

**PLAINTIFF'S
EXHIBIT**

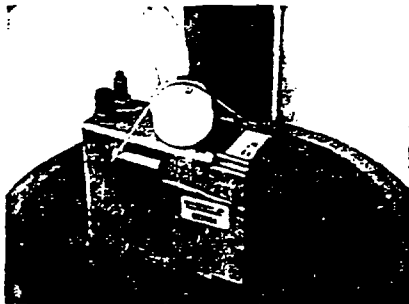
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Asbestos has been used as a building material for many years, but the greatest concentration of use was during the 1940s and 1950s, especially in shipyards during and after World War II. When ships were being overhauled, the ripped out asbestos was available at minimal charge for contractors who found ways to reuse it in public buildings as fireproofing, thermal insulation and sound proofing.

The uses included spraying it onto beams and ceilings, wrapping it around steam

and hot water pipes, and applying it in a cement form to the outside of boilers.

Most older buildings which have not been substantially remodeled during the past 20 years have asbestos wrapped around steam or hot water pipes as thermal insulation. This type of wrap-



The top photo shows a pump with filter for sampling air to determine possible asbestos contamination. Bottom photo depicts badly damaged pipes and beams — note that damaged asbestos is scattered over the floor.

ping is called pipe lagging. The building may also have a furnace which has been insulated with asbestos wrap for thermal reasons, and the structural beams and ceilings may have been sprayed with asbestos for fireproofing. Each of these uses of asbestos is an application where the material can degrade and release a substantial quantity of asbestos fibers into the environment.

There are other uses of asbestos such as in automobile brake linings, heat protecting clothing, vinyl asbestos floor tile or ceiling tiles, asbestos siding or roofing tiles and solid asbestos sheets

placed behind a fireplace, which are not as potentially harmful to the public.

How to determine the risk associated with asbestos

Most of the health hazards associated with asbestos are pulmonary or lung diseases. Therefore, for asbestos to be hazardous it has to be in a form which can be breathed. When asbestos insulation products are manufactured, the asbestos is "fluffed up" into a fibrous form and then mixed with

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One of the projects Stansel has worked on is the industrial hygiene monitoring during the asbestos removal from 24 Seattle Public Schools. Most recently she has written the scope of work specifications for asbestos abatement at Seattle-Tacoma International Airport, and has been a consultant to the FAA during an asbestos removal project at their Air Route Traffic Control Center in Auburn, WA.

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ASBESTOS

'Friable' is a term used for badly-damaged asbestos.

binders to hold the fibers together. With age, the plasters or binders holding the fibers together disintegrate allowing them to be exposed to the air and potentially be released into it.

Asbestos products such as vinyl asbestos floor tiles and house siding are much less likely to disintegrate. These materials cause problems only when ground to dust.

"Friable" is a term used to indicate asbestos in a badly damaged condition, such that is capable of releasing fibers into the air. The definition is "easily crumbled or turned to powdery dust by hand pressure." Obviously, this is a very bad definition in that it encourages a person to do exactly what should not be done — i.e. to check for friability by seeing if the material can crumble easily, thereby potentially exposing himself to airborne asbestos.

Because of this fact, the friability of asbestos should only be evaluated by experienced or specially trained personnel who

are aware of the problem and use adequate protection.

Friability is a term best used to denote and evaluate the condition of asbestos sprayed onto beams and ceilings in public or commercial buildings. However, only in rare cases does it apply to badly damaged pipe lagging or the covering of old furnaces and boilers. Since pipe lagging is usually not friable, any potential asbestos fiber release can be eliminated by having the pipes rewrapped by an experienced pipe lagger.

Asbestos in schools and public buildings

Many schools and university buildings constructed during the "baby boom," right after World War II, or to accommodate the returning GI's, are still in use. They are prime examples of where asbestos may have been sprayed onto ceiling or beams. In addition, they may have asbestos on the pipes (*lagging*) or around the boilers.

The Environmental Protection Agency has mandated through federal law that *all* schools must take certain steps with regard to asbestos building materials which may have been used in them. However, one cannot be sure the material is asbestos until it has been analyzed by a laboratory. For that reason, they refer to the materials simply as "friable".

Risk assessment for friable asbestos

Since only airborne asbestos is a health hazard, it is not necessary to arbitrarily remove all asbestos in a building. Removing it will eliminate the problems once and forever, but if the cost or logistics are prohibitive, other methods of control should be considered. The composition of the asbestos, its location and condition, as well as the degree of damage, should all be used in arriving at a decision regarding measures.

There have been two important
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Liability...

Since the only actual standards for permissible exposures to airborne asbestos fibers apply exclusively to the occupational setting, the formulation of levels considered safe for the public, or in public buildings, remains an unsettled issue. The employer is protected from excessive claims against him for asbestos-related occupational disease because the payments are made through the Workmen's Compensation system; but this is not the case for the building owner when people who are not his employees are using the building.

Because there is concern regarding both building owner liability and the size of claims which may be leveled against the building owner by the courts in the future, building owners tend to be extremely thorough and conservative when trying to assess the degree of asbestos hazard within their buildings.

The state-of-the-art analytical method for determining the air concentration of asbestos fibers is to count the fibers on a filter by scanning electron microscopy, or transmission electron microscopy, rather than by the NIOSH-approved methods for occupational exposures (using light microscopy). This method makes the smaller and thinner fibers substantially more visible by providing a magnification of 4,000 to 10,000 times, rather than 400 times. For the values from the air

samples to be useful they must be compared to values obtained from air sampled outside on a dry day and analyzed the same.

This method can be illustrated by looking at a large metropolitan airport which has a considerable amount of sprayed-on asbestos in the restricted access baggage handling areas, but none in the public areas. To decide on the appropriate control technology, bulk and air sampling and physical assessment must be done in those baggage areas. To address the issue of potential owner liability, air samples need to be taken in the public areas of the terminal (such as the baggage claim area) and then analyzed by the more sensitive, more expensive electron microscopy.

The results from both sets of samples must then be compared to outdoor samples taken either in the uncovered parking garage or in a near-by shopping center parking lot.

The typical cost for a bulk analysis by polarized light microscopy and X-ray diffraction, combined, is \$30-\$35. The same cost is typical for a filter sample of air analyzed by phase contrast microscopy. Scanning electron microscopy or transmission electron microscopy will range from \$300-\$500 per sample, and is used only where building owner liability, as opposed to employer liability, is being considered. □

ASBESTOS

Two rating systems assess the degree of risk.

rating schemes developed which attempt to facilitate these decision-making processes. The first method originated with Dr. Benjamin Ferris, at the Harvard School of Public Health; the second approach is from the Canadian Ministry of Labour.

In the Ferris rating scheme, the Ferris Index equals an expression made up of the variables expressing accessibility, condition, friability, location and percentage of asbestos:

Ferris Index = $(A + C + F + L) \times P$;
A = Accessibility, C = Condition, F = Friability, L = Location and P = Percentage.

Accessibility is the ease with which the asbestos fibers can become airborne as a consequence of the architectural design, the location of the asbestos, or the activities which are occurring in the building. It is rated 1-4, as follows:

1 = Totally enclosed (i.e. behind a suspended ceiling); 2 = Inaccessible, beyond the reach of the population using the building; 3 = Accessible in low activity areas only; and 4 = Accessible in high activity areas such as gyms, cafeterias, hallways and stairways.

Condition of the asbestos is rated by Dr. Ferris according to the degree of visual degradation, rather than encouraging tests for friability: 1 = No damage at all, the condition is very good; 2 = Mild damage; 3 = Moderate damage; and 4 = There is evidence of severe damage with areas missing, hanging loosely or showing signs of delamination and water damage.

Friability of the material is rated from 1-4. It is the extent to which the material can be broken apart when a person or object makes contact with it. This is where the hazard from pipe lagging typically becomes less severe in the rating scheme, because

pipe lagging is rarely as friable as sprayed on asbestos. The ratings for friability follow:

1 = Non-friable or firmly bound; 2 = Slightly friable; 3 = Moderately friable; and 4 = Very friable, breaks apart with very little pressure.

Location — a value of 1 is included in the equation if the material is not in an air plenum; but a value of two is used if it is. An air plenum is the mixing chamber for the return air which may be recirculated throughout the building.

Percentage of asbestos contained in the material is rated as follows: 0 = Less than one percent; 1 = One to ten percent; 2 = Eleven to twenty-five percent; 3 = Twenty-six to fifty percent; and 4 = Fifty-one percent or more.

All of these values are plugged into the following equation: **Ferris Index** = $(\text{Access.} + \text{Cond.} + \text{Fri.} + \text{Loc.}) \times \text{Percent}$.

The recommended actions are as follows: 0 - 4, No action; 5 - 9, Review in 2 to 3 years; 10 - 15, Review in one year; 16 - 20, Either surveillance or control; and 21 or over, Control.

Another decision-making criteria to be used is air sampling. Since asbestos is not hazardous until it gets into the air as microscopic fibers, measuring the airborne concentration of asbestos provides additional complementary information. The units of measurement for air sampling are fibers per cubic centimeter of air. For units of fibers per liter, divide by 1,000 to compare the results to fibers/cc. To get the units of fibers per cubic meter, fibers/cc should be divided by one million for comparison.

The air inside a building cannot be expected to be any cleaner or to contain less asbestos than normal outside air. (*The filters on a furnace simply do not trap the invisible microscopic fibers.*) In the outdoor environment there are typically 0.003 fibers/cc in rural or suburban areas, and 0.005 fibers/cc in urban areas. This is also the air level to be expected in a build-

ing which has never contained any friable asbestos building materials.

To ascertain what the air concentration of asbestos is, one can arrange to have air sampling done by an industrial hygienist, or a qualified laboratory. While there are certainly many competent people providing this service, the American Board of Industrial Hygiene has a certification program for industrial hygienists, and the American Industrial Hygiene Association certifies laboratories.

The industrial hygienist will set up a small portable pump in the location of concern and draw air at a pre-set rate through a special filter for a measured length of time — typically 2 to 4 hours — at 2 liters of air per minute. The filter traps all the asbestos fibers, plus other dirt and dust in the air.

At the laboratory, a technician cuts a pie-shaped wedge out of the filter and mounts it on a microscope slide. The filter material is dissolved, leaving the dust and fibers visible to the trained eye with phase contrast microscopy. Thus, the fibers on a known area of the filter are actually counted and calculations are performed to determine how many asbestos fibers there were per cubic centimeter of air.

Air quality standards for asbestos

Unfortunately, there are no standards as to what concentration of asbestos fibers in the air are legally acceptable for the public to breathe. The occupational health laws have been very specific about what a "normal healthy adult worker" may experience while on the job, and data exists as to the typical outdoor concentration.

When the asbestos concentration inside a building is elevated over the outside level, but is not necessarily high enough to require action under the occupational health and safety laws, plans and decisions must be made

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ASBESTOS

Removal is definitely not a job for amateurs

to remove or control the asbestos in both a conservative and a reasonable manner.

The present OSHA occupational health standard for asbestos specifies a maximum 2 fibers/cc time-weighted average exposure, and a 10 fibers/cc ceiling concentration for asbestos. As of Summer 1984, there have been several sincere, but as yet incomplete attempts to lower this permissible level. A proposed temporary emergency standard of 0.5 fibers/cc was struck down by the courts on a technicality. Immediately, the federal Office of Management and Budget submitted a revised proposal for an even more strict standard, 0.2 fibers/cc.

Despite what the rules say, most people are willing to act reasonably and minimize exposures to asbestos. Within many state-operated OSHA programs, the "action level" for airborne asbestos is set at 0.1 fiber/cc., considerably lower than the standard itself. This is the air concentration at which an employer is expected to start taking serious steps to reduce his employee exposures. It is also the concentration at which the employer needs to provide medical exams, air monitoring and elaborate record keeping. This action level of 0.1 fiber/cc is also a very significant level for the public to be aware of in deciding what to do about asbestos building materials.

If the air levels are distinctly below 0.1 fiber/cc, or close to the outdoor level of 0.005 fibers/cc, a program of surveillance may be appropriate. But, at an airborne level above 0.1 fiber/cc, steps to remove or control the asbestos are necessary. Between 0.01 fiber/cc and 0.1 fiber/cc, it is most appropriate to retain the services of an experienced professional industrial hygienist.

The asbestos control options available

There are four common procedures which can be used to control friable asbestos: (1.) surveillance; (2.) encapsulation; (3.) enclosure; and (4.) removal. It is extremely important that care be taken to plan the operation well, as there have been documented cases where enthusiasm instead of wisdom has increased airborne asbestos levels rather than controlling and lowering them.

Surveillance is not simply a matter of avoiding action in an asbestos problem, but rather a procedure of establishing records that the materials have been inspected at pre-determined intervals to look for evidence of damage. The records should include a photograph or two, plus the date; the results from air samples, if taken; and the name of the person(s) responsible for the inspection. It is not a program of avoiding action, but rather of verifying that deterioration has not occurred.

Encapsulation entails spraying, coating or painting the asbestos with a bonding sealant which will keep the asbestos fibers well glued together, and eliminate any chance of friability developing. There are two types of encapsulating products commercially available: penetrating sealers which soak into the asbestos and glue the fibers together; and bridging encapsulants, which form a continuous membrane on the surface which is impervious to fiber penetration. The two methods may be used separately or in combination.

Encapsulation is especially well-adapted for pipe lagging and may include covering the pipes with a pre-wet fiberglass cloth or vinyl wrap. It can also be used with boilers, but there are distinct limitations in using it with sprayed on ceilings. Since the sealant rarely penetrates the asbestos further than about $\frac{1}{8}$ ", it will add weight to a ceiling and may encourage delamination. The EPA has devised a very useful

decision guide for determining when it is appropriate to choose encapsulation.

Very often *enclosure* is chosen as a control method in combination with encapsulation. Examples would be putting in a suspended ceiling or a false ceiling to limit the accessibility to overhead pipe lagging. Rarely should enclosure be used by itself; but if one has decided to use regular planned surveillance and/or encapsulation, enclosing the asbestos may be both an effective and appropriate additional method of control.

Enclosure is not a method to be recommended for badly damaged or friable asbestos ceilings, since the carpentry work of adding the enclosure would in itself greatly increase the asbestos fibers released into the environment.

For badly damaged friable asbestos, *removal* and disposal in an approved hazardous waste disposal site may be the only appropriate method of control. However, removal is not a simple procedure. The project must be handled by an experienced contractor with a trained crew. As the initial step, the entire removal area will be isolated from the rest of the building with a heavy sheet of vinyl plastic. A double air-lock must be constructed to eliminate the possibility of the fibers escaping outside the removal area, and the interior must be controlled with exhaust ventilation with high efficiency particulate filters to keep it under negative pressure.

The asbestos must be dampened with a low pressure spray of water containing a wetting agent, and then removed wet.

Asbestos removal is definitely *not* a home-owner or building-manager type project. It requires elaborate controls to guard against the infiltration of asbestos into other areas of the building and/or the outdoor environment. It also necessitates that the workers be protected with respirators, disposable clothing, and medical surveillance.

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