SPRAYCRAFT corporation

2506 CONEY ISLAND AVENUE
BROOKLYN, N.Y. 11223
PHONE: (212) 645-2506

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PLAINTIFF'S EXHIBIT
USM-311

April 6, 1976

U.S. Mineral Products Co.
Stanhope, N.J.

Attn: Mr. Jim P. Verhalen

Dear Jim:

I am enclosing herewith copy of the Report published by Mount Sinai School of Medicine on "Asbestos Contamination of Building Air Supply Systems". This is the item extracted which we discussed at our last Association Meeting. I have succeeded in getting this copy from Bill Nicholson and am retaining the original here and sending a copy to you so that we may review it and come up with some unified course of action if any such thing is feasible.

With kindest regards.

Very truly yours,

SPRAYCRAFT CORPORATION

Herbert L. Levine
President

HLL:ms
Encl.

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DATED

ASBESTOS CONTAMINATION OF BUILDING AIR SUPPLY SYSTEMS

William J. Nicholson, Arthur N. Rohl, Irving Weisman
Environmental Sciences Laboratory, Department of Community Medicine, Mount Sinai School of Medicine of the City University of New York

Asbestos-Containing Spray Fireproofing

Sprayed, asbestos-containing, inorganic fiber insulation was introduced into the United States in 1935. It found considerable use during the late 1930's and 1940's for decorative finishes and acoustical insulation in night clubs, restaurants, hotels, and other buildings. When this material was also found to be useful as a fireproofing agent, Underwriters Laboratories gave approval for this purpose in 1944. The first use of sprayed asbestos-containing material for strictly fireproofing purposes on a large multiple-storied building occurred in 1958, with the construction of the 60-story Chase Manhattan Bank building in New York City. This use expanded rapidly until, in 1970, well over half of all large multi-story office buildings constructed in this country made use of such sprayed material as a fireproofing agent. Formerly, structural steel in multi-story buildings had to be encased in concrete to prevent buckling in case of fire. The use of sprayed asbestos material provided adequate fire protection and reduced installation costs through its rapid application and a lower weight load upon the structural steel components. Such spray material also has found use for thermal insulation and condensation control.

There are two principal methods of applying sprayed mineral fiber. In the dry method, dry material, including binders, is dumped from a paper shipping bag into a large hopper, where the material is agitated and subsequently blown into a 3- or 4-inch hose. The hose conveys the material to a nozzle at the actual site of application. As the dry material leaves the nozzle, it passes through the focus of a ring of fine water jets. Mixing takes place at this focal point, which is within 12 inches from the end of the nozzle. This produces a fibrous matrix held to the steel by the water-activated binders.

The wet method differs in that the material is premixed with water in the hopper, and the resulting slurry is pumped through a hose and sprayed upon the surface to be coated. The mechanical equipment is similar to that used to apply plaster. Portland cement and gypsum present in the cementitious wet mix provide a bond to building steelwork. Of the two application procedures, the surface produced by the cementitious procedure is significantly less friable.

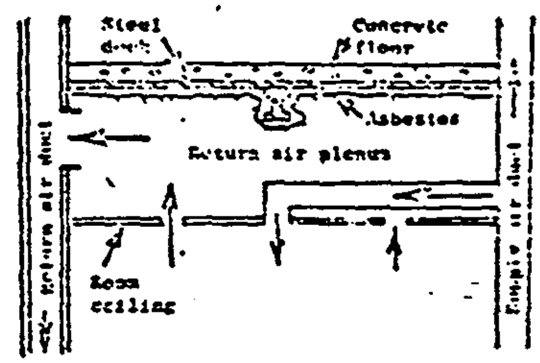
The material used for dry spray fireproofing in building construction usually is a blend of 5 to 30% chrysotile asbestos fiber, mineral wool, clay binders (as bentonite), adhesives, synthetic resins, and other proprietary agents, such as oils. The material used for acoustical and decorative purposes may contain a greater percentage of mineral wool and little or no asbestos fiber. Materials applied as a sprayed slurry often will contain vermiculite, gypsum, and shorter asbestos fibers. Because the cementitious material has a much greater density and increased weight per unit area, a supporting structure must be designed accordingly.

The quantity of mineral fiber used for spray applications in the United States increased steadily from 1958 to 1970. It has been estimated that 40,000 tons of material were used for fireproofing alone in 1969. (1) In 1969 and 1970, a survey of asbestos emissions in New York City revealed that the major office buildings under construction in Manhattan would use in excess of 2,000 tons of spray fireproofing material, estimated to contain approximately 300 tons of asbestos. Smaller buildings under construction in other boroughs use perhaps an equal amount of such asbestos material.

During the application of spray fireproofing material, it was not uncommon for the widespread dissemination of asbestos to occur. In an earlier study, (2) measurements made about sites of spray application of asbestos showed environmental asbestos concentrations to exceed those of background by more than 100 times. Because of concern for the possible health effect on the populations of urban centers from such use of asbestos, this procedure was prohibited in various localities (New York, Boston, Philadelphia, Illinois) in the early 1970's, and finally prohibited nation-wide by the Environmental Protection Agency in 1973.

One insidious form of possible environmental asbestos exposure, however, remains from this process, either through damage or erosion of acoustical spray materials, or through erosion into building air supply systems of asbestos fibers from spray-lined plenum spaces in office buildings. Figure 1 schematically illustrates a duct-supply, plenum-return air system commonly used in recently constructed buildings.

Figure 1



Cross-section of ceiling plenum space showing air flow and location of fibrous spray fireproofing covering structural steel

Here, air is supplied to occupied rooms through sheet metal ducts. Return air, however, is not ducted but passes through a plenum space formed by the hung ceiling of a room and the underside of the floor above. It then is carried to the fan room through centrally located ducts, mixed with perhaps 15 to 25% fresh air, undergoes minimal filtration, and then is recirculated throughout the building. An alternative procedure, that of having the return air also carried in a sheet metal duct from building rooms adds significantly to construction costs. As the steelwork within the plenum space has usually been sprayed with asbestos-containing material, the possibility of erosion of asbestos fibers into the air supply system exists. Additionally, maintenance activities within this space can damage the fireproofing and contaminate the air supply system.

Assessment of Asbestos Contamination

To test this possibility, 116 samples of indoor and outdoor air have been analyzed for asbestos. Nineteen buildings in five United States cities were chosen to represent the various construction uses of asbestos-containing spray materials. Usually, eight samples were taken at a given building site: two within the fan chamber sampled the return air most recently in contact with the fibrous spray material, four samples in offices at different locations within the building, and two samples of outside air taken on the roof or at the air intake to the fan room. In

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general, samples were taken over an 8- to 16-hour time period during normal operation of the air distribution system. Occasionally, samples would be taken at night to minimize inconvenience to building occupants. Most buildings were sampled three, on consecutive days.

The samples were collected on 0.8 μ pore size Millipore filters, having an effective area of 10.6 cm^2. The air flow was produced by a vacuum pump fitted with a [illegible] critical orifice. Following submission to the Environmental Protection Agency in North Carolina and [illegible], the 118 samples were analyzed using previously described electron microscopic techniques.

To prepare a sample for each analysis, a portion of the membrane filter with the collected material was mounted on a microscope slide and ashed in a low temperature activated oxygen asher for 30 minutes to one hour. This served to remove the membrane filter material, all organic material in the collected sample, soot, and other carbonaceous material. The residue, consisting mostly of fly ash and mineral matter, was dispersed on the microscope slide by grinding the sample with a much [illegible] in a solution of 1% nitrocellulose in amyl acetate for 5 to 10 minutes. The sample was dispersed fairly uniformly over two microscope slides by placing another glass microscope slide over the ground sample, and drawing the microscope slides apart. Upon evaporation of the amyl acetate, the dispersal was scanned for uniformity by light microscopy, and representative areas were chosen for transfer to electron microscope grids for scanning. For each sample, at least one grid square from four separate prepared grids was scanned. In some cases, usually those with exceptionally high values, eight grids were scanned from two sample preparations to increase the reliability of the results. In general, the scanning of additional squares yielded values approximately those originally obtained, and the results were simply averaged.

The processing of blank filters with each set of four samples served to monitor contamination and provide a measure of laboratory background. These analyses indicated an average background level of 10 nanograms (ng) existed, and this value was subtracted from each sample mass prior to the calculation of the concentration. This, in turn, led to equivalent background of from 2 to 5 ng/m^3 in a given sample of the sets analyzed here. As the background is independent of the volume of air sampled, those samples with the larger air volumes had the lower correction value.

Table 1 lists the average asbestos concentrations of indoor and outdoor air in different buildings grouped by the type and use of insulation material. Considerable variability exists in the air concentrations measured in various buildings. Average values found for the air inside buildings range from 2.5 ng/m^3 to 200 ng/m^3, with individual measurements from 0 to 800 ng/m^3. For the outside air, the variation for the average concentration at a given site extends from 0 to 45 ng/m^3. Contamination is suggested in those buildings that have average levels at least three times greater and 10 ng/m^3 higher than concentrations measured outside. Of the four buildings in which contamination is suggested (buildings B, C, D, and F, fireproofed with fibrous spray), two were recently constructed and the other two were unique in that no sealant had been applied over the asbestos spray material.

While no widespread evidence of contamination was found in this study of buildings having decorative or acoustic spray, three buildings with decorative spray had a sample with a fiber concentration exceeding 100 ng/m^3, suggesting localized contamination. Additionally, incidents of contamination at such buildings have occurred elsewhere. Where it occurred, visible damage to spray material was evident.

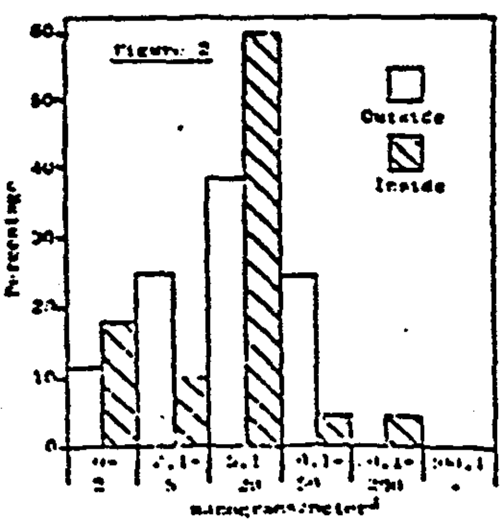
Table 1

Average Asbestos Concentrations in the Air of Buildings According to Type of Spray

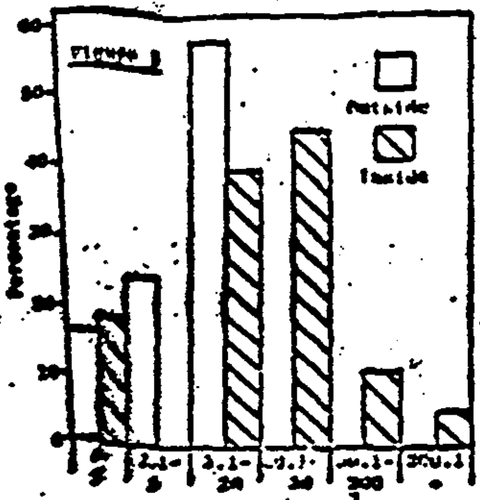
Building	Average Asbestos Concentration (ng/m^3) Building Air	Outside Air	Year Building Constructed
Cementitious Spray			
A	66*	46	[illegible]
B	12	15	1966
C	7	4	1970
D	2.5	5	1972
E	12	9.2	1968
F	0.5	24	1965
Fibrous Spray			
A	8.7	3.0	1966
B (no sealant)	20	9.2	1969
C (no sealant)	77	12	1970
D	20	8	1972
E	11	14	1968
F	200	—	1972
Acoustic or Decorative Spray			
A	2.1	4.3	1958
B	8.2	18	
C	41*	33	
D	17*	—	
E	27*	—	
No Asbestos Spray			
A	7.5	0	1932
B	9.2	2.0	1973

*An individual value exceeding 100 ng/m^3 was found, suggesting localized contamination.

Distributions of individual asbestos concentrations for buildings using cementitious and fibrous spray are plotted in Figures 2 and 3. A similar plot for buildings with acoustic or decorative spray was not possible as only limited data were available on outside air concentrations at the time of sampling.



Percentage of cementitious spray samples lying within a specified concentration range



[illegible] of fibrous spray samples [illegible] specified concentration range

Referring [illegible] figures, it can be seen that a greater percentage [illegible] concentrations exceeding 20 ng/m³ is found [illegible] air of those buildings in which dry-type [illegible] spray fireproofing has been used. (Twenty [illegible] arbitrarily selected for this comparison. [illegible] measured ambient air asbestos concentrations [illegible] absence of specific sources, are lower.) [illegible] over half of the indoor samples exceeded [illegible] with none of the outside concentrations [illegible] this value. On the other hand, there [illegible] significant difference in the distribution of air [illegible] concentrations in buildings using cementitious [illegible] material.

Environ[illegible] Concentrations

For [illegible] purposes, Table 2 lists the range of [illegible] concentrations in quarterly composites of 24-[illegible] air samples taken in 30 metropolitan [illegible]. As can be seen, the great majority of [illegible] lie in the concentration range under [illegible] only two exceed 20 ng/m³, and only one exceeds [illegible] sample taken in a city having four asbestos [illegible] manufacturing plants with uncontrolled [illegible].

Table 2

[illegible] of Ambient Air Samples
[illegible] by NASN

Asbestos [illegible]	No. of Samples in range
[illegible]	61
[illegible]	102
[illegible]	12
[illegible]	9
[illegible]	2
[illegible]	1
[illegible]	187

[illegible] chrysotile air levels near sites of spray [illegible] taken during the time period [illegible] 1970, [illegible] much in excess of background concentrations [illegible]. In other determinations of [illegible] asbestos concentrations, data taken [illegible] suggest air levels often [illegible] ng/m³. The highest concentration [illegible] circumstances has been 5,000 ng/m³.

Table 3

Chrysotile Levels Near Spray Fireproofing Sites

Sampling location	Number of samples	Asbestos air level in 10^{-9} g/m³ Range	Average
1/8-1/4 mile	11	9 -375	60
1/4-1/2 mile	6	8 - 84	25
1/2- 1 mile	8	3.5- 36	18

Health Effects

Data are accumulating that exposure to asbestos in other than occupational circumstances is sufficient to produce disease. In 1960 Wagner (4) documented cases of mesothelioma in residents of an asbestos mining area of South Africa. Many of these individuals had never worked with asbestos; their exposure was associated with living about the mines, mills, or roadways along which the asbestos fiber was transported. In 1964, in a review of 76 cases of mesothelioma in the London Hospital by Newhouse and Thompson, (2) roughly half were found to be in the former employees of an asbestos products manufacturing facility. The disconcerting feature was that of the remainder, 11 were in individuals who lived within one-half mile of the asbestos factory, and nine were in individuals who lived with workmen employed in that factory. Recently, a study (6) of the population of relatives of former workmen of an amosite products factory in Paterson, New Jersey, has shown that 35% of family members have X-ray evidence characteristic of asbestos exposure. Additionally, four cases of mesothelioma have so far been identified in this group of relatives of asbestos workmen.

No exposure data exist on the concentrations of asbestos dust to which these various populations were exposed 20, 30, or 40 years ago. However, the finding that most peak environmental asbestos exposures in similar circumstances (about sites of spray asbestos application, about uncontrolled asbestos factory operations, and in homes of insulators or asbestos factory workmen) are usually in the hundreds of ng/m³, with occasional values exceeding 1,000 ng/m³, suggests that long-term exposure of many people to concentrations above 100 ng/m³ creates a risk of later asbestos disease. Thus, the higher levels observed in some buildings in this study should be viewed with concern.

Future Monitoring Perspectives

A. Cementitious spray fireproofing

No evidence was developed in this study for asbestos erosion from cementitious spray fireproofing material used in the plenums of building supply systems. This conclusion, however, is a tentative one, as it is drawn from a limited sampling program in only six buildings. Prudence would suggest that periodic sampling of such buildings be initiated in order to verify the continued validity of the results presented here.

B. Decorative or acoustic spray application

Indications of contamination of [illegible] building from past application of acoustic spray exist in this study, as well as some isolated circumstances. Noteworthy in the latter [illegible] are a school in Wyoming, a Yale library, the Long Beach courthouse, and a U.C.L.A. dormitory. In all circumstances where significant air contamination has arisen, however, directly visible damage to the sprayed material was evident. Thus, visual monitoring of the structural integrity of the spray material appears to be sufficient to assess possible contamination. Where damage is found, however, corrective action should be taken. This action may extend from appropriately resealing the material, to complete removal, as has been done in the specific cases mentioned above.

C. Fibrous asbestos-containing spray fireproofing

This study presents strong evidence for the erosion of fibers in some buildings fireproofed with fibrous-type, dry-spray, asbestos-containing material. This is particularly evident in those buildings most recently constructed and in those buildings in which no sealant was applied over the spray material. However, all buildings will at times have repair and maintenance activities taking place in the plenum space that can lead to contamination incidents. Since visual monitoring of the integrity of the spray material in the plenum space is not possible, investigations should be made of feasible filtration systems that can be used in these buildings to remove any asbestos contamination that may occur from erosion of the fireproofing material.

D. Recommendations for future monitoring

1. An effective inspection and monitoring program should be developed that would verify the integrity of asbestos spray material used for acoustic or decorative purposes on the walls and ceilings of public rooms and buildings. This would be primarily a visual inspection to verify that damage to such material was not taking place. Only in isolated circumstances would air sampling be necessary.

2. Periodic spot sampling and analysis of the air in buildings using cementitious fireproofing should be made in order to verify the results of this study and to assure that future air contamination of these buildings does not occur.

3. More extensive sampling and analysis for asbestos should be done in those buildings where fibrous spray fireproofing has been used, in order to define the full extent of asbestos air contamination.

E. Recommendations for future control procedures

1. Research must be undertaken to determine an effective and economically feasible filtration system that can be used in buildings with air supply plenums sprayed with such fibrous materials.

2. Procedures should be developed for use during maintenance activities that may be required in asbestos-lined plenum spaces in order to minimize possible building air contamination. Consideration should be given to system isolation, area enclosure, localized wetting, and cleanup by vacuuming.

3. Procedures must be developed and specified for use in those buildings in which the asbestos is to be removed because of unacceptable contamination. Here, consideration must be given to both occupational and future environmental exposures.

References

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