Heat or Otherwise Altered Asbestos

Background

Building materials that contain asbestos may at times be exposed to high temperatures or chemicals. Asbestos insulation samples applied to boilers, furnaces, steam pipes, etc., are exposed to very high temperatures for extended periods of times. All types of building materials may be exposed to very high temperatures in fires of all types (wildfires, building fires, etc.). This exposure can eventually alter the asbestos present, changing slightly or not so slightly, the crystal structure and chemical composition of the fibers. Other scenarios, such as exposure to acids, can also have similar effects on asbestos fibers, but by far, the most common example is the alteration of the asbestos by high temperatures.

Though amphiboles are common in these types of samples, it is typically chrysotile that shows the greatest degree of alteration, because it can be altered at a lower temperature as compared to most amphiboles. For chrysotile, the optical properties and Selected Area Electron Diffraction (SAED) are the most affected, since this relates to the fiber's crystal structure. Amphiboles also will exhibit a change in Refractive Index (RI), but the SAED, as measured in TEM, is not typically affected. For all asbestos types, heating fibers will eventually cause their RIs to increase. For amphiboles, crocidolite and amosite seem to show the earliest and most significant change in RI when heated, though other amphibole varieties do show more moderate changes. The loss of SAED in chrysotile may be related to the more delicate nature of the chrysotile scrolled structure, where bonds between the scrolled structures may be more stressed and likely to break than in the more durable amphibole crystal. More extreme alteration is needed to have a significant effect on amphibole SAED.

Morphological changes include change of color; chrysotile becomes a light-brownish color, amosite becomes rusty brown, and crocidolite becomes reddish brown. The most notable change in these fibers is crocidolite loses its grey-blue appearance and changes to a positive sign of elongation. Crocidolite also is the first of these types to exhibit any change at all; a short duration at 375°C is enough to start causing these changes.
Additionally, most asbestos types become less flexible after heating. Chemical alteration also effects RI, but instead of an increase, this normally lowers the refractive index.

In PLM, when the analyst sees suspect asbestos fibers that just don't look quite right, morphology may be similar, but some of the fibers look like they have been fused together into bundles with a "blocky" appearance. RIs may either be too high or low for asbestos for the suspect fiber type, and color of fibers in plane polarized light has a light brown, reddish-brown, or rust brownish color. If you see some of these 'indicators,' you will probably also find the refractive indices are no longer in range to identify as asbestos, and in the case of suspect crocidolite, the sign of elongation will be positive.

In TEM, when the chrysotile scroll looks to be damaged or fused with neighboring fibers, an analyst typically finds SAED patterns for suspect chrysotile fibers will most likely not be attainable. In addition, the elemental identified as asbestos, even if the chemistry remains unchanged.

It is also important to note that according to OSHA (and a number of its state counterparts), altered asbestos is considered to be asbestos, even if not considered countable asbestos by the method.

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EMSL's Policy

When we encounter a fiber(s) suspected to be altered asbestos because the identifying characteristics (RI, fiber color, sign of elongation, diffraction, EDXA) are outside the acceptable normal range:

For PLM:
The analyst will reexamine the raw sample under a stereoscope, and locate any large bundles of suspect material. Mount the bundles in RI oil, picking apart the bundles to try and recover some un-altered asbestos. This may include crushing or teasing these bundles to expose the fibers in the middle of the bundle that may be less altered, or completely un-altered. When suspect material is deemed to be asbestos with normal optical properties, then the sample goes from "no asbestos detected" to at least "<1%."

EMSL will only consider the portion of the suspect asbestos fibers that possess correct optical properties to actually be asbestos for the purposes of final results. It is likely <1% asbestos will be reported in these situations.

Just because asbestos fibers with RI values are detected, does not mean they should be extrapolated to the entire sample of "abnormal" fibers.

For TEM:
The analyst may see altered elemental ratios, such as lowered Mg in chrysotile, along with faint or absent diffraction patterns. The analyst may attribute the abnormal chemistry or diffraction to heat-altered asbestos, but without the observation of the "normal" properties, it still cannot be called asbestos. In the case of chrysotile, a spectra with a lower than expected Mg peak and absent or poor SAED, may be a non-asbestos fiber, such as sepiolite. Amphiboles are more likely to possess standard SAED diffraction and chemistry, so it is less likely you will need to make that call for them.

Just like PLM, when trying to determine an estimated percent of altered asbestos in TEM, EMSL will only consider the portion of the suspected asbestos fibers that possess correct diffraction and/or chemistry to actually be deemed asbestos for the purposes of final results.

Just because some fibers with correct SAED and/or chemistry are detected, this does not mean the identification can be made to all similar fibers.

Reporting:
Regardless of whether the final result is non-detect or ≤ 1% or > 1%, it is very important to report both the portion of suspect altered asbestos as non-asbestos fiber on the reports, as well as placing a comment on the sample report, such as:

PLM: "Numerous fibers were found with optical properties outside the acceptable limits for regulated asbestos. These fibers are possibly altered asbestos fibers, and were not included in the asbestos sample concentration."

TEM: "Numerous fibers were found with diffraction patterns and/or chemical composition outside the acceptable limits normal range of regulated asbestos. These fibers are possibly altered asbestos, and were not included in the asbestos sample concentration."

Question: Is heat altered or chemically treated asbestos still asbestos?
Answer: Whether the analysis is PLM or TEM, the methods give laboratories specific criteria to use to determine if a fiber is countable as asbestos. These criteria must still be met, even when it is believed outside circumstances, such as heat, may be the cause.

If you have any questions, or require additional information, please do not hesitate to contact us!
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