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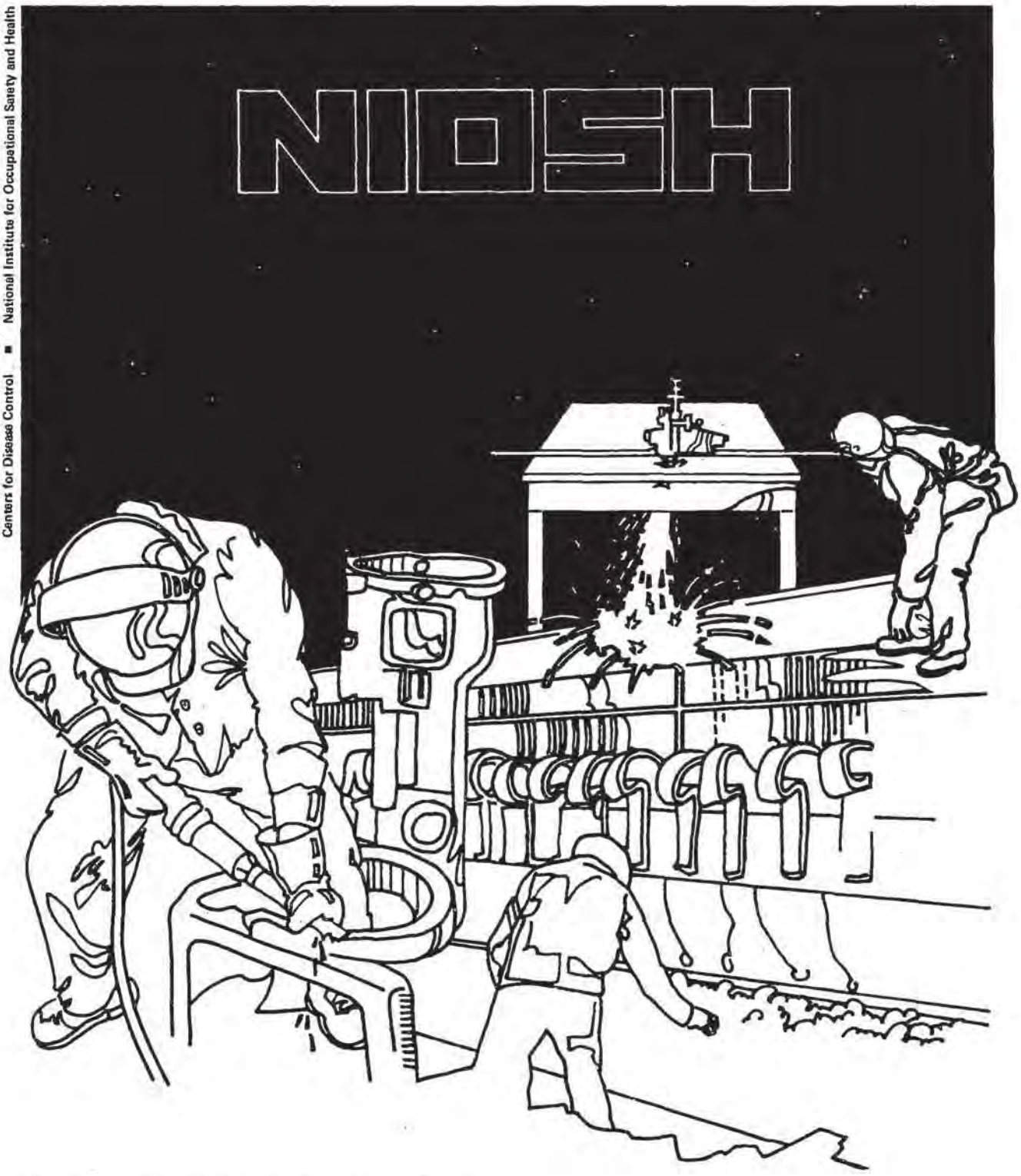

Health Hazard Evaluation Report

HETA 81-100-1140
RAYBESTOS FRICTION MATERIALS COMPANY
CRAWFORDSVILLE, INDIANA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 81-100-1140
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RAYBESTOS FRICTION MATERIALS COMPANY
CRAWFORDSVILLE, INDIANA

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I. SUMMARY

On November 25, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation at Raybestos Friction Materials Company, Crawfordsville, Indiana. The request was made to evaluate employee exposure to lead and asbestos throughout the facility. There was also a concern about potential formaldehyde exposure in the brake block mixing area, and the number of heart attacks among Raybestos employees, especially among mechanics.

NIOSH conducted an environmental/medical field evaluation at the Crawfordsville facility on March 11-13, 1981. Personal airborne sampling was conducted to evaluate employee exposures to formaldehyde, asbestos, and six inorganic metals (iron, magnesium, lead, tin, barium, and zinc).

Formaldehyde concentrations collected on eight personal samples ranged from below the limit of detection to 0.82 parts formaldehyde per million parts of air (ppm). All values were below the OSHA PEL of 3.0 ppm, but above the NIOSH recommendation. NIOSH considers formaldehyde to be a potential occupational carcinogen and recommends that airborne concentrations be maintained at the lowest feasible level. Airborne concentrations of six personal asbestos samples ranged from 0.03 fibers per cubic centimeter of air (fibers/cc) to 0.67 fibers/cc. These values are below the OSHA PEL of 2.0 fibers >5 microns/cc, but four of the samples collected were above the NIOSH recommended standard of 0.1 fiber >5.0 microns/cc. Airborne concentrations for the three metals detected on personal samples ranged from 24.6 micrograms/cubic meter (ug/m^3) to 96.7 ug/m^3 for barium, 9.3 to 12.7 ug/m^3 for iron, and 11.5 to 14.0 ug/m^3 for magnesium. Lead and zinc were not detected on any of the samples. These values are all below the current OSHA PEL. NIOSH currently has no recommended standard for these metals. Airflow pattern checks of the local exhaust ventilation equipment indicated that the equipment was functioning satisfactorily.

Medical interviews did not reveal findings that could be attributed to asbestos, lead, or other heavy metal exposure. Limitations of available medical and environmental data for past workers precluded comprehensive evaluation of heart attacks and other cardiovascular disease. Recommendations were made relative to potential work place-related cardiovascular risk factors.

These results indicate that during the NIOSH survey a health hazard did exist for employees working in the brake block area. Airborne concentrations of personal samples of formaldehyde and asbestos were in excess of current NIOSH criteria. Recommendations are made for increased environmental monitoring of airborne contaminants and for modification of employee work practices.

KEYWORDS: SIC 3714 (Motor Vehicle Parts and Accessories), asbestos, formaldehyde, metals, brake shoe, sintering, cardiovascular disease.

II. INTRODUCTION

In November 1980, NIOSH received a confidential request for a health hazard evaluation (HHE) at Raybestos Friction Materials Company, Crawfordsville, Indiana. The requestor(s) asked NIOSH to evaluate employee exposure to asbestos and lead. The entire facility was listed as the area of concern. Pre-survey discussions with the requestor(s) revealed additional concerns about formaldehyde exposure in the brake block mixing area and about the number of heart attacks among Raybestos employees, especially among mechanics.

NIOSH distributed Interim Report No. 1 for this investigation in October 1981, following the initial site visit. The second Interim Report was distributed in December 1981.

III. BACKGROUND

The Crawfordsville facility began production in 1952, at which time only the sintered metal division was in operation. The brake block division began production in 1973 and the facility has remained essentially unchanged since then. At the time of the March 11-13, 1981, NIOSH visit, the company employed approximately 430 hourly workers. Of this total, approximately 270 worked in the sintered metal division, 93 worked in the brake block division, and approximately 68 were employed as machinists, mechanics, and other skilled craftsmen.

The sintered metal division produces clutch facing units for use in heavy-duty applications. Clutch facings are composed primarily of copper with lesser quantities of other materials (iron, lead, zinc, and graphite). Lead content ranges from 2% to approximately 8% by weight. The powdered raw materials are combined in the mix area. The mixes are transferred to the wafer press area and subsequently compressed into wide, thin, disk-shaped wafers. Pairs of such wafers are sandwiched around single similarly shaped steel disks that have been stamped and/or cut and ground in an adjoining area. These wafer-disk units are sent to the sintering area where they undergo a heating process that metallurgically bonds the wafers to the metal disk. Finally, the clutch facings undergo a series of operations that include curing, grinding, drilling, slotting, and grooving.

The brake block division produces pads for brake shoes. Asbestos (chrysotile), barium, lead, zinc, graphite, and phenol-formaldehyde resin (components vary depending upon the specific formulation) are combined in the mixing area. Subsequently, the mix is transported in an open dumpster to the rotary briquetter, where individual briquettes (blocks of pad material) are formed. An individual briquette is approximately 36 inches long, 7 inches wide, and 1 inch thick.

The briquettes are transferred to curing presses, where they are compressed and partially cured. Final curing of the briquettes occurs

in curing furnaces. Briquettes then undergo a variety of processing operations including cutting, grinding, and countersink-drilling. The final products are individual brake blocks (pads), approximately 4 inches wide, 6 inches long, and 3/4 inch thick, that are ready for attachment to the metal portion of brake shoes.

NIOSH had performed a health hazard evaluation at this plant in 1971-72 in the sintered metal division, which was the only division in operation at that time, in response to concerns about the potential hazards of exposure to iron, copper, lead, magnesium, zinc, tin, antimony, molybdenum, graphite, and silica.[1] Sixty-one samples were collected from which 337 individual determinations were made. Maximum measured levels from that study and the corresponding 1972 OSHA PEL's are shown in Table I. None of the airborne concentrations exceeded the OSHA standards of 1972, although some lead samples were higher than the reduced OSHA PEL of 50 micrograms per cubic meter of air sampled (ug/m^3) that was promulgated in 1980.[1,2] The highest respirable silica concentration detected was 74% of the standard. Symptoms reported by the 15 workers interviewed included cough and nose/throat irritation.

NIOSH conducted an environmental/medical survey at the Crawfordsville facility on March 11-13, 1981. The visit consisted of an opening conference, a walk-through survey, and an environmental/medical field evaluation. Management personnel, union representatives (A.I.W., Local No. 164), and individual employees were interviewed. NIOSH personnel discussed medical records, including screening results for asbestos- and lead-exposed workers, and reviewed OSHA 200 Accident and Occupational Illness Forms. NIOSH also obtained copies of results of environmental sampling conducted by management.

NIOSH investigators decided to concentrate the environmental aspect of the evaluation in the brake block area.

This decision was made after consideration of the following seven items:

1. Pre-survey comments received from the requestor.

2. Discussions at the opening conference.

3. Observations made during the walk-through survey.

4. Review of a 1972 HHE Final Determination Report of three environmental surveys conducted at this facility.[1]

5. Discussion with a principal NIOSH investigator on the previous health hazard evaluation.

6. Discussions with Federal OSHA personnel concerning OSHA inspections of the facility in 1978, 1979, and 1980.

7. The brake block division was scheduled to close in April 1981.

IV. MATERIALS AND METHODS

Personal airborne sampling was conducted to characterize employee exposures to formaldehyde, asbestos, and inorganic metals. In addition, area samples were collected for formaldehyde and general metals to assist the laboratory in the analysis of personal samples. Following analysis of area samples and based on the results, personal samples were analyzed for six inorganic metals (iron, magnesium, lead, tin, barium, and zinc).

Formaldehyde samples were collected on charcoal tubes attached via flexible tubing to a battery-powered pump calibrated at 50 cubic centimeters/minute (50 cc/min). Asbestos samples were collected on AA filters loaded into three-piece cassettes. The cassettes (used open-faced) were attached via flexible tubing to a battery-powered pump calibrated at 2.0 liters per minute (LPM). Metals samples were collected on M-5 filters loaded into two-piece cassettes. The cassettes were attached via flexible tubing to battery-powered pumps calibrated at 1.7 LPM. Following collection in the field, all samples were returned to NIOSH laboratories for analysis. Formaldehyde samples were analyzed by ion chromatography according to NIOSH Method P&CAM No. 318 with small variations in the preparation and analysis of samples.[3] Area airborne filter samples for metals were analyzed using inductively coupled plasma-atomic emission spectroscopy. Personal airborne filter samples for metals were analyzed by atomic absorption spectrophotometry according to NIOSH Method P&CAM No. 173.[4] Two of the personal samples were analyzed for tin using a modification of NIOSH Method P&CAM No. S-183.[5] This method prescribes a cellulose-type of filter. Because of the possibility of the loss of tin tetrachloride, formed from the decomposition products of PVC and tin, it was thought necessary to analyze known amounts of tin on filters of the same type. Since the known amounts of tin were available on AA filters, an M-5 filter was added to each and, to make conditions the same with the samples, a AA filter was added to each sample. Recovery of the known amounts of tin was a little over 100% so that the loss, if any, did not appear to be detectable to within the precision and accuracy limits of the method. Tin was below the limit of detection on both samples. Asbestos samples were analyzed according to NIOSH Method P&CAM No. 239 utilizing phase contrast microscopy.[4]

Medical

Thirty-two of 481 current workers were interviewed by the medical officer. An effort was made to sample workers from a wide range of job categories. Workers from clutch plate and brake block production and machinists/mechanics/skilled craftsmen were selected at random for interview. Current workers who were reported to have had heart attacks

also were interviewed. Questions were directed broadly toward cardiovascular, respiratory, and neurological symptoms.

Existing lead monitoring and respiratory (chest X-rays, pulmonary function testing) surveillance programs and technical and logistical aspects of assessment of cardiovascular disease were discussed at the opening and closing conferences. Blood lead surveillance data were requested and were received later for review by NIOSH. Logs of OSHA 200 reports were reviewed by the medical officer.

V. EVALUATION CRITERIA

A. Formaldehyde

Formaldehyde is a colorless, flammable gas with a strong, pungent odor. It can form explosive mixtures with air and oxygen. As an important industrial chemical of major commercial use, formaldehyde is found commonly in the industrial environment.[6]

Formaldehyde causes eye, nose, and throat irritation at concentrations of 0.1 to 5 ppm. Higher exposures may produce coughing, tightening in the chest, decreased lung capacity, a sense of pressure in the head, and/or palpitation of the heart. Exposures at 50 to 100 ppm and above can cause serious injury, such as pulmonary edema (collection of fluid in the lungs) or pneumonitis (inflammation of the lungs). Formaldehyde has been shown to induce nasal cancer in laboratory animals and to have mutagenic activity in several test systems.[6]

The Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit (PEL) for formaldehyde is 3.0 parts formaldehyde per million parts of air (ppm) based on an 8-hour time-weighted average (TWA).[2] The NIOSH recommended standard for occupational exposure to formaldehyde was 1.0 ppm based on any 30-minute sampling period.[7] This recommendation was designed to prevent irritation effects. However, NIOSH recommended in a Current Intelligence Bulletin (CIB) issued in 1980 that formaldehyde be handled as a potential occupational carcinogen.[6] The American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Value (TLV) is 2.0 ppm, which is a ceiling value. ACGIH is proposing to change the formaldehyde TLV and to consider it as an industrial substance suspect of carcinogenic potential for man.[8,9]

B. Asbestos

Asbestos is a general term given to several silicate compounds. Of these chrysotile (white asbestos) accounts for approximately 95% of the asbestos used in the United States. Asbestos is widespread in

the environment because of its extensive use in industry and the home. Over 3,000 products contain asbestos.

Exposure to asbestos is known to cause a lung fibrosis called asbestosis. The onset of asbestosis is usually gradual, developing over a period of 10 to 30 years.[10,11] Asbestos exposure also is associated with increased incidence of lung cancer and mesothelioma (malignancy of the internal surfaces of the chest and abdomen).

The OSHA PEL for asbestos is 2.0 fibers, >5.0 micrometers, per cubic centimeter of air (5.0 fibers >um/cc).[2] The NIOSH recommended standard is 0.1 fiber >5.0 um/cc.[12] The ACGIH TLV covers a range from 0.5 fibers >5 um/cc to 2.0 fibers >5 um/cc depending upon the type of asbestos material involved.[8,9]

C. Metals

The OSHA PEL for barium (soluble compounds) is 0.5 mg/m^3 based on an 8.0-hour TWA.[2] The ACGIH TLV is also 0.5 mg/m^3 based on an 8.0-hour TWA.[8] Ingestion of soluble barium salts can cause potassium deficiency with potentially severe nervous system, heart, and gastrointestinal effects.[13] NIOSH currently has no recommended standard for barium.

The OSHA PEL for tin (inorganic compunds) is 2.0 mg/m^3 based on an 8.0-hour TWA.[2] The ACGIH TLV is also 2.0 mg/m^3 based on an 8.0-hour TWA.[8] Inorganic tin dust or fume can cause a benign pneumoconiosis in which tin accumulation in the lung causes characteristic X-ray changes but does not cause symptoms or long-term respiratory changes.[9,14] NIOSH currently has no recommended standard for tin.

Inhalation (breathing) of lead dust and fume is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion (swallowing) of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. Absorbed lead can damage the kidneys, peripheral and central nervous systems, and the blood-forming organs. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women. Blood lead levels below 40 ug/deciliter whole blood are considered to be normal levels which may result from daily environmental exposure. The new Occupational Safety and Health Administration (OSHA) standard for lead in air is 50 ug/m^3 calculated as an 8-hour time-weighted average for daily exposure.[15] The standard also dictates that workers with blood lead levels greater than 60 ug/deciliter must be immediately removed from further lead exposure and, in some circumstances, workers with lead levels of less than 60 ug/deciliter must also be removed. Removed workers have protection for wage, benefits, and seniority for up to 18 months until their blood levels decline to

below 50 ug/deciliter and they can return to lead exposure areas.[15]

The OSHA PEL and the ACGIH TLV for total nuisance particulates are 15.0 mg/m^3 and 10.0 mg/m^3, respectively.[2,8] These criteria were used to evaluate employee exposure to iron, magnesium, and zinc. NIOSH has no recommended standard for nuisance particulates. Nuisance particulates cause lung tissue reaction, but the reaction is reversible, does not cause scarring, and does not damage lung structure. Nuisance particulates may cause unpleasant deposits in the eyes, ears, and nasal passages and may cause skin or mucous membrane injury by chemical or mechanical action or secondary to cleaning procedures to remove the substances from the skin.[9]

D. Cardiovascular Disease

The term "heart attack" typically indicates either an acute episode of heart muscle cell death from insufficient oxygen delivery to the muscle cells or else an acute impairment of the heart's pumping action from disruption of the mechanisms that coordinate its rhythmic beating. Such acute events usually occur within a context of cardiovascular disease, such as high blood pressure or occlusion of the heart's blood vessels. Known or suspected factors that influence the likelihood of developing cardiovascular disease include age, hereditary factors, diet, exercise, emotional stress, cigarette smoking, and obesity.[16] Some chemical substances, such as carbon monoxide,[17] carbon disulfide,[18] and trichloroethylene[19] can cause acute events in individuals without known heart impairment and may contribute to the development of cardiovascular disease. Suspicion that a work place factor is contributing to heart attacks is strengthened if there appears to be a pattern in terms of time of day, day of week, time of year, location in plant, job title, or similarities of chemical or physical exposures among workers who have had heart attacks.[20]

VI. RESULTS

A. Environmental

1. Formaldehyde

Table II presents the air sampling results for formaldehyde. Formaldehyde concentrations ranged from below the limit of detection (8.0 micrograms formaldehyde/tube) to 0.82 parts formaldehyde per million parts of air (ppm) sampled. One partial shift sample (3 hours) had a concentration of 1.24 ppm.

Detector tube sampling during the morning of the day shift near the rotary briquetter indicated employee exposure to

formaldehyde ranging from nondetected to 3.0 ppm. Therefore, a personal sample was obtained on an employee working at the rotary briquetter for the remaining 3 hours of the shift (see Table II). Highest exposures were for rotary briquetter operators, although one sample, as noted, was for a 3-hour period.

Subsequent to the field survey, NIOSH laboratory personnel discovered that the method (P&CAM No. 318) used to collect formaldehyde samples had a problem of sample stability. Quality control tests of the method indicated that actual airborne concentrations are 20 to 50% higher than reported values. Therefore, the values in Table II must be considered as minimum concentrations.

Results of sampling using direct-reading indicator tubes to measure airborne concentrations of formaldehyde ranged from nondetected to 4.0 ppm. Four tubes (two per shift) used at a height of approximately 5 feet indicated airborne formaldehyde concentrations of 1.0, 2.0, 3.0, and 4.0 parts per million (ppm) in the rotary briquetter area. Three other detector tubes used in the curing press area, on a platform on top of the rotary briquetter, and in the finishing department (as background for other areas) detected no airborne formaldehyde concentrations. These values should be considered as indicating a range of potential exposures rather than exact exposure concentrations. Certified direct-reading indicator tubes have ±35% accuracy at one-half the exposure limit and ±25% at 1 to 5 times the limit.[21] The formaldehyde tubes have not been certified[22] and thus may not be as accurate as certified tubes are. The formaldehyde indicator tubes are still useful for estimating airborne contaminant concentrations and for evaluating short-term or ceiling values.

The NIOSH recommended standard, intended to prevent irritation effects, for occupational exposure to formaldehyde was 1.0 ppm based on any 30-minute sampling period.[7] However, NIOSH recently published a Current Intelligence Bulletin (CIB) for formaldehyde. In the CIB, NIOSH reports that formaldehyde has induced certain types of cancer in laboratory animals. NIOSH recommends that formaldehyde be handled as a potential occupational carcinogen.[6] Thus, airborne concentrations of formaldehyde should be reduced to the lowest feasible concentration. Airborne formaldehyde levels obtained in the rotary briquetter area indicated employee exposures in excess of the NIOSH recommendation.[6]

While in the rotary briquetter area, the NIOSH industrial hygienist experienced eye irritation and detected an odor that was suggestive of formaldehyde.[9,23] Formaldehyde is known to

be a possible cause of eye irritation at the levels measured in this area. However, other materials associated with the phenolic resin used in this area, such as ammonia (NH_3) and hexamethylene tetramine, might also cause eye and/or skin irritation.[7,9,24]

2. Asbestos

Table III presents the air sampling results for asbestos. Concentrations of asbestos samples ranged from 0.03 fibers per cubic centimeter to 0.67 fibers per cubic centimeter (fibers/cc). These values are all below the OSHA PEL of 2.0 fibers >5.0 microns/cc and the ACGIH TLV for chrysotile asbestos of 2.0 fibers >5.0 microns/cc.[2,8] Four of the six values obtained are above the NIOSH recommended standard of 0.1 fibers >5.0 microns/cc.[12]

3. Metals

Table IV presents the air sampling results for inorganic metals. Concentrations for the three metals detected on personal samples were 24.6 micrograms per cubic meter (ug/m^3) to 96.7 ug/m^3 for barium, 9.3 ug/m^3 to 12.7 ug/m^3 for iron, and 11.5 to 14.0 ug/m^3 for magnesium. These values are all below current OSHA PELs and ACGIH TLVs.[2,8] At the present time, NIOSH has no recommended standard for these metals.

4. Ventilation

Spot checks of the local exhaust ventilation equipment indicated that it was working satisfactorily. The airflow patterns observed were satisfactory on process machinery equipped with local exhaust ventilation. The only machinery without local exhaust ventilation was the rotary briquetter, which was partially enclosed, and the curing presses, which were not enclosed.

5. Work Practices

Observation of employee work practices revealed that manual material handling techniques could be improved such that airborne dust levels might be reduced. Employees in the finishing department were involved in transporting materials from transport carts to their work station and vice versa. When employees transferred multiple brake blocks from one surface to another, they tended to release the blocks a few inches above the working surface. When the blocks struck the working surface, particulates could be seen rising from the dropped blocks and from dust already on the surface.

Material handling techniques for asbestos in the mixing area were good. Asbestos packages were opened under a hood, and used asbestos wrappers were stored under the hood until collected for disposal. However, empty containers from other raw materials were thrown into a pile such that visible airborne dust was generated from the residue remaining in the bag. At least one of these materials had warning labels on the bag concerning the need of protective clothing and the importance of avoiding skin contact.

While conducting the walk-through survey, an employee was observed to be welding at a height of approximately 8 feet in close proximity to work stations and to the main aisle through the work area. No attempt had been made to isolate the floor space located beneath the welding operation. Sparks and burning bits of metal were observed falling onto the floor.

B. Medical

The medical officer interviewed 17 workers involved in clutch plate production, 5 from the brake block division, and 10 machinists/mechanics/skilled craftsmen. Interview findings by work category are presented in Table V.

The average age of workers in the mechanic/machinist/skilled craftsmen category was higher than the average age for the work force as a whole. This reflected the reported pattern of bidding into these positions from positions elsewhere in the plant. The lower age of most workers in the brake block area presumably reflected the younger age of workers who were hired when the brake block division began operation in 1973.

Respiratory findings by smoking category are shown in Table VI. Small sample size precluded assessment by work category after stratifying for smoking status. Both workers who reported having had heart attacks were smokers at the time of the episode.

Eleven workers reported numbness or tingling of the arms or legs, of whom 6 reported a suspected cause, including neck injury, carpal tunnel syndrome, diabetes, and possible stroke.

None of the workers interviewed was aware of any current kidney impairment.

Only limited identifying information was obtained about employees who were reported to have had heart attacks in the past. This did not provide a sufficient basis from which to initiate an appropriate investigation of cardiovascular disease in this group of workers.

Environmental measurements by Raybestos has indicated that maintenance personnel and workers in the clutch plate area may be exposed to airborne lead. Blood lead values are obtained on a yearly basis from these workers. The work setting and work practices are routinely evaluated for any worker who is found to have a level that exceeds 40 ug/dl (micrograms per deciliter). Company records for February 1979 through April 1981 for possible lead-exposed workers showed levels greater than 40 ug/dl for 5 of 105 specimens in 1979, 8 of 87 in 1980, and none of 29 in 1981. (At least 3 of the 1980 specimens that showed elevated blood lead levels were obtained from a single worker.) One worker from the clutch plate area reported to the NIOSH medical officer that he had been found to have an elevated blood lead level which he attributed to a non-workplace use of molten lead.

VII. DISCUSSION AND CONCLUSION

Results of environmental sampling indicate that during the NIOSH survey employees were exposed to airborne concentration of formaldehyde and asbestos, which are in excess of current NIOSH recommendations for these chemicals. Asbestos is a known human carcinogen[12] and NIOSH recommends that formaldehyde be handled as a potential occupational carcinogen.[6] NIOSH recommendations for known or potential carcinogens is that these materials be controlled to the lowest level feasible. The recommendation for asbestos is that it be controlled to the lowest level detectable by available analytical techniques. At the present time, this level is defined as 0.1 fiber >5 um in length/cc of air.[12]

Employees were not exposed to concentrations of metals approaching any of the current environmental criteria.[2,8]

The respiratory findings revealed by interviews suggested association with cigarette smoking. The absence of reported respiratory symptoms among workers exposed to airborne asbestos fibers has little predictive value, since the brake block process involving asbestos had been introduced to the plant only 8 years prior to this investigation and because the workers in the brake block area were relatively young.

The current investigation, company surveillance data, and data previously obtained in OSHA inspections do not suggest the likelihood of illness attributable to lead exposure in this group of workers.

The concerns about heart attacks among workers could not be assessed definitively. Such an assessment would have required detailed information about medical history, personal habits, and in-plant exposure data for past workers. The difficulties in obtaining this information and the relatively small number of workers involved would virtually have assured an inconclusive outcome had an exhaustive study been attempted.

Heart disease and heart attacks can be associated with the work place. Factors about which management and workers should maintain vigilance are heat stress and carbon monoxide exposure, each of which can potentially cause or precipitate cardiovascular events.

VIII. RECOMMENDATIONS

Recommendations are made per conditions observed during the NIOSH field survey. The Brake Block Division closed down, as scheduled, subsequent to the NIOSH survey.

1. Management should incorporate environmental sampling of the rotary briquette and curing press area into the existing environmental sampling program. Eye irritation experienced by the NIOSH industrial hygienist and airborne concentrations obtained with detector tubes indicated a potential problem that may be due to formaldehyde exposure.

2. Manual material handling techniques in the brake block department should be improved to help reduce generation of airborne dust potentially containing asbestos, lead, and other contaminants.

3. When welding is being performed during normal production, a safety zone should be delineated to ensure that no one accidentally enters the welding area. This is particularly important when welding is being performed overhead.

4. Usual good work practices should minimize potential work place-related contributors to cardiovascular stress, including carbon monoxide, welding fume, and heat burden.

5. Usual compliance with U.S. Department of Labor mandated medical surveillance should be maintained for asbestos and lead-exposed workers:

    a. Workers exposed to airborne asbestos should receive a yearly medical examination, including chest X-ray and pulmonary function testing.

    b. Workers in an environment in which the airborne concentration of lead exceeds the action level of 30 ug/m^3 for more than 30 day/year should be monitored according to 29 CFR 1910.1025, with provisions that relate to blood lead and zinc protoporphyrin monitoring, medical examinations, medical intervention, and removal of affected workers from areas of potential lead exposure including 29 CFR 1910: Vol. 46, No. 238 (December 11, 1981).

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Industrial Hygiene Section

X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Raybestos Friction Materials Company, Crawfordsville, Indiana
2. Confidential Requestor
3. Authorized Representative of Employees, Local 164, Allied Industrial Workers
4. NIOSH, Region V
5. OSHA, Region V

For the purpose of informing the approximately 400 affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

Summary of Previous Environmental Measurements
Collected During a 1972 NIOSH HHE Survey (HHE 71-21)

Raybestos Friction Materials Company
Crawfordsville, Indiana
HETA 81-100

	Maximum Level	Location in Plant	Relevant OSHA Standard (in 1972)
Lead (as Pb)	0.08 mg/m^3	Milling/Slotting/Grooving (personal sample)	0.2 mg/m^3 *
Copper (as Cu dusts, mists)	0.37 mg/m^3	Drilling and Punch Press (area sample)	1.0 mg/m^3
Iron (as iron oxide)	1.034 mg/m^3	Grinding (personal sample)	10.0 mg/m^3
Zinc (as zinc oxide fume)	trace (<0.40 mg/m^3)	-	5.0 mg/m^3
Magnesium (as magnesium oxide fume)	trace (<0.40 mg/m^3)	-	15.0 mg/m^3
Antimony and Compounds (as Sb)	not detected (<0.005 mg/m^3)	-	0.5 mg/m^3
Molybdenum (as soluble compounds)	not detected (<0.001 mg/m^3)	-	5.0 mg/m^3
Tin (inorganic compounds, except oxides)	not detected (<0.005 mg/m^3)	-	2.0 mg/m^3

(continued)

TABLE I (continued)

	Maximum Level	Location in Plant	Relevant OSHA Standard (in 1972)
Silica - total dust	2.8 mg/m^3	Grinding (personal sample)	5.7 mg/m^3 **
Silica - respirable dust	1.4 mg/m^3	Milling/Slotting/Grooving (area sample)	1.9 mg/m^3 ***
Graphite	not evaluated	-	15 million particles per cubic foot of air

* PEL reduced to 50 micrograms (0.050 mg)/m^3 in 1980.[1,2]

** Calculated using OSHA formula $\left(\frac{30 \text{ mg/m}^3}{\% \text{ Free Silica } +2}\right)$

*** Calculated using OSHA formula $\left(\frac{10 \text{ mg/m}^3}{\% \text{ Free Silica } +2}\right)$

TABLE II

Airborne Concentrations of Formaldehyde - Personal Samples

Raybestos Friction Materials Company
Crawfordsville, Indiana
HETA 81-100

March 12-13, 1981

Location	Sample Time	Date	Volume (Liters)	Concentration (ppm)
Raw Material Prep.	0905-1512	3-12	17.5	LLD
Curing Press Oper.[1]	0908-1504	3-12	0.7	LLD
Curing Press Oper.	0911-1514	3-12	20.7	0.39
Rotary Briquetter Oper.[2]	1211-1502	3-12	9.2	1.24
Curing Press Oper.	0002-0658	3-13	18.1	LLD
Curing Press Oper.	0000-0657	3-13	15.7	LLD
Curing Press Oper.	0005-0702	3-13	26.4	0.37
Rotary Briquetter Oper.	2358-0655	3-13	19.9	0.82

1 = Invalid sample due to inadequate pump flow.
2 = Sample taken during 2nd half of shift following detector tube sampling, which indicated formaldehyde exposure at Rotary Briquetter.
LLD = Below limit of detection (8.0 ug formaldehyde/tube).

Environmental Criteria: OSHA PEL = 3.0 ppm
ACGIH TLV = 2.0 ppm
NIOSH Recommendation = Lowest level feasible

TABLE III

Airborne Concentrations of Asbestos Fibers - Personal Samples

Raybestos Friction Materials Company
Crawfordsville, Indiana
HETA 81-100

March 12-13, 1981

Location	Sample Time	Date	Volume (cc)	Concentration (fibers/cc)
Raw Material Mixer	0755-1507	3-12	864,000	0.03
Machine Finisher	0809-1516	3-12	854,000	0.40
Drill and Counter Draft	0812-1520	3-12	860,000	0.56
Raw Material Mixer	2351-0653	3-13	844,000	0.04
Slab Cut	0013-0706	3-13	826,000	0.67
Machine Finisher	0023-0705	3-13	804,000	0.45

Environmental Criteria: OSHA PEL = 2.0 fibers >5.0 um/cc
ACGIH TLV = 2.0 fibers >5.0 um/cc (chrysotile)
NIOSH Recommendation = 0.1 fiber >5.0 um/cc

TABLE IV

Airborne Concentrations of Metals - Personal Samples

Raybestos Friction Materials Company
Crawfordsville, Indiana
HETA 81-100

March 12-13, 1981

Location	Sample Time	Date	Volume (m^3)	Concentration (ug/m^3)*			
				Ba	Fe	Mg	Sn
Raw Material Prep.	0758-1510	3-12	0.65	96.7	9.3	14.0	-
Weigh Briq. and Cure	0802-1500	3-12	0.63	38.0	6.3	12.6	-
Rotary Saw	0816-1518	3-12	0.63	57.2	12.7	38.1	-
Raw Material Prep.	2255-0649	3-13	0.62	-	-	-	LLD
Machine Finish "Champhur"	0025-0648	3-13	0.58	-	-	-	LLD
Slab Cut	0017-0705	3-13	0.61	24.6	LLD	11.5	-

* Lead and zinc were not detected on any samples.
LLD = Below limit of detection (Ba = 3.0 ug, Fe = 3.0 ug, Mg = 1.0 ug).
- = Not analyzed for.

Environmental Criteria:

Ba (Barium - soluble compounds) = OSHA PEL - 500 ug/m^3
ACGIH TLV - 500 ug/m^3

Fe (Iron - nuisance dust) = OSHA PEL - 15,000 ug/m^3
ACGIH TLV - 10,000 ug/m^3

Mg (Magnesium - nuisance dust) = OSHA PEL - 15,000 ug/m^3
ACGIH TLV - 10,000 ug/m^3

Sn (Tin - inorganic compounds) = OSHA PEL - 2,000 ug/m^3
ACGIH TLV - 2,000 ug/m^3

TABLE V

Medical Interview Data by Work Area

Raybestos Friction Materials Company
Crawfordsville, Indiana
HETA 81-100

Symptom Description	Clutch Plate Area (n=17)	Brake Block Area (n=5)	Machinists, Mechanics, Skilled Craftsmen (n=10)
Shortness of breath with exertion	5	0	4
Cough in the morning	5	0	2
Phlegm in the morning	2	0	2
Wheezing/whistling in chest	2	0	0
Chest pain associated with deep breath or movement	5	1	0
Chest pain made worse with exertion; better with rest	0	0	0
High blood pressure	4	1	5
History of heart attack	0	0	2
Numbness or tingling of hands or feet	6	1	4
Current smoker	9	1	6
Age ± Standard Deviation of Workers Interviewed	39±8	34±9	51±5
Age ± Standard Deviation of Hourly Work Force	37±12	32±7	45±9
Age ± Standard Deviation of Total Work Force (n=431)		38±11	

TABLE VI

Medical Interview Data by Smoking Category

Raybestos Friction Materials Company
Crawfordsville, Indiana
HETA 81-100

	Current Smoker (n=16)	Ex-Smoker (n=5)	Never Smoked (n=11)
Shortness of breath with exertion	7	1	1
Cough in the morning	7	0	0
Phlegm in the morning	4	0	0
Wheezing/whistling in chest	2	0	0
High blood pressure	3	3	4

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