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Dust Control Techniques in the Asbestos Industry

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Asbestos fiber is a remarkable and useful material in modern-day technology. Long exposure and relatively high concentrations cause various diseases. Process changes, leaktight equipment, industrial exhaust systems and dust filters are used to control dust exposures in mining and milling and manufacturing. Examples from asbestos mills, asbestos-cement pipe plants and textile operations are given. Belt conveyors, vibrating screens, bag opening stations, machine hoods, and textile cards are discussed. Duct design and filter selection are discussed.

Asbestos Fiber

ASBESTOS FIBER IS A REMARKABLE MATERIAL. It is literally a fibrous form of rock. It has the chemical composition of the rock with which it is associated. Table I lists some of the physical properties of the three most important types of asbestos fiber as well as those of the more common natural and man-made fibers. The greater surface area and the remarkably small fiber diameters of asbestos fiber are apparent. Two other properties that render asbestos fibers unique are their temperature resistance and their relative inertness to some types of chemical attack.

Asbestos fibers, although rocklike in chemical composition, are flexible enough to be spun into yarns and woven into cloths with heat stability known to the ancient Egyptians and Greeks.

Of the three forms of asbestos listed in the table, chrysotile is the most valuable economically in the United States, where it represents 95% of the over 800,000 tons of asbestos fiber used annually. In Quebec, Canada, where most of the fiber imported into the United States is mined, the asbestos is graded by numbers from 1 through 7. Group 7 represents the shortest fiber lengths and the lowest price; both length and cost increase with each group to group 3, which is suitable for spinning into yarn. Groups 1 and 2 are hand-cobbed fibers, produced in such small quantity as to have small economic importance.

Health Hazards

The first reports of asbestos-related disease were described as early as 1907. However, it was not till 1930, when Merewether and Price published an epidemiological study

TABLE I
Properties of Asbestos Fibers
Compared with those of Organic Fibers

Type	Color	Surface Area (sq cm/gm)	Tensile Strength (psi)	Fiber Diameter (μm)
Chrysotile	White	130,000–220,000	80,000 –100,000	0.02
Crocidolite	Blue	—	100,000 –300,000	0.03
Amosite	Yellowish brown	—	16,000[a]– 90,000	0.03
Common natural and man-made fibers		3,000– 10,000	80,000[a]	10–20

[a]Cotton.

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Elements of Dust Control

The methods used in the asbestos industry for the control of asbestos are the classical methods used by dust control engineers in all industry:

1. Enclose any dust source as fully as possible.
2. Place all dust-producing equipment under negative pressure by connecting to exhaust ventilation of adequate capacity.
3. Design and install a properly designed duct system.
4. Filter the dust-laden air adequately.
5. Move the air with fans of the proper types, having adequate volume and pressure capabilities.
6. Where normal principles of dust control are difficult or expensive to apply, process changes must be considered.

Describing how all the principles of dust control are applied to the field of asbestos mining and manufacturing is a massive job beyond the scope of one paper. Examples illustrating the principles given above will be described. Some of the methods are unusual and may be fruitfully applied to other industries.

Mining

The two most widely used pieces of equipment in asbestos mills are troughing belt conveyors and vibrating screens. In early milling operations, before about twenty years ago, these pieces of equipment were not covered to prevent dust generation in the mills.

The dust problems caused by belt conveyors are as follows:

1. Dry materials carried on the belt conveyor, at high speed, generate dust in the mill.
2. Chutes feeding either from one belt to another, or from other equipment onto the belt, generate dust.
3. The return belt is a serious source of dust contamination in asbestos mills. Dust carried on the bottom of the return belt is engraved on every idler carrying the return belt. Each idler becomes a source of dust generation.

Conveyor Enclosures

Figure 1 shows an enclosure that is often used to enclose the top portion of a troughing conveyor. It is particularly used at the location of chutes feeding either from one belt to another or from other equipment onto the troughing conveyor. This enclosure normally has a sheet metal section that encloses the belt on three sides. Rubber skirting on the two vertical sides bears against the surface of the belt. This skirting is adequate to prevent dusting from the material that rides on the belt. Of course, the belt width and the speed of the belt must be adequate to carry the material load within the skirt boards; otherwise the value of the skirting is negated by material forcing its way under the rubber skirting and out of the conveyor enclosure.

Chutes feeding the conveyor should feed axially onto the belt. The material should not be forced against the skirting. If possible, the chute should also be arranged so that a rock box may be placed at the base

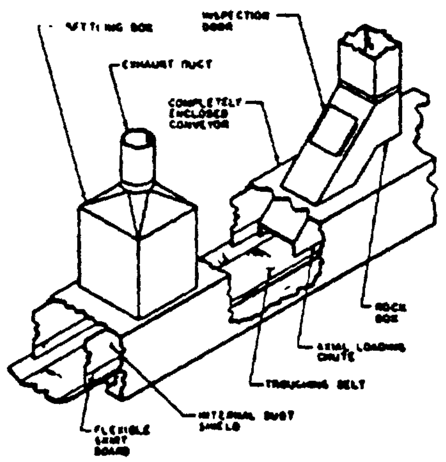

Figure 1. Conveyor belt enclosure.

finished products. Literally miles of chutes carry the material in process.

The design of the chutes is critical in determining the cleanliness of an asbestos mill. First and foremost, they must be designed to carry the required quantities without plugging. This specification requires that the chutes be adequate in cross section and be run at angles that cause material flow and minimize hang-ups. Long, straight drops must be avoided because a change of direction at the base of such a run will cause plugging or will pump large quantities of dust-laden air that will contaminate the mill.

Finally, the chutes must be free of leaks yet allow ready access in case of blockage. Access doors and poke holes must be provided but must be leak-tight in initial construction and remain so in use.

Where only asbestos fiber is handled, chutes may be of 10-gauge, all-welded steel, on the bottom and sides. The top cover can be even lighter gauge. However, the seams must be leak-tight. Cloth tape may be used for this purpose.

Where ore-containing rocks must be handled in chutes, they may be 3/16-inch or ¼-inch plate bolted and gasketed. For

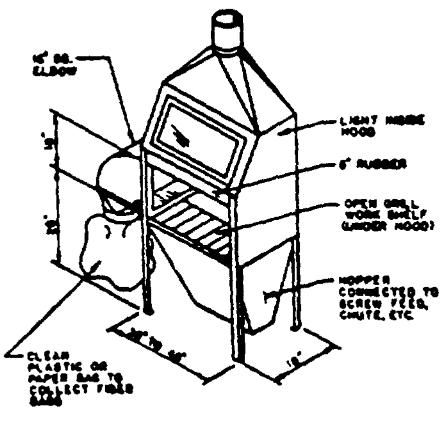

Figure 4. Asbestos fiber bag-opening station.

abrasion resistance, Ni-Hard liners may be required, since dust leakage may be due to holes worn in the chutes, as well as other leaks.

Packers

Most of the mill operations in the separation, grading, and mixing of asbestos fibers are done without human aid. However, the packing of the finished fiber used to be a manual operation. The pressure packer, developed by Johns-Manville, eliminated most of the human handling. The fiber is weighed, compressed, and forced into a paper bag for shipment with a minimum of human effort.

Manufacturing

Most manufacturing operations receive pressure-packed bags of asbestos fiber in 100-pound bags that are palletized and shipped in boxcars. Dust control starts with the unloading operation of the boxcar. Care in shipment and unloading is required to eliminate bag breakage and contamination of the boxcar. Dirty bags should be repaired and vacuum cleaned before storage in warehouse areas.

The pressure-packed bags are brought to manufacturing areas and opened in bag-opening stations, as shown in Figure 4. The pressure-packed bag must be put in the bag-opening stations before the paper bag is slit. An in-draft of approximately 200 feet per minute is maintained in this station by the dust pipe.

The fiber cake may be fed into an opening machine or into the boot of an elevator. The opened bag may be charged into a clean bag, a shredder, or a large (16-inch-diameter) bag-conveying pipe. Machines may be necessary to break up the pressure-packed cake so that it can be handled in the manufacturing process. This machine may feed into a large ventilated opening such as the boot of an elevator, or into a low-pressure pneumatic conveying system which controls the windage from the machine.

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The organic lap is fed in the form of rolls into the card, avoiding the difficult problem of conveying blends containing organic fiber to the feed box at a card machine. Scraper conveyors, installed below the card, carry accumulations of asbestos fiber blend back into the card operation.

Wetting

In mining operations, particularly in ore processing and crushing, wet ore causes much less of a dust problem than dry ore. This observation has been applied to manufacturing. In textile manufacturing, wetting the yarn reduces dust generated in twisting and in weaving.

Wet cutting and fiber opening have been applied to reduce the dust generated in manufacturing operations.

Exhaust Ventilation

Equipment that handles asbestos fiber must be designed as leak-tight as possible. This includes bins, elevators, conveyor enclosures, screen covers, screw conveyors, chutes, and conveying ducts. However, it is impractical to design equipment that is leak-tight at installation and from then until the end of the useful life of the equipment. Exhaust connections are therefore installed to maintain all leaks and openings under negative pressure so that room air may leak into the asbestos system instead of dust leaking out.

The number of variables affecting the amount of air to be exhausted is so great that only experience can indicate the amount of exhaust to be applied to each of the dust producers in the industry. However, the principle is an important one. It is desirable to maintain all parts of asbestos control systems under negative pressure. It is more desirable to carry air under negative pressure than to pressurize an asbestos dust system.

Duct Design

Velocities

Ducts are designed to carry air at velocities ranging from 3000 to 3500 feet per minute to 5000 to 5500 feet per minute. The lower velocities are used for dust control ducts where relatively small concentrations of well-opened fiber must be carried, such as the dust control systems at textile plants. The highest velocities are used where space is restricted and where large chunks of material must be carried, as in dust systems for the machines that cut and shape Transite pipe.

Most systems, including low-pressure pneumatic conveying systems, function well at duct velocities of 4000 to 4500 feet per minute.

Dust Risers

In multistoried asbestos mills, a practice has developed where vertical risers that have no carrying velocity are installed. The main value of these risers is to allow flexibility in the mill. Duct connections may be added in future years with no concern for settlement or overloading the riser. At the base of the riser, a rotary valve must be installed to remove settled material.

Materials of Construction

Ducts are generally built of sheet steel, black or galvanized. Table II shows the sheet metal gauges commonly used for most duct sizes. These gauges are suitable for most average-duty dust systems. For heavier duty and more abrasion resistance, elbows may be made of 14-gauge welded construction. They may be square, with a removable back plate, sometimes protected by suitable rubber linings.

Since ducts are generally round for dust

TABLE II
Sheet Metal Gauges
for Duct Handling Asbestos Fiber

Diameter Straight Duct	U.S. Standard Gauge Steel Duct
4–8	20
9–18	18
20–30	16
31–40	14
41 & over	14

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will dictate the use of various synthetics despite reduced efficiency.

High-energy scrubbers are used today only where moisture problems preclude the use of fabric filters. There are few examples of such applications. Scrubbers may become somewhat more prevalent, but it is not believed that they will be competitive with fabric filters.

There are few instances of electrostatic precipitators in the asbestos field. In general, small electrostatic precipitators are much more expensive than fabric filters. In the old Johns-Manville Jeffrey Mills, there was a high-voltage electrostatic precipitator that filtered about 1,400,000 cfm. Its efficiency was poor, about 70%. At present, a fabric filter is filtering about 5,000,000 cfm. Its efficiency exceeds 99.99%. In addition to numerous small filters, there is one on the ore dryers filtering 700,000 cfm, and a normal ambient temperature filter filtering 600,000 cfm.

Fans and Fan Systems

It is certainly preferable to operate fan systems that control asbestos fiber dust so that the entire system is under negative pressure. All leaks would, therefore, leak room air into the system instead of leaking dust out. In that event, the system fans are located on the clean-air side of filters. Fans used in that location may be air-foil bladed or backwardly curved fans to save power. In small systems, material-handling fans with "air" wheels are also used.

In some instances, where it is desirable to simplify systems or to reduce costs, filters have been operated under positive pressure with fans handling dust-laden air. Fans in that location are radial-wheel, material-handling fans. Of course, the system following the fan, and the fan itself, must be completely leak-tight.

Vacuum Cleaning Systems

Regulations recently promulgated prohibit the use of brooms and compressed air to clean dust off equipment in plants and mines that use or manufacture asbestos fibers. Effective and well-designed vacuum cleaning equipment is required.

There are numerous types of portable vacuum cleaning units on the market. They range from the great array of units suitable for household use to large, heavy-duty units designed primarily for industrial work. Most of the light-duty units available on the market have no place in industrial plants.

1. Tools and hose must be 1½ or 2 inches in diameter. Smaller equipment cleans too slowly. Larger equipment is too unwieldly.

2. The static pressure in the 1½- or 2-inch pipe of a tool connected to a 25-foot length of flexible hose should be 1 to 2 inches of mercury. This pressure should not fall off rapidly with use.

3. The most important single feature of a well-designed vacuum unit is the filter. It should be a fabric filter of sufficient area to maintain good suction at the tools in use. Small single bags and paper filters are inadequate to do a good filtration job.

4. A heavy-duty, multistage centrifugal compressor, powered by a 3- to 7½-horsepower motor, can generate the required airflow and pressure to operate a satisfactory machine.

5. The unit must be equipped with a reasonable size dust bucket so that cleaning can go on for adequate periods.

Stationary systems have been used in asbestos mines and plants for many years. Piping systems, carefully designed, can bring vacuum cleaning connections to every area of a mill or plant so that men equipped with a 25-foot length of hose and tools can clean everywhere. The central station equipment is similar to that desirable for portable equipment, except that the size and pressure must be greater. The capacity depends on the number of men who will use the system at any one time. The pressure must be

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Jim Culp
for your info,
Ernie H.

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Enclosed you will find three (3) articles relating to Health and Asbestos Fibre. We thought you might find these to be of interest.

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Very truly yours,

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Sr. Customer Service Coordinator
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