

DETERMINATION OF ASBESTOS IN TALC BY OPTICAL MICROSCOPY

The six kinds of asbestos can be distinguished from talc and from each other by their refractive indices, other optical crystallographic properties, and morphology as determined with a polarizing microscope (AOAC 1970 36.541-36.543). Talc occurs mainly in the form of thin plates, which may appear fibrous when seen edgewise in microscopic view. Beta and gamma indices of talc vary from about 1.575 to 1.590, beta being very close to gamma. All of the principal refractive indices of chrysotile are less than 1.590. One can, therefore, distinguish chrysotile asbestos from fibrous looking talc particles in a 1.574 refractive index liquid, and the amphibole types from talc in a 1.590 liquid. The accompanying table of optical crystallographic properties for talc and the asbestos minerals shows refractive indices which are usually encountered in these minerals, but occasional samples may have indices which are somewhat higher or lower. For practical measurement of optical properties shown in the table, particles identified by this method should be at least 5 μ m or longer.

Method

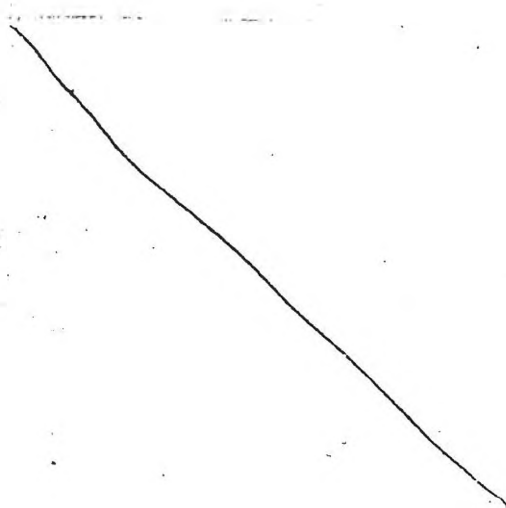
Weigh out 1 mg. of a representative portion of talc on each of two microscope slides. Mix the talc with a needle to spread evenly over the suitable area on one slide with a drop of 1.574 refractive index liquid, and then the other with 1.590 liquid, and place on each a square or rectangular cover glass sufficiently large so that the liquid will not run out from the edge (ca. 18 mm. square) and will provide a uniform particle distribution. Fibers counted by this method should meet the following criteria:

- (a) length to width ratio of 3 or greater
- (b) length of 5 μ m or greater
- (c) width of 5 μ m or less.

Count and record the number of asbestos fibers found in each 1 mg. as determined from a scan of both slides with a

polarizing microscope at a magnification of approximately 400 X. In the 1.574 liquid, chrysotile fibers with indices less than 1.574 in both extinction positions may be present; in the 1.590 liquid, amphibole types of asbestos fibers with indices exceeding 1.590 in both extinction positions may be present. Check extinction and sign of elongation for tentative identification. For specific identification of asbestos fibers, make additional mounts in appropriate refractive index liquids, and refer to the optical crystallographic data in the table.

When the count of asbestos fibers reaches 150 per mg, stop at a suitable location on the slide and estimate total number of asbestos fibers on slide by a factor calculated from the total area of slide divided by the area actually counted.



OPTICAL CRYSTALLOGRAPHIC CHARACTERISTICS OF ASBESTOS MINERALS AND TALC

Substance	Reference for n	$n\alpha$	$n\beta$	$n\gamma$	Extinction	Elongation
Actinolite	(2) p. 172	1.614	1.630	1.641	Inclined	Positive
	(8) p. 285	1.615-1.655	1.625-1.665	1.64-1.68		
Amosite	(4) p. 261	1.663*	--	1.680		
	(4) p. 261	1.675*	--	1.702		
Anthophyllite	(2) p. 170	1.598	1.623	--	Parallel	Positive
	(2) p. 222	1.598	--	1.623		
	(5) p. 298	1.598-1.674	1.605-1.685	1.615-1.697		
	(2) p. 222	1.608	--	1.631		
	(2) p. 172	1.619	1.630	1.640		
	(6) p. 236	1.619-1.633	1.630-1.642	1.640-1.657		
	(2) p. 173	1.629	1.635	1.640		
	(2) p. 116	1.633	1.638	1.652		
Chrysotile	(2) p. 99	1.493	1.504	1.517	Parallel	Positive
	(2) p. 100	1.508	1.512	1.522		
	(3) p. 154	1.529-1.559	1.530-1.564	1.537-1.567		
	(8) p. 260	1.53-1.54	--	1.54-1.55		
	(6) p. 290	1.542	--	1.555		
	(8) p. 260	1.542	1.543 (calc.)	1.555		
	(2) p. 104	1.546	1.550	1.557		
	(1) p. 40	1.546	1.557	1.557		
	(1) p. 40	1.548	1.560	1.560		

* $\frac{n\alpha + n\beta}{2}$

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Substance	Reference for n	n α	n β	n γ	Extinction	Elongation
Crocidolite	(2) p. 187	--	1.695	--	Parallel	Negative
	(6) p. 241	1.693	1.695	1.697		
	(2) p. 127	1.697	1.700	1.703		
Talc	(8) p. 259	1.538-1.545	--	1.575-1.590	Parallel or 2° or 3°	Positive
	(2) p. 164	1.539	1.589	1.589		
	(3) p. 167	1.539	1.589	1.589		
	(6) p. 281	1.539	1.589	1.589		
	(8) p. 259	1.540	nearly = n γ	1.575		
	(1) p. 41	1.541	1.585	1.585		
	(1) p. 41	1.544	1.592	1.592		
	(1) p. 41	--	1.594	1.594		
	(7) p. 758	1.545	1.584	1.584		
Tremolite	(2) p. 222	1.599	1.613	1.625	Inclined	Positive
	(8) p. 285	1.599	1.613	1.625		
	(3) p. 169	1.599-1.612	1.613-1.626	1.625-1.637		
	(2) p. 169	1.600	1.616	1.627		
	(2) p. 222	1.602	1.614	1.635		
	(2) p. 222	1.602	1.618	1.631		
	(6) p. 237	1.602-1.623	1.613-1.638	1.624-1.650		
	(7) p. 766	1.604	1.612	1.628		
	(2) p. 222	1.604	1.617	1.630		
	(2) p. 222	1.609	1.622	1.636		
	(2) p. 222	1.609	1.623	1.636		
	(2) p. 222	1.613	1.621	1.634		

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REFERENCES

1. Chidester, A. H. Petrology and Geochemistry of Selected Talc-bearing Ultramafic Rocks and Adjacent Country Rocks in North-Central Vermont. Geological Survey Professional Paper 345. U. S. Department of the Interior. 1962.
2. Larsen, E. S. and H. Berman. The Microscopic Determination of the Nonopaque Minerals. Geological Survey Bulletin 848. U. S. Department of the Interior. 1934.
3. McCrone, W. C., et al. The Particle Atlas. Ann Arbor, Michigan. 1967
4. Peacock, M. A. The Nature and Origin of Amphibole-Asbestos in South Africa. The American Mineralogist 13 : 241-286. 1928
5. Rabbitt, J. C. A New Study of the Anthophyllite Series. The American Mineralogist 33 : 263-323. 1948.
6. Rogers, A. F. and P. F. Kerr. Thin-Section Mineralogy. New York. 1933.
7. Ross, M., W. L. Smith, and W. H. Ashdon. Triclinic Talc and Associated Amphiboles from Gouverneur Mining District, New York. The American Mineralogist 53 : 751-769. 1968
8. Winchell, A. N., and H. Winchell. The Microscopical Characters of Artificial Inorganic Solid Substances. New York. 1964.