**Asbestos Facts Sheet**

by Julie Baldwin, UM associate professor of geosciences and associate dean of UM College of Humanities and Sciences.

**What is asbestos?**

Asbestos is not a single substance, but is rather the generic name for a group of six regulated fibrous magnesium silicate minerals of which one, chrysotile, belongs to the serpentine family and five: actinolite, amosite, anthophyllite, crocidolite, and tremolite, belong to the amphibole family. In general, there are over 40 amphibole minerals that are capable of exhibiting an asbestiform habit. In particular, two of these additional fibrous amphiboles were identified in Libby, Montana.

Asbestiform refers to a subset of fibrous minerals that exhibit the additional qualities of flexibility and separability of individual fibers. Typically, asbestiform minerals also have relatively small fiber diameters (usually under 1 micron) and long fiber lengths (>5-10 microns). For counting purposes, the Occupational Safety and Health Administration (OSHA) defines an asbestos fiber as having a length >5 microns and a length-to-width ratio (aspect ratio) >3:1. [1 micron = 1/1000 of a millimeter]

The asbestos minerals differ from each other in their physical and chemical properties, and each mineral can exist in a wide range of fiber sizes. These characteristics, as well as fiber durability, surface area, and iron content are important determinants of asbestos toxicity.

Structurally, chrysotile is a sheet silicate (similar to micas or talc) where the individual sheets are rolled into relatively long, flexible, and wavy fibers. Amphibole asbestos is a chain silicate that has fibers that are substantially more brittle than chrysotile.

<table>
<thead>
<tr>
<th>Mineral Group</th>
<th>Mineral Name</th>
<th>Asbestiform Name</th>
<th>Chemical Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serpentine</td>
<td>serpentine</td>
<td>chrysotile</td>
<td>Mg₃Si₂O₅(OH)₄</td>
</tr>
<tr>
<td>Amphibole</td>
<td>riebeckite</td>
<td>crocidolite</td>
<td>Na₂(Fe,Mg)₃Fe³⁺₂Si₈O₂₂(OH)₂</td>
</tr>
<tr>
<td>Amphibole</td>
<td>grunerite</td>
<td>amosite</td>
<td>(Fe,Mg)₆Si₈O₂₂(OH)₂</td>
</tr>
<tr>
<td>Amphibole</td>
<td>tremolite</td>
<td>tremolite</td>
<td>Ca₂(Mg,Fe)₆Si₈O₂₂(OH)₂</td>
</tr>
<tr>
<td>Amphibole</td>
<td>anthophyllite</td>
<td>anthophyllite</td>
<td>(Mg,Fe)₆Si₈O₂₂(OH)₂</td>
</tr>
<tr>
<td>Amphibole</td>
<td>actinolite</td>
<td>actinolite</td>
<td>Ca₆(Fe,Mg)₆Si₈O₂₂(OH)₂</td>
</tr>
</tbody>
</table>

Chrysotile currently accounts for 99% of world's commercial, purposeful use of asbestos [NIOSH 2011].
99.7% of the asbestos fibers in McGill Hall were identified as chrysotile in the airborne and surface load testing. Two amosite structures were identified in the dust wipe samples. (http://www.umt.edu/facilities/asbestos/McGill_Hall_testing.pdf)

In Craighead and the temporary ASUM classroom surface load samples, all fibers were identified as chrysotile. (http://www.umt.edu/facilities/asbestos/Craighead.pdf) (http://www.umt.edu/facilities/asbestos/ASUM_Furnishing%20Testing.pdf)

Sources:


What is considered a fiber and what are typical fiber concentrations in the air we breathe every day?

OSHA defines an asbestos fiber for counting purposes as a particle with a length >5 µm, a width greater than 0.25 µm, and a length-to-width ratio (aspect ratio) >3:1. These are the counting guidelines used in the NIOSH 7402 method that is used in air sampling (https://www.cdc.gov/niosh/docs/2003-154/pdfs/7402.pdf).

Currently, U.S. OSHA regulations require that workplace air concentrations of asbestos not exceed 0.1 f/cc (fibers/cubic centimeter). Note that this occupational standard is not relevant to children or the general public since the OSHA permissible occupational exposure limit for asbestos is considered to be a significant risk standard. That is to say, as with other carcinogens the indicated occupational exposure limit for asbestos would reduce, but not eliminate, the significant risk of adverse health effects compared to having no standard.

As a result of human use, asbestos fibers are now widely dispersed in the environment. Background levels in the air are extremely low, about 0.0001 f/cc (Holland and Smith, 2003). Measurement of indoor concentrations in homes, schools, and other buildings that contain asbestos range from about 0.00003–0.006 f/cc (ATSDR, 2001).

For comparison, most of the airborne fiber levels in McGill Hall measured in January 2019 were below the measurable detection limits. One measurement from McGill Hall room 014/001A measured 0.0025 f/cc, which was the only measurement above the detection limit, containing 1 fiber of chrysotile.

All air samples from Feb. 7th and Feb. 11th in McGill, Craighead, and the temporary ASUM classroom were below measurable detection limits.
What is the difference between air sampling and surface dust sampling and can you extrapolate airborne concentrations from surface load numbers?

Two types of samples were taken in McGill Hall – accumulated dust wipe samples to determine surface loading and airborne measurements to determine airborne fiber concentrations. As stated above, the air samples have been below detection limits, with the exception of one sample noted above. However, surface wipe samples contained relatively higher concentrations. It is important to note that surface sampling represents accumulated dust and is not equivalent to airborne concentrations.

Though some studies have attempted to calculate a “resuspension” value for correlating surface and airborne data (Fowler and Chatfield, 1997), there are large uncertainties noted by these researchers. The EPA, having tested these relationships at many sites where the relationship could not be confirmed, does not use these methods and instead uses activity-based sampling, which is a personal monitoring approach that can be useful for assessment of asbestos contamination of both outdoor soil and indoor dust.

In summary, since the exposure of interest for risk is the inhalation pathway, EPA relies on measurements of asbestos in air, rather than dust, soil, or bulk material to the extent practical (EPA 2008). The high surface loading in some samples is one line of evidence for past fiber deposition, however the airborne measurements provide assurance that the present air quality is safe.

Sources:


What do we know about how long asbestos fibers stay in our bodies?

When you breathe asbestos fibers into your lungs, most fibers will be removed by being coughed up in a layer of mucous and then swallowed into the stomach. The fibers that are deposited in the deeper parts of the lung are removed slowly. Some fibers can remain in place for many years and may never be removed. The ATSDR toxicological profile states that amphibole asbestos fibers are retained longer in the lung than chrysotile fibers.
Biodurability studies of chrysotile estimated lifetimes of about 9 months for a 1-micron-diameter fiber, and a model prediction that fibers with diameters of 0.1 micron would require only weeks to dissolve completely (Hume and Rimstidt, 1992). In another study, researchers found that the calculated dissolution time of a 0.25 micron thick fiber of chrysotile using a simulated lung fluid is in the range 94–177 days, very short if compared to that of amphibole fibers (49–245 years) (Gualtieri et al., 2018). Thus there is evidence that chrysotile may be more readily cleared from the body than amphibole forms. However, at high occupational exposures for chrysotile, it has been demonstrated that pleural plaques may be an independent risk factor for lung cancer death (Pairoń et al., 2014).

Several lung pathology studies have been carried out by Churg looking at aspects such as lung fiber burden (amount of fibers), relative fiber size (short vs long), and fiber type. These studies were carried out on several different populations, from miners and millers, to shipyard and insulation workers. He noted that the severity of fibrosis was positively correlated with the lung fiber burden but in some cases was negatively correlated with fiber length. That negative correlation may suggest that short fibers (less than 5 microns) may be more important to some aspects of asbestos-mediated toxicity than previously thought. The observation may also indicate that the surface area of the fiber plays an important role – short, curly fibers have a greater surface area than long, straight fibers (Cook et al., 2017).

Sources:


**Will a single asbestos fiber hurt me?**

No one can say because it is impossible to conduct such a study. The general population is exposed to low levels of asbestos primarily by inhalation and small quantities of asbestos fibers are ubiquitous in air. Thus people are exposed to many asbestos fibers throughout their daily lives.

Most of the people who become ill from exposures to asbestos were exposed to high concentrations of asbestos and usually for extended periods of time. There are examples such as in Libby where the likelihood of having CT (computed tomography) scan abnormalities was associated with increased numbers of pathways of exposure. Most people who get sick from asbestos worked with asbestos in some way.

A smaller number of people that have gotten sick from asbestos lived with someone that worked with asbestos. In a limited number of unique settings, some people have gotten sick from asbestos if they lived near asbestos mining operations or other industrial sources of asbestos. All of the above circumstances result in exposure concentrations and exposure durations that are much greater than what is experienced by the general population when interacting with buildings known to contain asbestos. That being said, for any carcinogen, one should minimize their exposure to the greatest extent practical.

**Sources:**

Have Minimal Risk Levels been established for short duration, non-occupational exposure to asbestos?

Data regarding the adverse health effects associated with acute- or intermediate-duration exposure to asbestos are lacking or are too limited to support the derivation of a Minimal Risk Level. Only a few inhalation or oral studies have sought to determine the effects of short-term exposures to asbestos. There are no human data on noncancer effects after acute exposures, and no acute-duration Minimal Risk Levels have been derived.

Sources:

How can asbestos affect children?

In the small number of studies that have looked at asbestos exposure in children, there is no indication that younger people might develop asbestos-related diseases more quickly than older people. However, the onset of disease at a potentially younger age in this population resulted in EPA weighting early life exposures more heavily than exposures later in life in their unit risk values (EPA 2008, Appendix E).

Relevant pediatric sections in the ATSDR toxicology report are:
Section 1.6 - How Can Asbestos Affect Children?
Section 1.7 - How Can Families Reduce the Risk of Exposure to Asbestos?
Section 3.7 - Children’s Susceptibility
Section 6.6 - Exposures of Children

Studies that have been conducted on asbestos levels in schools have stressed the low fiber counts in the air even when the buildings contained asbestos-containing material (Mossman et al. 1990).

Sources:


Where can I get more information?

A good place to start is ATSDR (Agency for Toxic Substances and Disease Registry). Much of the information presented here is from their Toxicological Profile for Asbestos. A summary version of this report is here: https://www.atsdr.cdc.gov/toxfaqs/tfacts61.pdf

The full technical report may be found here: https://www.atsdr.cdc.gov/toxprofiles/tp61.pdf

ATSDR also has a public-facing website, Asbestos and Your Health, here: https://www.atsdr.cdc.gov/asbestos/

Other useful sites include the EPA and OSHA asbestos sites:
https://www.epa.gov/asbestos
https://www.osha.gov/SLTC/asbestos/

In addition, the World Health Organization’s asbestos site is here:

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