop sheet with a spray bottle of amended water, roll carefully toward the middle so no dust spills out (if any has been created) and place in a waste bag and seal the bag shut.
- Please be aware that ceilings in attics will not support a person's weight and appropriate precautions should be taken to ensure safety.

4.1 Concrete Block Wall Assessment and Sampling

Primarily assess exterior walls or walls that used to be exterior walls (renovated buildings/additions).

Examine the walls for an opening where the insulation may be visible.

Examine base building drawings to see whether block insulation was specified.

When all else fails – perform destructive testing and use a sledgehammer or core drill to create openings in the block. Sample any vermiculite as per the instructions below;

- Ensure that the sampling area is restricted to persons wearing PPE appropriate for the sampling and site conditions.
- Place an appropriate sized drop sheet of polyethylene on the floor directly below the sampling area and securely fasten in place against the subject wall using tape.
- Wear a half face air purifying respirator equipped with HEPA-filtered (P100) cartridges during sampling
- Use safety glasses during sampling
- Using a sledgehammer, create a small opening in the lower course of the block wall. Be sure to position the opening away from the web of the block, and in a location which will provide access into the hollow interior cavities. To avoid the web of the block, openings should be located approximately 4 cm on either side of the centre plane and 8 cm above any mortar or the base of the block

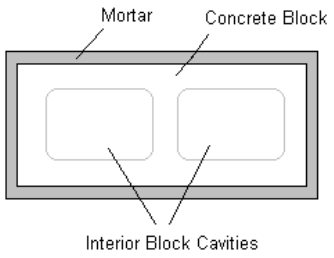

Figure 1: Construction of Typical Concrete Block
Note the solid structural components around the edges and along the centre plane of a typical block. Vermiculite insulation, if present, occupies the hollow interior block cavities.

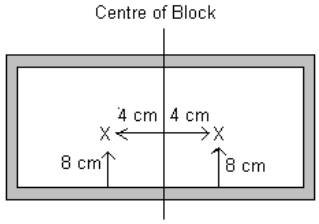

Figure 2: Location of Proposed Sampling Openings
To avoid the hard structural components, sampling openings should be created approximately 4 cm on either side of the centre plane, and approximately 8 cm above any mortar or the base of the block.

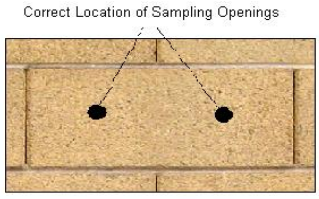

Figure 3: Location of Actual Sampling Openings

5. ANALYSIS OF VERMICULITE

EACO recommends the use of Polarized Light Microscopy (in short, the PLM method) for analysis. This is the method specified in Ontario Regulation 278/05 (and most other provincial regulations) and is defined as U.S. Environmental Protection Agency Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials. July 1993. O. Reg. 278/05, s. 3 (1).

Bulk vermiculite samples submitted for analysis of asbestos content should primarily be analyzed using the PLM method. Use of the PLM method should be able to determine if amphibole fibre is present. The analyst must be experienced in preparing the vermiculite sample properly and the same analyst that analyzes the slide(s) should prepare the slide(s).

A negative or non-detect result should be questioned IF the analyst (a) suspects the material to be Libby vermiculite or a mix of Libby vermiculite and other types or; (b) if the vermiculite is covered or mixed with tar. In these cases EACO recommends that the sample should be subjected to a 2nd analysis using the Transmission Electron Microscopy (TEM) method.

The TEM method has higher magnification and greater sensitivity. In general, the TEM approach is more time consuming and more costly than PLM. The TEM method that EACO recommends is the ASTM TEM Qualitative Method (currently in DRAFT form).This method does not attempt to precisely quantify the content of asbestos. It is a presence or absence technique. Quantification is more costly.

Using either method, samples results are recorded as simply "absence/presence" of asbestos and a quantity is not reported. If ***amphibole*** asbestos is detected, even at low concentrations by PLM, the material shall be considered as an asbestos-containing material (ACM). This precaution is necessary despite low content of asbestos (which seems to be right around the regulated level in Ontario), as high airborne fibre concentrations can be generated during disturbance of vermiculite. Defining the Libby amphibole as "absent or present" in vermiculite is also prudent since the concentration of amphibole asbestos can vary from bag to bag and building to building, and can even vary depending on the method used to collect a sample. Precise quantification becomes an unnecessarily proposition.

EACO recommends reporting the result as "amphibole asbestos", in conjunction with Health Canada's description. However, labs may describe the results alternately as:

- Libby amphibole
- Libby amphibole asbestos
- Actinolite/Tremolite

- Non-Regulated Amphibole
- Non-Regulated Fiber

For quality control purposes and due to the technical concerns identified relative to sampling and analyses, the selected laboratory conducting the bulk analysis by PLM shall be accredited by either:

- The National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP) for selected test methods for the identification of asbestos in bulk samples.
- The American Industrial Hygiene Association (AIHA) Industrial Hygiene Laboratory Accreditation Program, including bulk asbestos analysis for PLM methods.

Certificates of laboratory accreditation must be provided upon request.

6. VERMICULITE ABATEMENT

6.1 Zonolite Attic Insulation Abatement

In most cases, the removal of ZAI should follow Type 3 abatement procedures as prescribed in Ontario Regulation 278/05. These procedures are defined alternately as "High Risk" in other provinces.

Alternately, abatement can be completed using a varied or modified Type 3 procedure. In this instance, a HEPA filtered vacuum extraction system is used. This is an exterior vacuum system in which a truck mounted or machine driven system is used (much larger than portable HEPA vacuums used for abatement). A vacuum extraction system offers the benefit of adding an engineering control of increased negative draw of air at the point of disturbance. This decreases the exposure to the worker as opposed to other methods which may increase the airborne concentration within the asbestos work area. The procedure is modified from Type 3 procedures as follows;

- A shower is deleted from the decontamination facility.
- A 3 chamber decontamination facility is replaced with a one chamber facility for workers and waste.
- An efficient waste bagging system must be present at the vacuum extraction end of the process.

Where contractors have workers performing vacuum extraction, either periodic exposure assessments should be performed, or a remote shower should be considered.

EACO recommends that the following requirements of a Type 3 operation apply, regardless of the method used for abatement;

- Workers must wear appropriate personal protective equipment (See Section 7) when working within the asbestos work area or in areas where exposure may be possible.
- No eating, drinking, smoking, chewing in the work area.
- Post signs outside the work areas as per the requirements of O.Reg 278/05
- Implement methods appropriate to the type of work area required for decontamination (Workers must wash their hands and face upon leaving the work area if no shower is present due to use of a vacuum extraction system, or shower if Type 3 procedures are used).
- Disable all ducts and air handling systems that are within the attic or run through the attic.
- Negative pressure within the asbestos work area must always be established. A negative air pressure of 0.02 inches of water, relative to the area outside the enclosed area is required. Ensuring that replacement air is taken from outside the enclosed area and is free from contamination with any hazardous dust, vapour, smoke, fume, mist or gas, etc. Monitor pressure differential through the use of a properly calibrated manometer.
- The spread of dust from the work area shall be prevented (e.g. seal attic and soffit vents with polyethylene). However, other openings to the exterior of the house (soffit vents under vermiculite that are impossible to seal, gaps in the sheathing that are covered by shingles, etc.) do not have to be sealed with polyethylene, but negative pressure may have to be increased if there are significant openings to the exterior.
- Light misting of the air with amended water to control the spread of dust must be performed. Do not cause water damage or mould growth.
- Workers performing abatement must be certified under Ontario Ministry of Training, Colleges and Universities (MTCU) Program 253W.
- Supervisors must be certified under MTCU Program 253S
- Contractors and consultants must have appropriate insurance as per Section 4.
- A Notice of Project form must be filed with the Ministry of Labour
- Dust and waste shall not be permitted to fall freely from one work level to another.

- Post removal sealer (glue or lockdown agent) is applied to the entire attic space upon completion of abatement, unless it would damage equipment or finishes.

All other regulated procedures appropriate to the removal method apply.
EACO strongly recommends against dropping or demolishing ceilings with the ZAI remaining on the top. Very high airborne fibre levels can be created when this is done.

6.2 Vermiculite Filled Block Wall Abatement

For abatement of block walls with block fill containing vermiculite, Type 3 procedures as per Regulation 278/05 apply.

Indoor or outdoor procedures (with heavy equipment) may be required depending on the location (outdoor procedures for exterior walls/building demolition).

EACO recommends a consultant be engaged to determine procedures and to determine disposal methods. In certain circumstances (load bearing walls) the vermiculite cannot be safely[5] or effectively separated from the block wall and in these cases the total asbestos content may have to be considered for disposal purposes (less than 0.5%). Considerations must be given to the transportation requirements (waste must be collected and placed in lined bins (bladder bagged) and the disposal site.

7. PERSONAL PROTECTIVE EQUIPMENT

For all vermiculite abatement projects, a minimum of a powered air purifying respirator (PAPR) with P100 filters should be used.

Remove street clothing and don disposable, fibre impermeable coveralls.

Disposable fibre impermeable boot covers are highly recommended. Otherwise footwear requires either effective cleaning or must be place in a bag for transport, when workers leave the asbestos work area.

Comply with additional safety procedures as required by the Ontario Occupational Health and Safety Act.

5 Creating holes in the entire wall or removing one half of the face of the block to remove the vermiculite at a load bearing wall, for example.

8. POST ABATEMENT INSPECTION AND REPORTING

8.1 Air sampling

Following the completion of the vermiculite removal process, and depending on the work area, final air clearance monitoring may be required. Where this is required, the procedures and quantity of air samples to be recovered should follow the requirements as described in Ontario Regulation 278/05.

Where air sampling is performed for final clearance, the airborne fibre concentration criterion as stipulated by Ontario Regulation 278/05 of 0.01 fibres/mL should be used. Prior to and during the air sampling process the work area should be subjected to a simulated forced air disturbance with leaf blowers and box fans as per the requirements of Ontario Regulation 278/05. EACO recommends using a third party consultant that is an EACO member, and therefore has the appropriate qualifications and insurance to perform the final visual inspections and air sampling

8.2 Reporting

In some cases (especially residential projects), the goal is to remove the vermiculite from the building so that a sale of the asset can proceed. Hiring an abatement contractor to remove the material may not be enough for this purpose. To satisfy the stakeholders involved in a real estate transaction the following may be required:

- A qualified consultant should be retained
- A visual inspection and air monitoring may be performed
- A report stating the vermiculite has been removed, and work area has been adequately cleaned of dust and debris and a report stating the results of the air monitoring clearance analytical results (often one combined report).

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