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Dust Control in the Asbestos Textile Industry

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Some of the sources of asbestos dust exposures in the asbestos textile industry are described. Two important and moderately involved dust control problems are discussed for carding units and weaving looms. Illustrations are included.

Introduction

IN A VERY comprehensive publication *Industrial Health Hazards and Occupational Diseases in Ohio* resulting from a statewide survey during 1914 by Dr. E. R. Hayhurst, Director, Division of Occupational Diseases, no mention is made of any asbestos processing operations, possibly because there may not have been any in Ohio at that time.

Between October 1929 and January 1931, a study was made of the potentiality of asbestos as a health hazard for the Metropolitan Life Insurance Co. by Dr. A. J. Lanza, Dr. W. J. McConnell, and J. W. Fehnel. This request came from officials representing the asbestos industry in the United States.

Then followed a two-section publication by the Commonwealth of Pennsylvania, Department of Labor and Industry, issued as Special Bulletin No. 37, October 1934, and No. 42, September 1935. This study was under the supervision of Dr. W. B. Fulton, Chief of Industrial Hygiene. This was followed by *A Study of Dust Control Methods in an Asbestos Fabricating Plant* in October 1938 by J. J. Bloomfield and R. T. Page of the Public Health Service. The following are some of the conclusions at the end of this study: "Adequate data have not yet been published to justify the determination of threshold limits of dustiness which will produce asbestosis in any definite period of time. In the absence of such threshold values, it is not possible to determine permissible limits of dustiness on a medical basis. Nevertheless, any appreciable decrease in the amount of asbestos dust will cause a decrease in the incidence and severity of the resulting asbestosis. The elimination of all dust in an industrial workroom is rarely necessary from a physiological standpoint and usually economically impracticable."

The first comprehensive medical and engineering study of the health hazards in the asbestos textile industry in this country was made in 1937. This was a cooperative study made by the U. S. Public Health Service and the State Board of Health and the Industrial Commission of North Carolina. The results of this project were published as Public Health Bulletin No. 241 entitled *A Study of Asbestos in the Asbestos Textile Industry.*

Operations and Controls

Asbestos as received in burlap bags, passes through a scheduled routine of operations such as preparation, carding, spinning, twisting, brake-band and broad cloth weaving and through other varied processing equipment, depending upon the final use of the products. This paper covers some of these processes.

Not much of the asbestos processing equipment is or has been designed for asbestos production. Practically all equipment in use is similar to that used for cotton and woolen goods production, with only slight or no modification.

Figure 1 illustrates the first major operation in asbestos processing to free the fibers from the rock—the use of a mill for crushing the raw stock as it is received from the mines. Though not much dust seems to be dispersed during the crushing action of the large steel rollers as they revolve about on the inside of the steel housing, which operation may range from 5 to 20 minutes, considerable dust is dispersed when the stock is dumped out of the burlap bags and again when the crushing operation is completed and the stock is either discharged to the floor, into wheeled contain-

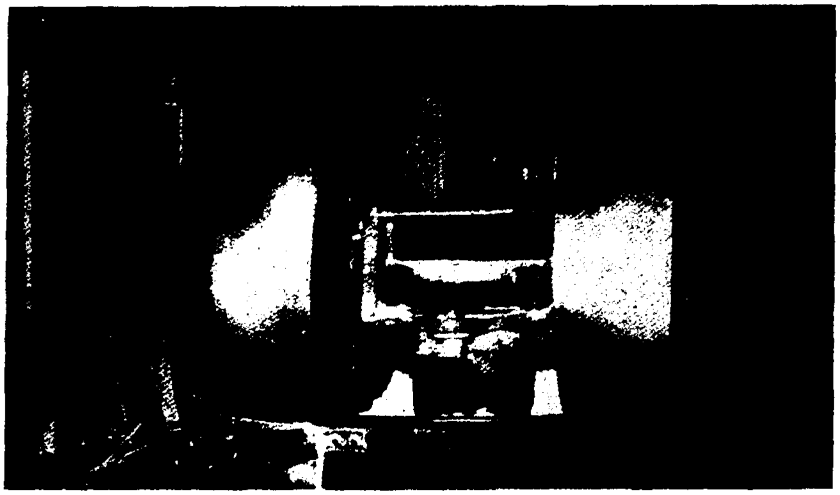

FIGURE 1. Mill for crushing asbestos fiber.

ers or replaced in bags by hand for subsequent processing. The particular technique involved depends upon the extent of the variations in production procedures or the extent of the mechanization which has developed in the industry.

Little published data are available relative to operator exposure at these units, usually one or two in a plant, since there are many other processing units continuously in operation in the same department, so that results are usually tabulated under the heading of Preparation Department. Concentrations may vary from 2-8 million particles per cubic foot of air (mppcf). Operators are not usually stationed at these units even though the cycle of operation may be of short duration. This situation may vary depending upon stock production demands.

The entire top of the steel pan may be provided with a mechanically exhausted enclosure, complete with an opening through which a bag of stock may be emptied. Operators should be provided with and be required to wear approved respiratory equipment, but this is rarely done. If available, the equipment is usually not worn.

An Opener or Willower is illustrated in Figure 2. In some of the older plants crushed stock was usually dropped on the floor and actually heaved into the open feed bin of the unit—shown at the right of the unit, provided with exhaust. Handling was usually performed by means of a pitchfork. This hand tool created as serious a problem in the asbestos textile industry as does the shovel in the foundry industry. In many installations modern handling procedures feed the crushed stock directly to the feed bins, eliminating one serious source of asbestos dust dispersion in the Preparation Department.

The beating and combing action which takes place within the machine produces a large amount of dust which is forced out of the usually loose-fitting enclosure. The production of dust is severely increased when waste asbestos, recovered from cyclone separators which form a part of the usual dust removal system, is willowed for reclaiming purposes. This is called "fly willowing."

All asbestos fibers must be mixed with cotton before they can be spun and woven. As a rule, from 5 to 20% by weight of cotton is added to asbestos textiles produced in this country. This is due to the fact that the individual asbestos fibers resemble fine polished metal rods, free from any serrated surfaces. This characteristic explains the extreme difficulty encountered in attempting to spin a thread of pure asbestos. A certain amount of cotton fiber must be added as a binder or supporting agent for proper spinning. Modern textile production specifications may also include the use of synthetic fibers.

The pre-mixing operation is called piling or layering and consists of placing cotton and asbestos in alternate layers in a pile. In some of the older plants this is or has been done on the floor near the Picker Mixing Unit. This is an exceedingly dusty operation. Modern procedures have eliminated hand layering or piling and it is now done automatically by feeding both stocks on to a belt conveyor for transportation to the mixing unit. In some plants a spray of mineral oil may be automatically added to the layered stock.

The Picker Mixing Unit also produced considerable asbestos dust. Modern adequate dust control has changed this. The initial dispersion resulted when the mixed stock was discharged into the feed hopper and the high speed internal cylinder and auxiliary rollers created fine dust which was forced out of the enclosure by the fan action of the equipment. In the older installations partial enclosures, little or inadequate local exhaust and pitchfork handling of stock, all added their quota to the dust exposure. These serious dust-producing operating conditions have practically disappeared from the modern asbestos textile plant.

The mixed stock is usually air-conveyed to storage bins before it goes to the next operation which is carding. Mixed stock from the storage bins is hand moved or forked to hand trucks. On arrival at the carding units, the stock is again hand moved from within the trucks to the feed hopper of the first unit of breaker card. Revamped handling procedures in some of the modernized plants may include pneumatic conveying of the stock directly to the feed bins of the Breaker Card Unit. The carding performs two functions, provides additional mixing and arranges the fibers in parallel positions to form roving from which textile yarns are produced.

The twin carding units consist of a breaker card and a finisher card. The stock is transferred from the rear of the first card to the rear of the second card by a so-called camelback inclined slat conveyor. Each card consists of a central large diameter cylinder and many auxiliary rollers, the surfaces of which are studded with fine steel bristles like a hair brush. These are high speed machines, which cause considerable asbestos dust dispersion.

The exit mechanism of the finishing card separates the web into ribbons and by means of a transverse action of rubber-covered shafts, these ribbons are rubbed mechanically and are condensed into untwisted strands called roving.

All carding units are provided with enclosures, some partial and some complete, and are mechanically exhausted. Much is to be desired relative to dust control in some installations. There are two problems involved, containment of the fine asbestos dust created

FIGURE 2. Fiber recovery process using willower and vibrating screens.

FIGURE 3a. A standard card enclosure with exhaust ventilation at the top-center.

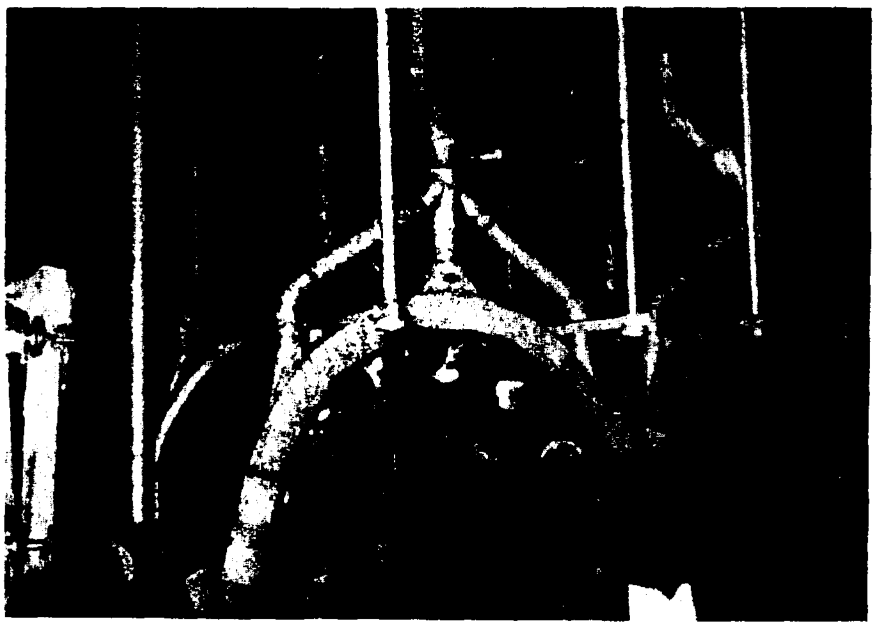

FIGURE 3b. Engineering enclosure of a card. Photograph taken with exhaust ventilation in operation.

by the action of the high speed pin-studded processing cylinder and circumferential rolls and the application of minimum exhaust to prevent the removal of stock from the cards to the dust collectors. Since the fan action of the equipment creates an internal pressure within the enclosure, any opening becomes an exit port for the dispersion of fine asbestos dust particles.

In Figures 3a and 3b two types of applied exhaust are illustrated, first a so-called standard "trade" type and the second a studied and engineered design which had proven satisfactory in one plant. The acceptance was based on the definite reduction in visible dust dispersion and a demonstrable reduction of essential stock removal from the stock being processed. There is no top central exhaust as is normally provided through the so-called "standard" card enclosure. The two partial circumferential ducts, 4 x 6 inches are provided with slots one-half inch wide along the lower plate of each duct. Three 4-inch diameter exhaust connections distributed along the top plate of each duct provide excellent exhaust distribution.

Subsequent processing operations involve spinning, twisting and winding. The yarn or roving is twisted or spun into threads on either mule or ring spinning frames. The spinning process is one of imparting a twist to the roving to facilitate further processing and to provide tensile strength. The twisting operation involves the twisting of several single yarns to provide larger and stronger yarns. Figures 4a and 4b illustrate a twisting frame and a modern spinning frame. Few of these units are provided with exhaust though the present tendency is to provide such protection.

FIGURE 4b. A front baffle on a spinning frame effectively controls the dust. The enclosed bottom area is provided with exhaust ventilation.

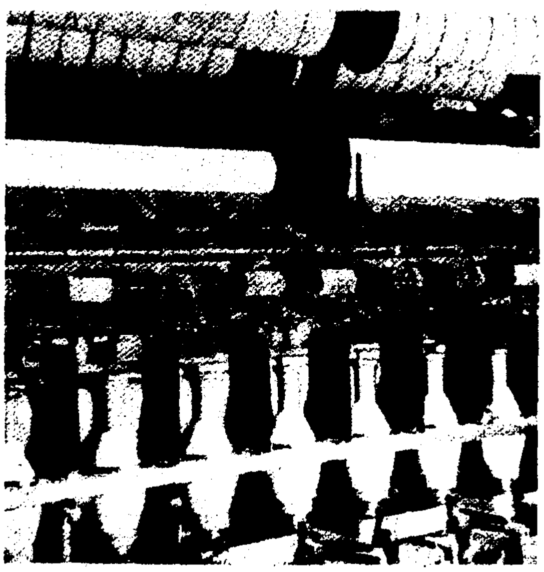

FIGURE 4a. This view of a twisting frame shows where whipping action of threads causes dispersion of the dust.

In February 1947, a design was submitted to one plant to exhaust one spinning frame as an experiment. The idea was rejected, possibly because there was no such unit properly functioning in the entire industry at that time. A spinning frame is approximately 39 ft. long and production mechanism is located both along the front and rear upper longitudinal machine areas.

The design contemplated blanking-off one main longitudinal section extending upwards approximately 16 inches from the floor and two other auxiliary longitudinal sections each approximately 8 inches in height. There would only remain a longitudinal section approximately 10¼ inches in height at the rear of all spools being wound for air entrance requirements. The spool area is the generating point of maximum dust dispersion due to the high speed whipping action of the thread as it travels down from the jack spools above,

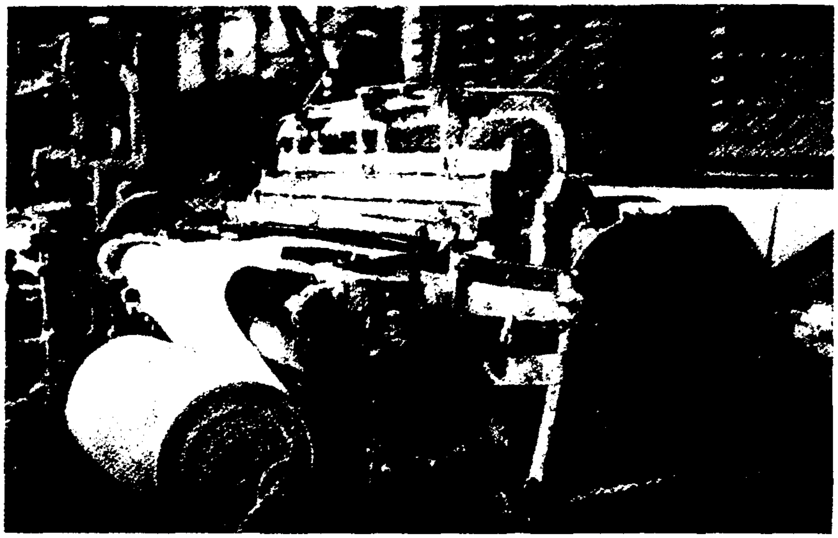

FIGURE 5. Broadcloth weaving loom.

passing through rollers and guides until it is finally wound on the spools below.

Such a design is shown in Figure 4b with one additional important feature—the provision of sectional partially curved baffle plates located in the area where the whipping action of the thread is most intense. These plates prevent excessive dust dispersion resulting from the whipping action of the thread. Exhaust air is drawn across, above and below the plane of the spool area, through the longitudinal area at the rear of the spools, leading to floor openings. These openings terminate in exhaust ducts located near the ceiling of the lower floor. Commercial designs seem to be available but no engineering data are revealed.

The final item of presentation covers cloth weaving. Little if any attention had been given to the control of dust dispersion from this operation and few plants are known to have installed adequate dust control. There seems to be a peculiar apathy in connection with the control of asbestos dust from weaving looms possibly because there is so much exposed moving mechanism. Further, the continuous periodic stopping of the loom mechanism to repair thread breaks may be responsible for the lack of interest to house any of the moving mechanism.

The unexhausted broadcloth loom is seen in Figure 5 with the large number of threads in the upper right area being fed from a portable structural steel unit called a creel. Depending upon the cloth width desired, there may be as many as 1500 threads leading into the cast iron heddle frames in the center of the loom. The shuttle mechanism, which whips across the front of the loom and then automatically reverses itself, is not clearly shown.

Early attempts to provide exhaust ventilation above the area of the shuttle bar movement were not very successful. The arrangement may be explained as follows:

1. Vertical rectangular exhaust ducts are located at each side of the loom frame. Each upper duct section is provided with a pivot joint so that it may move forward over the shuttle path and then back to a vertical position as the woven cloth slowly moves forward to the wind-up spindle.
2. Across the area above the cloth and shuttle, where the shuttle movement develops, is a horizontal duct section connected to the pivot connections of the vertical side duct legs. The lower surface of this duct is provided with a narrow slot 0.5 to 0.75 inch in width, usually tapered from the center of the loom to the elbow which connects to the vertical side legs.

Some of these units were never found

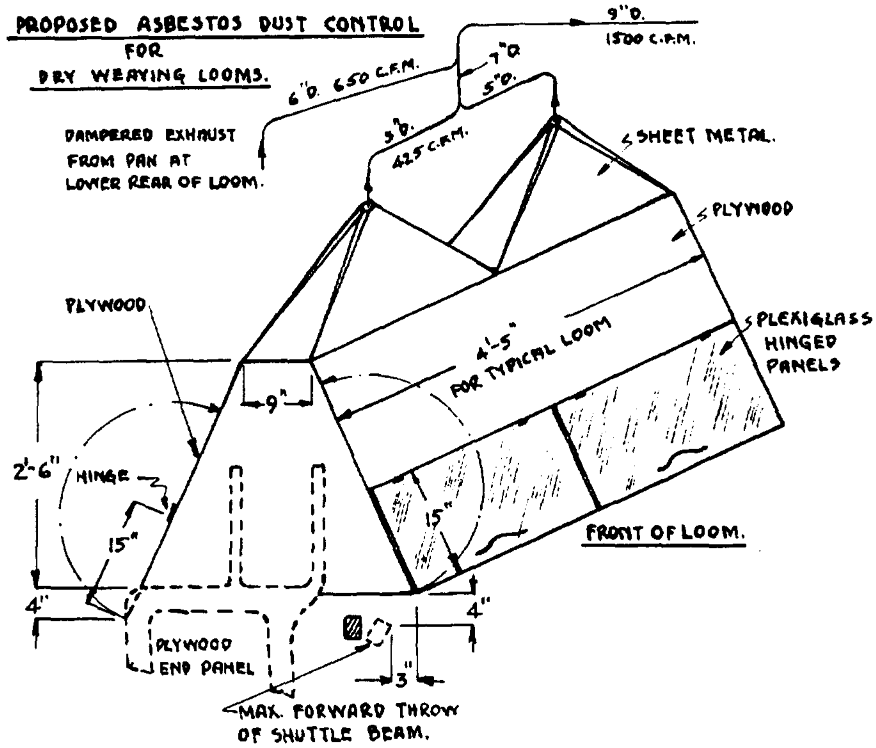

FIGURE 6a. Diagram of hood enclosure for broadcloth weaving loom.

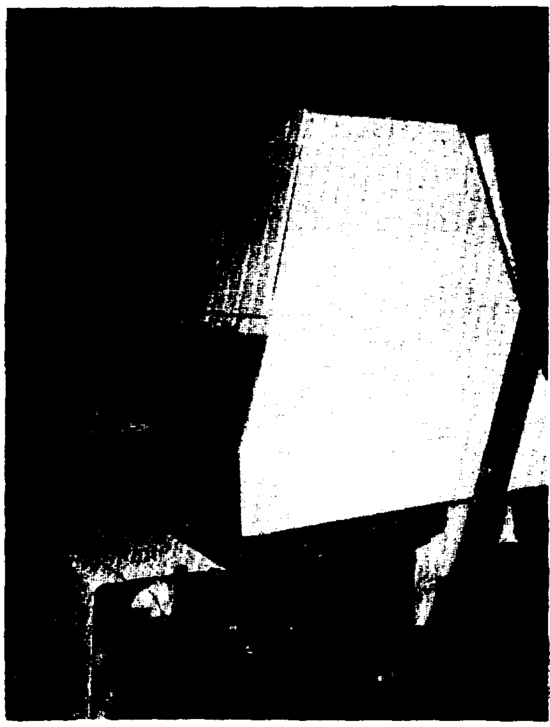

FIGURE 6b. Front view of hood enclosure for broadcloth weaving loom showing front-opening plexiglass windows.

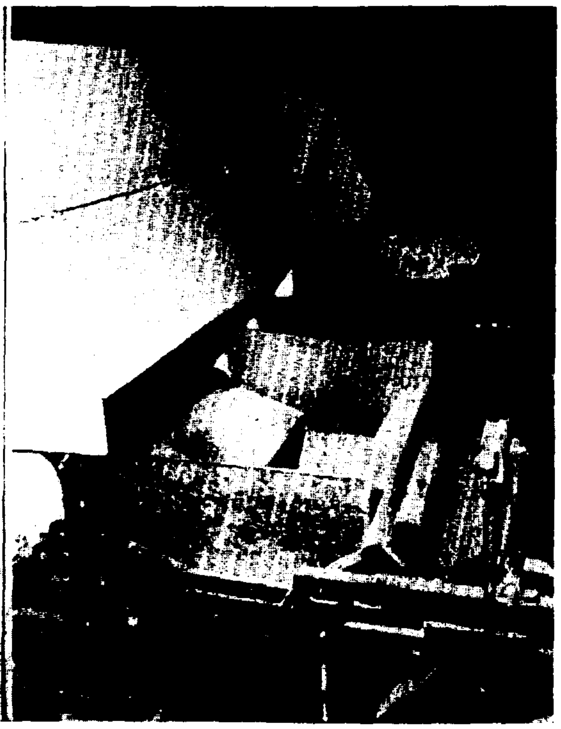

FIGURE 6c. Rear view of enclosure for broadcloth weaving loom showing catch-pan and exhausted hopper.

satisfactory to provide adequate dust control due to the fact that even with moderate air entrance velocity to the slots comparatively little air was being moved, but more particularly and from personal observation, the prime area of dust dispersion is at the cast iron heddle frames, which move up and down continuously. The asbestos-cotton threads pass through flattened steel eyelets which are a part of steel wire units comprising the heddle frame. The upward and downward movement of these frames create a chafing or rubbing action of the threads, releasing considerable asbestos and cotton dust not only to the breathing zone of the operator but to the entire production area. In some plants, fine dust dispersion from cards and looms is characterized as "smoke." Then there is the considerable quantity of floor-droppings which add their quota to the environmental dust load. This will be discussed further.

A second attempt, provided by the engineering department of one plant, is a modification of the first idea, except that the exhaust is upwards and not downwards, the slots are not continuous but are about 9 x 3/4 inches and the end connections are 3 inches in diameter. The duct section also moves forward and backwards as previously, pivoted at the end box connection to a short section of heavy corrugated rubber tubing which flexes at its lower box connection while the upper section connects to an inverted Y. Each leg of this connection is 3 inches in diameter leading to a 5-inch diameter line entering a cyclone collector located within the plant. Air discharge is to the outdoors. This arrangement has been successful and dust dispersion has been considerably reduced. Operators in this plant still wear non-approved cotton-type respirators.

Figures 6a, 6b and 6c illustrate a control developed for a broadcloth weaving loom. The basis of the design is the enclosure over the top of the entire loom area where the maximum dust dispersion results, the heddle frame and shuttle areas. The simplicity of this design does not indicate that it was readily acceptable. Asbestos dust dispersion has been studied in six asbestos textile plants during the past twenty-five years. Dust control has been discussed for many years, with special reference to control at weaving looms. It required a waiting period of eighteen years to finally convince one plant in the industry to utilize this design for nine dry weaving looms. A competitor, learning of this installation, installed the control for five dry weaving looms.

The entire enclosure may be disjointed from the overhead hood for complete accessability. The front of the unit is provided with sectional plexiglass windows to watch for broken threads. As can be seen, the hinged windows may be raised, providing complete accessability to the area between the shuttle and the heddle frame.

There is provided a catch-pan and exhausted hopper at the rear of the loom. The minimum floor droppage of stock is evident. There is some droppage from the lower center area of the loom but the loom mechanism prevented any collection control at this area. This may be done by cutting through the floor with a fish-tail connection located below the floor and vertical panels could be provided from the floor to a point upwards, this height to be determined by the interfering mechanism. A vacuum cleaner helped maintain good housekeeping at this floor area.

Previously without any exhaust, the stairwell and elevator shaft were always filled with asbestos and cotton fuzz. The stack effect through these areas carried the dispersed dust from the looms to the rough concrete surfaces of the walls and stairs. Now, due to the air demand by the nine looms, the stairwells and elevator shaft are clean.

Summary

This presentation covers experiences in six asbestos textile plants during the past twenty-five years. Two important and moderately involved dust control problems are discussed for carding units and dry weaving looms. Invariably, permission has not been granted to obtain photographs or to evaluate engineering performance of installed asbestos dust control installations. Information covering some modern technical advances in asbestos dust control have been provided through the courtesy of the Asbestos Textile Institute.