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# Facts About Asbestos

## . . . basic information on the effects, regulation, and control of this controversial material in the plant

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THE ADVERSE EFFECTS of asbestos on human health have been the subject of much controversy recently. The Occupational Safety and Health Administration (OSHA) considers asbestos a hazardous workplace substance, and it has been designated a hazardous air pollutant by the Environmental Protection Agency (EPA).

An estimated 8 to 11 million U.S. workers have been exposed to asbestos over the past 35 years, and one study claims that 17 percent of all cancer deaths in this country in the next several decades will be linked to exposure to asbestos. Despite the continuing discussion, certain facts about asbestos are indisputable. Some types of asbestos are more common than others; the substance has definite characteristics and uses, causes certain health problems, and can and should be controlled in the industrial plant.

**Characteristics**—Asbestos refers to a number of naturally occurring fibrous minerals. There are six major types: actinolite, amosite, anthophyllite, chrysotile, crocidolite, and tremolite. Their chemical compositions are given in Table I. Chrysotile is the principal type.

Asbestos is unique. It occurs naturally in a fibrous state and is the only mineral that can be woven or spun into cloth. Each fiber usually can be subdivided into a number of fibrils of the same original length. This friability allows the stiffness or flexibility of the fiber to be altered. Asbestos resists thermal degradation and attack by acids or alkalis. It is extremely stable, will not chemically decompose, has high physical and tensile strength and extreme fineness, and is able to absorb and to filter. Because of these qualities, asbestos has been used in many processes and products.

**Effects of Exposure**—It is generally agreed that three diseases are associated with exposure to asbestos: asbestosis and two types of cancer, bronchial carcinoma and mesothelioma. *Asbestosis* is caused by inhaling fine fibers and particles of asbestos. It is nonmalignant, but causes scarring of the lung tissues. The scarring results when abnormal fibrous tissues form and connect the lungs and the pleural membranes that surround the lungs. Asbestos bodies, another type of fibrous tissue formation, are also found in the lung tissues. On the average, 20 to 40 years may elapse between exposure and the onset of the illness. The most common symptom is shortness of breath. Asbestos-induced tissue formation will continue throughout life, even after exposure to asbestos fibers has ceased. The eventual result is death.

*Bronchial carcinoma* is a type of lung cancer. Occasionally, it will develop from asbestosis. Although the average onset time is about 40 years, lung cancer may develop at much earlier dates. However, a large majority of patients with asbestosis succumb before bronchial carcinoma develops.

*Mesothelioma* is an almost always malignant tumor of the pleura (a delicate membrane that encases the lungs) or of the peritoneum (a similar membrane that lines the abdominal cavity). Historically it was considered a rare disease, but it has shown up in persons exposed to asbestos fibers. Mesothelioma can develop separately, without a prior case of asbestosis.

Asbestosis and bronchial carcinoma usually are linked to high exposure to asbestos dust; mesothelioma can develop from low asbestos exposure. Meso-

Workers removing asbestos from pipe are protected from possible harmful exposure by coveralls and hoods of Tyvek spunbonded olefin material. Use of personal protective equipment is one way to guard against the adverse health effects of asbestos fibers. (Photo courtesy of Du Pont Co.)

**TABLE I. CHEMICAL COMPOSITION OF SIX MAJOR FORMS OF ASBESTOS**

| | |
|---|---|
| ACTINOLITE | $2CaO\text{-}4MgO\text{-}FeO\text{-}8SiO_2\text{-}H_2O$ |
| AMOSITE | $5.5FeO\text{-}1.5MgO\text{-}8SiO_2\text{-}H_2O$ |
| ANTHOPHYLLITE | $7MgO\text{-}8SiO_2\text{-}H_2O$ |
| CHRYSOTILE | $3MgO\text{-}2SiO_2\text{-}2H_2O$ |
| CROCIDOLITE | $Na_2O\text{-}Fe_2O_3\text{-}3FeO\text{-}8SiO_2\text{-}H_2O$ |
| TREMOLITE | $2CaO\text{-}5MgO\text{-}8SiO_2\text{-}H_2O$ |

thelioma is usually fatal and, like asbestosis and bronchial carcinoma, has a long latency period.

**Regulations**—Two federal agencies are primarily responsible for regulating asbestos emissions: OSHA and EPA. OSHA is responsible for worker safety and health; EPA is in charge of guarding the health of the general population. Other agencies involved include the National Institute for Occupational Safety and Health (NIOSH) and the Food and Drug Administration (FDA).

The Occupational Safety and Health Act contains special provisions for the control of toxic substances, including asbestos dust. A worker may not be exposed to more than two fibers of asbestos more than 5 microns long per cubic centimeter of air on an 8 hr, time-weighted average. Also, no worker may be exposed at any time to airborne concentrations in excess of five fibers per cc. OSHA also has established means to comply with these regulations, including provisions for protective equipment, methods of measurement and monitoring, caution signs and labels, housekeeping and waste disposal procedures, and record keeping and various types of required medical examinations. OSHA now has proposed that the allowable exposure be lowered to 0.5 fiber per cc of air.

Asbestos regulations apply to three areas under the jurisdiction of EPA: water, toxic substances, and air. Water pollution regulations have been established to cover certain sources of asbestos including the manufacture of asbestos-cement pipe, asbestos-cement sheet, asbestos paper (starch binder), asbestos paper (elastomeric binder), asbestos millboard, asbestos roofing, and asbestos floor tile. In these regulations, asbestos is considered only an incompatible water pollutant; adverse health effects from ingestion of asbestos fibers have not been determined.

Effluent from these source categories is to be treated with the best currently available practicable control technology. No limit has been set for asbestos fiber content, but maximum limits have been established for total suspended solids and pH control for 1 day and for an average of daily values over 30 consecutive days.

Each source category has different limitations because the best practicable control technology varies from process to process. For example, the limitations for the asbestos-cement pipe category are: a maximum of 1.14 lb of total suspended solids per ton of product per day, and an average of 0.38 lb of total suspended solids per ton of product over 30 consecutive days. The pH of the effluent must be between 6.0 and 9.0.

EPA's Office of Toxic Substances (OTS) enforces the Toxic Substances Control Act. Now in its infancy, this act will eventually become a useful tool in controlling chemical substances. (For a review of TSCA, see PE 7/20/78, p 94, file #7501.) A chemical substance inventory is being made and will be used to identify substances and determine characteristics and uses of chemical compounds. Asbestos is on the preliminary list. Although the OTS does get involved in cases of toxic contamination, asbestos contamination is still handled primarily by the air and water agencies.

Asbestos was designated a hazardous air pollutant by EPA in March 1971, but, because there is no reliable and accurate measurement technique, the standard contains no numerical limitations. Particulate emissions must be limited as much as possible, certain pollution control devices are required, and visible-emission limitations and work practices are imposed. The regulations continue to expand each time another significant source of asbestos emissions is found.

Asbestos-related air pollution regulations cover a number of categories: asbestos mills, road construction, manufacturing, demolition and renovation, spraying, fabricating, insulating, and waste disposal. For asbestos mill and fabrication operations, no visible outside emissions are permitted.

Manufacturing is divided into 11 subcategories: textile; cement products; fireproofing and insulation; friction products; paper; floor tile; plastics and rubber materials; chlorine; shotgun shells; concrete; and paints, coatings, caulks, adhesives, and sealants. Fabricating includes cement building products, friction products (except installation on motor vehicles), and cement or silicate boards.

Before building demolition and renovation in which substantial amounts of asbestos are involved, asbestos-covered items must be removed in pieces or stripped. During stripping, handling, and cleanup operations, asbestos must be wet.

Spraying materials that contain more than 1 percent asbestos on a dry weight basis also must meet the no-visible-emission requirement. Asbestos materials encapsulated with bituminous or resinous binders during spraying which are not friable after application, are exempt from spraying regulations.

Asbestos waste disposal requirements are extensive.

**TABLE II. INDUSTRIAL USERS OF ASBESTOS**

| | |
|---|---|
| **Asbestos-Cement Products Industry** | |
| roofing and siding shingles | cement water pipes |
| insulation board | asbestos-reinforced asphalts |
| electric motor casings | special concretes |
| wall materials | |
| **Floor-Tile Industry** | |
| **Asbestos Paper Industry** | |
| asbestos paper, felts | military helmet linings |
| roofing, padding | auto mufflers and hoods |
| stove linings | shotgun cartridges |
| heaters, cabinets | boiler coatings |
| **Friction Materials** | |
| brake linings | clutch facings |
| **Protective Coatings** | |
| paints | putties |
| sealants | caulking compounds |
| undercoatings | fireproofing coatings |
| **Textile Industry** | |
| curtains, draperies | fire hose |
| insulating wrapping | safety clothing |
| ironing board covers | filters for gas masks |
| motion picture screens | |
| **Food Processing** | |
| filters for processing fruit juices, alcohols, medicines, acids, etc. | |

Essentially, no visible emissions are allowed during handling, and all wastes must be disposed of at a sanitary landfill or its equivalent. If the dumping site does not meet sanitary landfill requirements, measures such as fencing, warning signs, or earthen covers may be necessary. Active and inactive disposal sites are included.

The Food and Drug Administration enters the picture because asbestos can be a contaminant in various foods or drugs. However, because of the lack of definitive evidence of the health hazards of ingested asbestos fibers, little action has been taken. Two regulations have been proposed: any food or food packaging material containing talc (which contains asbestos fibers) will be considered adulterated, and the use of asbestos-containing filters in the manufacture of parenteral drugs will be prohibited unless no substitute means of production exists.

**Contamination and control**—Asbestos contamination commonly occurs in five industrial operations: mining asbestos ores, milling asbestos ores, manufacturing products containing asbestos, using products containing asbestos, and disposing of asbestos-containing wastes.

In manufacturing, commercial grade asbestos from the mill is an ingredient in many products, Table II. Processes involving the use of asbestos fall into four general categories: receiving and handling raw asbestos, preparing asbestos fibers, blending and mixing asbestos with production materials, and handling asbestos-containing products.

Asbestos pollution occurs primarily in the handling, transport, and mixing of raw asbestos and when products containing asbestos are sawed or trimmed. Emission problems usually are controlled by maintaining the entire work area under a slight negative pressure or by exhausting contaminated air to a control device. Localized hooding systems minimize worker exposure to asbestos within the plant. For example, conveyors, mixing bins, loading/unloading areas, etc., should be fitted with hooding systems ventilated to fabric filters.

Many end uses of products containing asbestos are common. Some examples are spraying of asbestos-containing materials, field fabrication of asbestos-containing products, and use of friction products containing asbestos. Air pollution control systems are generally inadequate in these operations. They are generally performed in populated areas in locations exposed to the atmosphere. These uses, along with disposal practices, pose the most significant threat to the industrial worker.

Spray application of asbestos-containing materials is extensively employed for fireproofing of steel structures, and for insulation, soundproofing, and acoustical and decorative purposes. When used for fireproofing, the material usually is applied wet, as a ¼ in. thick coating, and allowed to dry to a hard finish. Large amounts of asbestos are used to cover a large surface area. In other uses, sprayed asbestos coatings range from ½ to 1½ in. thick and can be very soft and spongy in texture.

Emissions from spraying operations occur from overspray or from material that is not wet enough to adhere. Many operations are performed in open air and at high elevations, and large quantities of the material can settle on working areas and become secondary sources of asbestos pollution.

Pollution control devices cannot be used to control open-area emissions, so good work practices are needed to minimize pollution. Proper wetting of the spray, accurate spraying, minimizing the distance between the area being sprayed and the nozzle, and vacuum cleanup all are helpful. Whenever possible, the area should be sealed off by plastic-sheet barriers to contain the emissions.

Onsite applications of asbestos-containing products such as insulating materials, siding shingles, building boards, papers, and cement pipes can also be a major source of asbestos fibers. Field fabrication of such materials frequently requires fitting, sawing, and cutting, operations that emit asbestos fibers. Conventional emission control techniques, again, generally are inadequate. Instead, the work area should be isolated with plastic sheeting and strict cleanup practices should be employed. In some cases, portable cutting tools can be equipped with vacuum systems to collect the dust at the source.

Friction products containing asbestos include brake linings and disc brake pads, clutch facings in automatic transmissions, and brake blocks on trucks and construction and industrial equipment. Emissions occur during normal use from wear and during inplant repair. Localized vacuum and hooding devices should be used in repair shops to control emissions from grinding and relining operations; emissions from normal use are uncontrollable.

**Disposal**—All the processes and operations discussed generate asbestos-containing wastes, including broken and extra pieces, debris from demolition and renovation, tailings from mining and milling operations, particulate matter from pollution control devices, and other items contaminated with asbestos.

Fugitive emissions associated with disposal practices are generated by wind, vehicular traffic, or unloading operations. These emissions can be minimized by keeping wastes wet and by dumping on calm days. Dumped wastes should be covered with earth and a vegetation cover should be grown on the surface.

Proper work practices and cleanup procedures should also be employed during demolition or renovation. Asbestos fibers can be discharged to the atmosphere through ventilation systems. Enclosing the area to be renovated limits the contamination. Again, asbestos materials used in these projects should be kept wet during removal, transportation, and disposal to minimize unwanted emissions.