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Exposure to Asbestos in the Use of Consumer Spackling, Patching, and Taping Compounds

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Abstract. *Analysis of representative samples of spackling, patching, and jointing compounds, purchased at retail stores in the New York City area, has shown that some contain asbestos minerals as well as other biologically active substances. Measurements suggest that home repair work involving the use of such materials may result in exposure to dust at concentrations sufficient to produce disease.*

Spackling and drywall taping compounds consist of extremely fine-grained white powders or premixed pastes. Plaster of Paris is supposedly the major constituent, but other light-colored materials including clays, micas, quartz, talc, and ground limestone, supplement or replace the plaster in many formulations. Chrysotile is added to some products, apparently because these minute fibers act as reinforcing agents. The presence of amphibole asbestos in some products results from its natural occurrence in talc, carbonates, and other rocks used as raw materials (*1*).

Fifteen samples of consumer spackling and patching compounds were purchased at hardware stores in the New York City area, four in 1972 or earlier and the remainder in January 1974. We analyzed the samples for mineral phases by polarized light microscopy, x-ray powder diffraction, and transmission electron microscopy, with particular attention to quantitative determination of asbestos minerals. The spackling and taping compounds consist mainly of particles smaller than 3 μm in average diameter or length (Fig. 1). Particles of this size are generally too small to

Table 1. Mineral content of consumer spackling and patching compounds and industrial drywall taping compounds.

Mineral phase	Frequency of occurrence of mineral phases	
	In 15 consumer spackling and patching compounds	In 10 industrial drywall taping compounds
Chrysotile	3 (5–10%)	9 (5–12%)
Tremolite	1 (4– 6%)	1 (5– 7%)
Anthophyllite	1 (10–12%)	
Talc	2	2
Quartz	9 (5–70%)	6 (10–30%)
Feldspar	1	
Pyrophyllite	2	
Mica	8	9
Kaolinite	5	7
Calcite	11	4
Dolomite	3	4
Plaster of Paris	7	6

be individually studied by polarized light microscopy, and identification is further confounded because these compounds commonly are mixtures of four or more different materials. The analytical use of the optical microscope with its limited resolution allows large numbers of fibers to go undetected. The asbestos minerals, in particular, are usually too fine-grained to identify. In such circumstances, x-ray powder diffraction may be used to identify and quantify the individual crystalline phases present in the mixtures.

In this investigation the amount of asbestos present in spackling compounds was determined by comparison with dilution standards (*2*). Binary systems of chrysotile, tremolite, and anthophyllite asbestos in plaster of Paris ($CaSO_4 \cdot \frac{1}{2}H_2O$) were prepared at varying dilutions on a weight-to-weight basis. Diagnostic reflections for each of the asbestos minerals were selected. These reflections were step-scanned by x-ray diffraction at increments of 0.02° 2θ, where θ is the dispersion angle, over a goniometric interval sufficient to define a peak-to-background ratio for the diagnostic reflections. A digital printout of elapsed time in a fixed-count determination was used to prepare precise positions and profiles of the diagnostic reflections. The area above background, determined with a compensating polar planimeter, was taken to be proportional to the concentration. Details of the method have been presented elsewhere (*2*). Samples of spackling and taping compounds were prepared, analyzed, and measured under the same conditions as the dilution standards. Comparison of the results of known dilution standards with the samples permitted the amounts of asbestos to be estimated with approximately 20 percent reproducibility.

The presence of certain minerals may interfere with the detection or quantitation of chrysotile in spackling and taping compounds. For example, chrysotile and kaolinite have similar crystal structures and consequently similar x-ray diffraction patterns (*3*). However, electron microscopy can be used to corroborate the results of x-ray diffraction and to directly estimate the asbestos content of materials, since each mineral type has a characteristic morphology and electron diffraction pattern.

The results of the analyses of 15 consumer spackling and patching compounds are given in Table 1. Three of the samples were found to contain chrysotile asbestos, and two others contained tremolite and anthophyllite asbestos. Talc was a major constituent in two samples and pyrophyllite in two. The crystal structure and physical properties of pyrophyllite are almost identical to those of talc; pyrophyllite may be considered the aluminum analog of talc. Its biological activity is presently unknown. Quartz was a major constituent in seven of the samples, and it was present in two others in lesser concentrations. On the basis of the x-ray intensities of several major quartz reflections, including those at 4.26, 3.34, and 1.817 Å, the amount of quartz present is estimated to be greater than 10 percent in the seven samples. Optical and transmission electron microscopy have shown essentially all the quartz to be of respirable size (< 5 μm). Both quartz and talc can produce pulmonary fibrosis (*silicosis, talcosis*) (*4*). One sample consisted largely of quartz with lesser amounts of feldspar and anthophyllite. This may indicate that the source material for this product was an anthophyllite schist. The combination of talc with some tremolite and quartz in another sample represents a common mineral association typical of commercial talc ore bodies.



Fig. 1 Electron photomicrograph of a consumer spackling product. Large numbers of chrysotile fibers and fiber bundles are present. Granular particulates are clay, mica, and carbonate minerals.

Both optical and electron microscopic analyses showed that the asbestos fibers present in the samples ranged in length from 0.25 to 8.0 μm. Most were shorter than 5 μm in length, which is respirable size, yet they were not generally detected by optical microscopy.

The possibility of asbestos exposure during home construction and repair is indicated by the fact that drywall construction workers are exposed to significant concentrations of asbestos air contamination. Mineralogical analyses of ten industrial drywall taping compounds show that nine contain chrysotile, in concentrations ranging from 5 to 12 percent (by weight) (Table 1).

Table 2. Asbestos fiber concentrations during use of taping compounds containing asbestos minerals. Multiplication of the number of fibers per milliliter by 10^6 gives the number of fibers per cubic meter of air, an amount which may be inhaled during 1 hour. An unstudied proportion of these fibers is retained and others are exhaled. Current (interim) regulations of the OSHA prohibit concentrations of 5 fibers per milliliter or more, longer than 5 μm, as a time-weighted average for workers. Concentrations above 2 fibers per milliliter will be illegal after 1976. Current regulations set a ceiling concentration of 10 fibers, longer than 5 μm, per milliliter of air.

Operations	Number of samples	Peak fiber concentration (fibers per milliliter)	
		Mean	Range
Pole-sanding (1 to 1.5 m)	10	10.0	1.2 to 19.3
Background (2.5 m), same room	3	8.6	3.5 to 19.8
Background (7.5 m), adjacent room	2	4.8	0.7 to 8.8
Hand-sanding (1 to 1.5 m)	11	5.3	1.3 to 16.9
Background (2.5 m), same room	2	2.3	2.1 to 2.5
Background (4.5 m), adjacent room	2	4.3	1.5 to 7.1
Dry mixing (1 to 1.5 m)	2	47.2	35.4 to 59.0
Background (3 to 6 m), same room	3	5.8	0.5 to 13.1
Background (5 to 10 m), adjacent room	2	2.6	2.1 to 3.1
Sweeping floor (3 to 15 m)			
15 Minutes after sweeping	1	41.4	
35 Minutes after sweeping	1	26.4	

We made measurements of peak asbestos air concentrations in the breathing zone of drywall construction workers, utilizing the standard technique of the National Institute for Occupational Safety and Health (NIOSH) for asbestos sampling and analysis (phase-contrast optical microscopy at × 430) (*5*). These air samples were also analyzed by transmission electron microscopy. Air samples were taken at various building jobs and job sites and included such operations as hand-sanding, pole-sanding, mixing of dry spackle with water, and sweeping after completion of such operations. Personal air samples were also taken in adjacent areas; such air samples, taken in the breathing zones of the operators, constitute measurements of their exposure to dust.

Table 2 shows that airborne concentrations of 5 fibers per milliliter of air or more, longer than 5 μm, are common during the use of drywall taping compounds containing asbestos. This exceeds the interim legal standard excursion set by the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor. The OSHA standard calls for an 8-hour time-weighted average. The discontinuous nature of these operations suggests that the 8-hour sampling is inappropriate in that peak exposures in the present instance, under a range of application and cleanup operations, greatly exceed the maximum allowable excursions of 10 fibers per milliliter for a 15-minute interval.

These concentrations, determined by the NIOSH method, are only suggestive of the total asbestos exposure. Comparison of optical microscopic and electron microscopic analyses of asbestos fiber counts of identical samples showed that, for every fiber visible by light microscopy (×400 magnification), there were from 200 to almost 1000 that could be seen only at electron microscopic magnifications of ×25,000.

The background measurements in Table 2 suggest that in home repair work involving sanding of spackling compounds, members of the entire household or other occupants of a building may inhale asbestos fibers. This could occur during mixing, sanding, or cleaning up of debris. During mixing of drywall taping compounds, spackle is gradually poured from a bag into a bucket of water and the mixture is stirred until the desired consistency is attained. Fiber counts measured during mixing were found to be from 7 to 12 times greater than the current occupational standard. Detectable fiber concentrations were found in adjacent rooms during mixing, and fibers were still suspended in the room air at least 15 minutes after mixing had ceased. Personal air samples were taken after sanding was completed. The floors of the rooms and halls were swept with a hand broom, which raised a cloud of dust. Fiber counts could not be made on floor sweeping samples because the filters were too heavily laden to count. Samples were taken after 15 minutes had elapsed, and, in one case, 15 m away in another room. Measurements showed that significant concentrations of asbestos remained suspended and could pervade living quarters for a considerable duration of time after sweeping had ceased.

In summary, our analysis of 15 representative samples of consumer spackling, patching, and taping compounds has shown that five contained appreciable amounts of chrysotile or other asbestos minerals. Many contained substantial amounts of quartz, talc, and other minerals with disease potential. Optical microscopic analysis of personal air samples obtained during the use of asbestos-containing compounds showed concentrations frequently in excess of the current occupational standard of 5 fibers per milliliter, longer than 5 μm. Use of these materials in home repair work (for example, mixing, sanding, and cleanup) may expose the user (and other members of the household) to significant concentrations of asbestos.

Even more important, none of the 25 industrial and consumer spackling and taping compounds examined had warning labels or indication that they might contain toxic or hazardous materials. It is, therefore, recommended that potentially toxic or hazardous materials be eliminated from consumer spackling, taping, and wall-patching compounds as soon as feasible. As an interim measure, labels should be required on such products stating their content and providing instructions for the use of appropriate respirator protection and for safe cleanup procedures, including the disposal of waste materials.

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