AIR HYGIENE STUDIES

Inland Manufacturing Division
Dayton, Ohio

October 31 and November 1, 1939

By: L. B. Case

Seven tests pertaining to asbestos dust, five tests pertaining to both asbestos dust and lead, and sundry observations were made in cooperation with Messrs. U. L. Adler, A. H. Flower, E. Gorman, A. J. Joyce, H. D. Croy, A. Dreher, D. M. Phillipi, M. B. Gordon, S. L. Connair, H. V. Kelly, J. Zimmerli, T. R. Jones, Schwartz, and Dr. R. D. Johnston.

The exposures under consideration are incidental to the production of brake linings and clutch facings. The brake linings and extruded clutch facings contain asbestos, rubber, and other ingredients but no lead or lead compounds. The woven clutch facings contain asbestos, brass wire, rubber and other ingredients, including litharge or its reaction products. The finished material contains lead compounds corresponding to approximately 1% of lead.

Conclusions and Suggestions

(a) The gasoline vapors in the cement department appear to merit further attention (p. 2).

(b) It appears desirable for the operator in the cement department to use an approved respirator while emptying litharge into the mixer, and that accumulations of dust should be removed periodically from the horizontal surfaces in the vicinity by a vacuum cleaner (p. 3).

(c) The situation in the laboratory probably is not serious but might merit the precaution of using a respirator and a vacuum cleaner (p. 3).

(d) The dust near the unwinding operation in the cement house approaches, or exceeds, the permissible limit and the use of a respirator is suggested (Test #1).

(e) The lead concentration found near the winding grinding clutch facings to thickness is unexpectedly high, and the location is recommended for further observation (Test #5).

(f) The lead concentration near the groove cleaning operation exceeded the permissible limit, and the installation of an exhausted table grating is suggested.

(g) Both the dust and the lead [illegible] "flap sanding" operation greatly exceed the permissible limits, and changes in method or ventilation are needed (Test #7).

(h) Substitution of vacuum cleaner [illegible] jet for removing debris from a drill press table is suggested (Test #2).

(i) The slitting machine with [illegible] dust in spite of the fact that the volume of air drawn [illegible] probably is inadequate Changes are suggested (Test #4).

(j) The continued use of respirators by the men weighing the ingredients of the brake lining compound appear to be desirable. The use of respirators during the brief period when the mixer is discharged also is indicated (Test #12).

Asbestos

The literature relating to occupational diseases contains many references to the effects of inhaling excessive amounts of asbestos. Public Health Bulletin #241, "A Study of Asbestosis in the Asbestos Textile Industry"; International Labour Office, supplement to Occupation and Health, dated January 1938 and entitled "Asbestos"; Public Health Reports, November 28, 1939, "A Study of Dust Control Methods in Air Asbestos Fabricating Plant"; and Sayers & Dreesen, American Journal of Public Health, March 1939, "Asbestosis", may be mentioned prominently in this connection. Hayhurst, in Industrial Medicine, October 1939, quotes George and Leonard in discussing 90 claims, ascribed to asbestosis, brought against a firm formerly manufacturing brake linings in Massachusetts. Twelve positive diagnoses were made, and the insurance carrier arranged compensation or settlement in excess of $50,000 for the twelve. Thirty of the remaining seventy-eight came to trial. There appears to be some difference of opinion regarding the diagnoses, especially in view of the re-examinations, of the twelve awarded compensation, some some eight or nine years after the cessation of the exposure.

As is common in these complicated affairs, there may be some difference of opinion regarding the permissible limit for asbestos dust. It appears proper, however, to accept the findings of Sayers & Dreesen (American Journal of Public Health, March 1939, p. 295-314), which indicate a permissible limit of 5,000,000 particles per cubic foot of air. They state: "Definite clinical and roentgenographic evidence of asbestosis is observed in exposed persons after 5 to 10 years of work in exposures exceeding 5 million particles per cubic foot of air," and "It appears that, if asbestos dust concentrations in the air breathed are kept below 5 m.p.p.c.f., new cases of asbestosis will not appear." Further, it may be prudent to disregard suggested distinctions between long fibres, short fibres, and particles too short to be classified as fibres.

Lead

About ten years ago, the Public Health Service conducted an investigation in a large storage battery plant and cautiously suggested 1.5 milligrams per 10 cubic meters of air as the permissible limit re. lead. A recent survey, involving air tests in 26 plants and the medical examination of approximately 700 men, is interpreted to confirm the previous conclusion and to indicate that the limit of 1.5 mg. is required to avoid "early plumbism". Discussion of the matter has suggested that "early plumbism" may not be very serious. Nevertheless, it appears prudent for lead concentrations to be maintained below that limit so far as possible.

Gasoline Vapor

As compared to chlorinated solvents and coal-tar hydrocarbons, it appears that gasoline vapors are relatively non-toxic. They are not, however, without physiological effect. A committee, acting in behalf of the Massachusetts Division of Occupational Hygiene, has suggested that 500 parts of vapor per million parts of air is a proper "limit for practical control". This is equivalent to 5.1% by volume. The 5% or allowable limit for gasoline vapor is approximately 1.4% by

volume (Bureau of Mines bulletin #278). ... Gordon stated that tests with an explosimeter have shown concentrations in excess of the flammable limit in certain locations at certain times in the cutting department. He further stated that concentrations approximating 20% of the explosive limit are quite common. The gasoline used is more volatile than the grades generally employed for automobile fuel. The men in the room complained when the doors and windows were closed, to simulate winter conditions, for about 15 minutes in Test #1. Mr. Flower stated that the matter could be given further attention to locate the principal sources of the vapors (there appear to be several) and to investigate the possibility of using a less volatile solvent.

Miscellaneous Items

Several additional situations were observed and discussed.

The air exhausted from the finishing operations on brake linings and clutch facings is passed through cyclone separators on the roof. As is common with cyclones, much of the finer material escapes. At times the fine dust is blown back into the factory via the windows in the monitor. Messrs. Connair and Gordon stated that the accumulation in the bin under the larger cyclone is removed and bagged three times per day. At times the dust from the bagging operation may enter the monitor windows. The accumulation in the bin has a tendency to catch fire and smolder. A fire hose is kept unreeled and in readiness at all times. The material does not wet readily, and it is difficult to extinguish the fires. Mr. Connair stated that the cyclones may be replaced by Cottrell or American Filter wet systems. Presumably the vendors of the equipment will be duly warned of the fact that the dust does not wet very readily.

Lead is one of the ingredients in the cement used in the clutch facings. Mr. Phillipi stated that three times each day a 50# bag is emptied into a mixer. Because of the brevity and infrequency of the operation, no test of the air was made. A sample of dust from an angle iron supporting the stairway contained 10.7% of lead.

Certain experimental compositions are finished in the laboratory. The operation is infrequent, and the alcove in which it is conducted is isolated, during the operation, from the remainder of the laboratory by a curtain. No specimens were available for grinding on November 1st and no test of the air was made. However, a sample of dust from the lamp shade contained 5.6% lead.

Mr. Schmate inquired about wood flour. He stated that it is used in some of the compounds, that the batches are mixed frequently, and that the men appear to inhale some of the dust. We are not well informed about the effects of inhaling wood dust. Woodworking has been a major industry, and power tools have been used for many years. It appears, however, that the matter has not been investigated thoroughly. Dr. Auclaide Ross Smith (Industrial Hygiene, New York Department of Labor, July and August 1936) has reviewed the literature bearing on the subject, and notes 14 references. The review indicates that wood workers have been above the average in susceptibility to bronchitis, pneumonia, tuberculosis, and perhaps other respiratory diseases. The status of the wood dust as a causative factor is indicated but not proven.

Methods of Test

The dust and lead samples were collected by means of the Greenburg-Smith Impinger apparatus. Normal butyl alcohol was the collecting liquid in each instance. The

counts were made according to the technique described in Public Health Bulletin #217. Lead was estimated colorimetrically by a procedure employing diphenylthiocarbazone.

Weather

Both days were clear with temperatures varying between approximately 30 and approximately 50°F. The windows in the monitors of the factory were partly open

TEST #1. ASBESTOS

Cement Department. 10/31/39. 2:18 to 2:42 (corrected for interruptions = 20 minutes)

The sample was taken in the aisleway between the supports from which asbestos cord is unwound. The cord then passes through tanks containing cement, then through drying towers and eventually is made into clutch facings. Dust escapes visibly from the cords during the unwinding process. We are informed that ordinarily ten men work in the room, which is quite large. One appeared to spend much of his time in the location sampled, and two others were working nearby.

Immediately prior to the test the doors and some of the windows were open. At our suggestion, Mr. Gorman arranged to have them closed in order to simulate winter conditions. The fan in the cupola was running, and the louvers in the wall were open. After about 15 minutes the men at the extruding machine, and the men on the platform objected to the gasoline vapor, and the time of the test was shortened.

No cement was compounded, on the platform over the location sampled, during the time covered by the test.

The test indicates 10,000,000 particles of dust per cubic foot of air. Even if allowance is made for the fact that the operator does not spend all of his time among the cords, and perhaps for the fact that the windows were closed (although they no doubt will be closed during the cold weather), the concentration found approaches, or probably exceeds, the permissible limit. Because of size and shape of the installation, the position of the operator, and the necessity of accessibility, it does not appear expedient to install ventilating equipment. Perhaps the operator could be persuaded to use a respirator, at least part of the time.

TEST #2. ASBESTOS

Cement Department. 10/31/39. 2:46 to 3:18

The sample was taken at the shoulder of one of the men blending brake lining compound.

Three Champion mixers are located near the westerly wall of the room (the same room that was involved in Test #1) and are used to blend the asbestos mixture (see Test #12) with gasoline, rubber, etc. The asbestos (and other dry ingredients) is received in boxes containing 1/2#. These are dumped into the Champion mixers. Gasoline (a relatively volatile grade) and rubber are added. The mixer is then covered with a wooden cover and permitted to run until the blending has been accomplished. About 4 minutes is required to charge two mixers. The escape

of dust, when the boxes are dumped, is very noticeable but also quite brief because the gasoline is added immediately afterward. There is a noticeable escape of gasoline vapor both during and following its addition. The covers do not fit tightly.

Three batches were mixed, and the floor was swept during the time covered by the test. One of the two operators wore a respirator while dumping asbestos but not while sweeping.

The doors and some of the windows were open during the test.

The test indicates 2,500,000 particles of dust per cubic foot of air.

TEST #5. ASBESTOS

Chamfering ends of brake linings.
Bldg. 11. Dept. 16. 10/31/39. 3:35 to 4:05

The sample was taken at the shoulder of the operator of the vertical grinding wheel used for the purpose. The wheel is hooded and connected to a fan. The rate of air-flow through the opening in the hood varied from 400 to 500 feet per minute. The normal rate of production is approximately 640 pieces per hour, and the operator spends about 4 out of 8 hours at this machine.

The test indicates 1,600,000 particles of dust per cubic foot of air.

TEST #6. ASBESTOS

Finishing brake lining strips to thickness.
Bldg. 11. Dept. 16. 10/31/39. 4:00 to 4:22

The sample was taken at the shoulder of a girl operating the machine which grinds both sides of the brake lining strips simultaneously. The machine is enclosed, and the housing is connected to a ventilating fan. There was no noticeable escape of dust. We understand that the machine is in use about three hours in each shift.

The slitter (Test #7) is located nearby. It was in operation only two minutes of the time covered by the test, but may have contributed somewhat to the dust count. The strips delivered from the slitter to the grinder are somewhat dusty.

The test indicates 5,000,000 particles of dust per cubic foot of air.

TEST #8. ASBESTOS and LEAD

Finishing clutch facing rings to thickness.
Bldg. 11. Dept. 16. 11/1/39. 8:20 to 8:34 - 9:12 to 9:22

The sample was taken at the shoulder of the inspector working at the outlet (westerly) end of the machine.

There was a draft of approximately 50 feet per minute from east to west.

The machine is similar to the one involved in Test #6. It is enclosed, and the housing is connected to a ventilating fan. There was no visible escape of dust. The machine is in use only part of the time.

Four women and two men were working in the aisleway extending about 20 feet west of the machine.

The brake lining slitter and the grinder used for the edges of the clutch facings were not in use during the time covered by the test.

The test indicates 2,000,000 particles of dust per cubic foot and 5.9 milligrams of lead per 10 cubic meters of air. This amount of lead, considered in conjunction with the direction of the draft, suggests that the ventilation of the machine may not be adequate. There is a possibility, however, that it may represent dust dislodged from the surface of the facings as they were handled by the inspector.

TEST #6. ASBESTOS and LEAD
Cleaning grooves in clutch facings.
Bldg. 11. Dept. 16. 11/1/39 3:30 to 3:02

The sample was taken at the shoulder of the girl cleaning the grooves in clutch facings by means of a file. She was located in the aisleway west of the grinder involved in Test #5. The grinder, however, was not used during this test. The brake lining slitter and grinder were not in use. The drill presses across the aisle were in operation. The operator of one of the drill presses uses an air jet periodically and may have contributed to the dust and lead found in this test.

We understand that this is a full time job, three shifts.

A draft of approximately 50 feet per minute was moving from east to west.

The test indicates 4,300,000 particles of dust per cubic foot of air and 5.2 milligrams of lead per 10 cubic meters of air. This amount of dust approaches the permissible limit, and the lead exceeds the permissible limit. Perhaps the filing operations could be performed over a small grating set in the top of the table. The grating would be connected to the exhaust fan via suitable duct work.

TEST #7. ASBESTOS and LEAD
"Flap sanding" inside and outside edges of clutch facings.
Bldg. 11. Dept. 16. 11/1/39 3:20 to 3:40

The sample was taken at the shoulder of the operator of the machine located near the end of the aisleway mentioned in connection with tests #5, #6, and #8.

A double ended polishing lathe is equipped with wheels made by attaching strips of emery cloth to a suitable hub. The term "flap sanding" is an apt description of the operation and equipment. The lathe is equipped with the customary sheet metal hoods. The hood over the wheel used for the inside edges had been opened to permit access. The flaps act as centrifugal fans and overwhelm the intended action of the exhaust ducts. The operator's clothing is blown tightly against his body and legs. There is a very noticeable escape of dust.

We understand that the machine is in use about five hours per shift.

The test indicates 20,000,000 particles of dust per cubic foot and 20.6 milligrams of lead per 10 cubic meters of air. These concentrations are greatly in excess of

the permissible limits. Perhaps the edges of the facings could be finished in some other manner. Perhaps a machine with mechanical feed could be enclosed more completely and ventilated adequately.

TEST #8. ASBESTOS and LEAD
Drilling clutch facings.
Bldg. 11. Dept. 16. 11/1/38. 10:24 to 10:54

The sample was taken at the shoulder of the girl operating a drill press near the easterly end of the aisleway. A duct terminal is located about 6" from the drill and has an inward flow of approximately 300 feet per minute.

The general draft in the vicinity was about 80 feet per minute east to west.

We understand that this is a full-time job.

An air jet is used periodically for removing chips and dust from the table of the machine. It may be responsible for much of the contamination found.

The test indicates 7,000,000 particles of dust per cubic foot and 3.7 milligrams of lead per 10 cubic meters of air. Perhaps a vacuum cleaner could be substituted for the air jet.

TEST #9. ASBESTOS
Slitting brake lining slabs into strips.
Bldg. 11. Dept. 1[illegible] 11/1/38. 11:08 to 11:33.

The sample was taken at the left shoulder of the operator of the machine which slits the slabs of brake lining material (23" x 15") into strips (1-3/4 x 15'). This is accomplished by a gang of thin grinding wheels mounted on a shaft. The machine is enclosed and connected to an exhaust fan via two terminals. One terminal is located at the outlet of the machine and the other at the inlet. The inlet is a slot 1-1/2"x 56". The terminal is located underneath and produces an inward flow of approximately 1000 feet per minute through the slot when no slab is in place. The slab, however, interferes with the flow through the upper part of the slot, and a very noticeable escape of dust occurs each time a slab engages the wheels.

Two suggestions may be offered:

(a) That the duct work be divided so that part of the ventilation is taken from the upper part of the machine.

(b) A soft rubber strip be installed in the upper part of the slot so it fills the space above the slab.

During the test there was a draft of approximately 80 feet per minute from east to west.

The thickness grinder was in operation during the test but probably did not contribute importantly to the contamination of the location.

We are informed that the machine generally is used about 2 hours per shift. We further understand that operators generally also run the chamfering machine (Test #3) and the saw (Test #10). These processes at average exposure somewhat in excess of the permissible limit.

The test indicates 27,000,000 particles of dust per cubic foot of air.

Test #10. ASBESTOS

Sawing brake lining strips to length.
Bldg. 11. Dept. 16. 11/1/38. 12:45 to 1:30, minus 15 minute interruption.

The sample was taken at the shoulder of the operator of the machine, which is known as a saw. However, the cutting tool actually is a thin abrasive wheel.

There was no measurable draft in the vicinity at the time of the test.

The machine is equipped with exhaust ducts with terminals in the table near the saw.

The thickness grinder (Test #4) was in use and may have contributed somewhat to the dust found. There was, however, a visible escape of dust or smoke from the saw. The strips, as they leave the grinder, are somewhat dusty.

We are informed that the machine is used about 3 hours per shift.

The test indicates 6,000,000 particles of dust per cubic foot of air.

TEST #11. ASBESTOS and LEAD

Grinding outer edges of clutch facing discs.
Bldg. 11. Dept. 16. 11/1/38. 1:30 to 2:30

one end of a double ended stand is used for the purpose. The wheel is enclosed and the housing is connected to an exhaust fan.

The machine is in use only part of the time.

There was a draft of approximately 50 feet per minute east to west.

The sample was taken at the operator's shoulder.

The test indicates 1,500,000 particles of dust per cubic foot and 0.9 milligrams of lead per 10 cubic meters of air.

Test #12. ASBESTOS

Mixing dry ingredients of brake lining composition.
Basement of Office Building. Dept. --. 11/1/38. 4:05 to 4:26

The asbestos and other dry ingredients are blended in a ball mill near by before transportation to the Cement Department (Test #13).

The ingredients are weighed and mixed as mentioned on the floor above. The mix This location is enclosed, and an exhaust fan and duct having installed in the roof. The

Air will be admitted through openings in the lower part of the partition. It appears prudent for the men to continue the use of respirators after the installation of the fan. The enclosure and the fan may be expected to prevent the spread of dust to other parts of the building but probably will not constitute sufficient protection for the men within the enclosure.

Mr. Schmaltz stated that the Fairfield mixer in the basement handles 2 batches during the first shift and one batch during the second.

The contents of the mixer are emptied, via a gated opening in the bottom, into boxes holding 100# each. About 30 minutes is required for discharging each batch. On the occasion of the test, the supply of regular boxes was inadequate, and about half of the batch was discharged into a steel tote box and transferred to fibre cartons. This extra handling increased the concentration of dust.

Two men were discharging the mixer. One was using a respirator. The two work together and appear to be exposed to the same concentration of dust. In order to get 100 pounds of the mixture into the boxes, it is necessary for the men to pack it with their hands. This brings their faces into close proximity with the source of the dust.

A ventilating duct has been installed above the opening in the mixer, and removes part of the dust. The terminal is 8" x 20", and the rate of air flow varied from 250 to 400 feet per minute.

The immediate vicinity of the mixer is used for storage. The nearest men regularly employed in the vicinity were about 35 feet away. Industrial trucks pass frequently through the aisleway beside the mixer.

The draft at the time of the test was variable in rate and direction.

The test indicates 25,000,000 particles of dust per cubic foot of air. Because of the intermittent nature of the exposure, this does not appear to be very serious. It is prudent, of course, for the men to use respirators. It also is desirable that the dust should not be permitted to accumulate too extensively, especially in the aisleway where it would be disturbed and distributed by the trucks.