

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION

REPORT NO. 79-45-649

THE TIMKEN COMPANY
CANTON, OHIO

DECEMBER, 1979

I. TOXICITY DETERMINATION

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) of pithand workers engaged in mold clean out and preparation activities at the stripper building of The Timken Company, Canton, Ohio, during the periods of February 12-13, 1979, and May 21, 1979. The results of the evaluation revealed the following:

1. The concentration of crystalline silica (free silica) in all five personal breathing zone samples exceeded both the NIOSH recommended time-weighted average standard of 50 micrograms of free silica per cubic meter of air and the OSHA standard (respirable dust permissible exposure limit= 10 milligrams per cubic meter of air divided by the % Quartz plus 2). On the basis of the data obtained in this investigation NIOSH has determined that a serious hazard of pithand employee exposure to silica existed at the time of this survey.
2. Laboratory analysis revealed that the bulk refractory material did not contain asbestos or fibrous glass; consequently, the potential for exposure to these materials did not exist. The fiber-like material present in the refractory material is mineral wool fiber which is known to cause severe itching reactions in contact with the skin and is presumably responsible for the skin irritation experienced by the workers.
3. The results of the personal air sampling for coal tar pitch volatiles (CTPV's) conducted on May 21, 1979, indicated levels of benzene extractables which were below

the 0.2 mg/M³ evaluation criteria, yet, laboratory analyses of the powdered coal tar pitch mixture identified known and suspected carcinogens as components of the mixture.

Although air sampling results for CTPV's were below the evaluation criteria, no safe concentration can be established for carcinogens. In order to substantially reduce the risk of cancer produced by coal tar products, the employer and employees should make every effort to keep exposures as low as possible.

Recommendations have been offered in this report for reducing worker exposure to free silica, mineral wool fibers, and coal tar pitch volatiles.

II. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

- a. United Steelworkers of America, Local No. 1123
- b. The Timken Company, Canton, Ohio
- c. U. S. Department of Labor, OSHA, Region V
- d. NIOSH, Region V

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an 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.

On January 29, 1979, NIOSH received such a request from United Steelworkers of America Local No. 1123 for a health hazard evaluation in the stripper building of the Timken Company Canton Steel Mill. The request alleged employee exposure to fibrous glass, asbestos, and other components of a refractory material during a mold clean-out operation.

Before NIOSH was contacted, a Compliance Safety and Health Officer (CSHO) from the Cleveland OSHA area office responded to a complaint alleging exposure to asbestos, fibrous glass and clay during the mold clean-out operation. The CSHO felt that individual exposure time to the refractory powder was limited and therefore no environmental samples were collected. The manufacturer of the refractory material informed the CSHO that the refractory material contained no asbestos. No citations were issued and the inspection was finalized on December 21, 1978.

NIOSH Interim Reports #1 and #2 were submitted to the requestors and plant management, respectively, during the months of February 1979 and July 1979. These reports provided the preliminary results of the initial and followup surveys, the results of environmental measurements for free silica, and recommendations designed to alleviate the exposure problem.

IV. HEALTH HAZARD EVALUATION

A. Process Description

The company is engaged in the production of steel and bearings. Twenty, thirty and forty inch molds are prepared in the stripper building for the pouring of molten steel. Two groups of three pithands are involved in various mold preparation activities during each eight hour shift.

The hot top refractory liners and sealing rings turn into a powder after molten steel has been poured into the mold. The pithand must clean these molds with compressed air after the ingots have been removed. The pressure at the end of the compressed-air line is between 50-90 pounds per square inch and this activity sends a cloud of refractory powder into the ambient air. After a series of molus have been cleaned the pithand paints the interior of the mold with a water based coal tar slurry in order to prevent the ingot from later sticking to the mold.

The three pithands alternate duties. No individual pithand is required to clean all molds that require service during the eight hour shift. Each pithand spends less than thirty-five minutes per shift cleaning the molds. The pithands wear air purifying dust and mist respirators and safety glasses during the clean-out operation.

B. Evaluation Design

On February 12-13, 1979, a NIOSH Industrial Hygienist conducted a walk-thru survey of the stripper building. Bulk samples of the refractory material were obtained for laboratory analyses of free silica, asbestos, and fibrous glass. Twelve confidential employee interviews were conducted.

On May 21, 1979, a NIOSH Regional Consultant and Industrial Hygienist conducted an environmental survey. Personal breathing zone atmospheric samples were taken to assess employee exposure to respirable free silica and coal tar pitch volatiles. All six pithands on the 4 P.M. to midnight shift were sampled in this survey. NIOSH investigators did not quantitate worker exposure to mineral wool fiber because the most hazardous material present in the refractory dust was free silica and the most reliable indication of a hazard to the worker's health was quantitation of worker exposure to free silica. A bulk sample of a powdered coal tar pitch mixture, a major ingredient of the water soluble coal tar slurry, was obtained for laboratory analysis of polynuclear aromatic hydrocarbons (PNA's).

C. Evaluation Methods

The laboratory analysis of the bulk refractory material for free silica was performed using X-ray diffraction (NIOSH method P&CAM #109¹, with modifications). The analysis of the refractory material for asbestos was performed using phase contrast, polarizing, and dispersion staining techniques.

The respirable free silica was collected on 37 millimeter diameter low ashing polyvinyl chloride filters. The sampling trains consisted of filters, 10 millimeter nylon size selective samplers, and battery powered air sampling pumps operating at 1.7 liters per minute. Analysis for quartz was performed using X-ray diffraction (NIOSH method P&CAM #109¹).

Coal tar pitch volatiles were collected on glass fiber filters followed by silver membrane filters and back-up pads which were mounted in 37 mm., 3 piece plastic cassettes. The sampling train consisted of filters

connected to battery powered air sampling pumps operating at 1.5 liters per minute. The samples were analysed for benzene solubles by benzene extraction and gravimetric determination utilizing NIOSH method P&CAM #217².

The dry, powdered coal tar pitch mixture was analyzed for polynuclear aromatic hydrocarbons by reversed-phase high pressure liquid chromatography. The analytical procedures involved application of a methanol/water solvent gradient. Retention times of specific peaks in the chromatograms derived from the samples were compared with those of known standard compounds for analytic identification.

D. Evaluation Criteria

A number of sources recommend airborne levels of substances under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Such airborne levels are referred to as standards or threshold limit values (TLV's). It is believed that concentrations below these limits represent conditions under which nearly all workers may be repeatedly exposed 8-10 hours per day, 40 hours per week, without suffering adverse health effects. Due to variations in individual susceptibility, a small percentage of workers may experience effects at levels at or below the threshold limit; a smaller percentage may be more seriously affected by aggravation of a pre-existing condition or by a hypersensitivity reaction.

The three main sources of criteria for this study are: (1) NIOSH Criteria Documents with recommended standards for occupational exposure; (2) General Industry Safety and Health Standards, U. S. Department of Labor, OSHA³; (3) Threshold Limit Values (TLV's), and their supporting documentation, issued by the American Conference of Governmental Industrial Hygienists (ACGIH)⁴.

The exposure limits applicable to the substances evaluated during this investigation are discussed below.

1. Free Silica - The primary health effects associated with inhalation of free silica is a form of pneumoconiosis (dusty lung) termed silicosis. As the silicon dioxide is deposited in the lungs, the silica stimulates production of fibrotic nodules. The nodules in turn compress the alveoli (air sacs) thereby decreasing the lung function and producing restrictive type pulmonary disease. The higher the concentration of free silica present in the

environment and the longer the exposure, the greater is the risk of developing silicosis.

NIOSH recommends that exposure to respirable free silica be controlled so that no worker is exposed to a time-weighted average (TWA) concentration of greater than 50 micrograms per cubic meter of air ($50 \text{ ug}/\text{M}^3$)

The OSHA standard for exposure to respirable quartz is based on a respirable dust concentration formula:
respirable dust permissible exposure limit = $10 \text{ mg}/\text{M}^3$
divided by the % Quartz + 2.³

2. Coal tar pitch volatiles (CTPV's) - Repeated exposure to coal tar pitch has been associated with an increased risk for developing lung and skin cancer. These materials may also produce phototoxic effects, whereby the skin and eyes become sensitive to sunlight resulting in skin erythema, burning and itching of the skin; eye irritation and lacrimation, conjunctivitis and interferences with vision.

The chemical composition of coal tar and coal tar products is extremely complex. It has been estimated that as many as 10,000 different compounds are present but currently only about 300 compounds have been identified. Coal tar often contains identifiable PNA components which by themselves are carcinogenic, such as benzo (a) pyrene, benzanthracene and chrysene. Other PNA's from coal tar products such as fluoranthene and pyrene may also cause cancer, but these causal relationships have not been adequately documented.⁶

NIOSH recommends that occupational exposure to coal tar products shall be controlled so that employees are not exposed to coal tar pitch at a TWA concentration of greater than $0.1 \text{ mg}/\text{M}^3$ of the cyclohexane-extractable fraction of the sample⁶. The OSHA standard is $0.2 \text{ mg}/\text{M}^3$ of the benzene extractable fraction, determined as a TWA. Because the CTPV samples were extracted with benzene, the OSHA standard will be used as the evaluation criteria in this report.

3. Mineral Wool Fibers - Mineral wool fibers are known to cause severe itching reactions in contact with the skin. The reaction seems to be induced mechanically, as the minerals without the fibers do not give a positive skin reaction in subjects tested. Very little information is available on the systemic effects of exposure to mineral wool fibers. The American Conference of Governmental

Industrial Hygienist (ACGIH) recommend that exposure to mineral wool fiber be controlled so that no worker is exposed to a TWA concentration of greater than 10 milligrams per cubic meter (10 mg/M^3).⁴

E. Evaluation Results and Discussion

The results from the laboratory analysis of the bulk refractory material revealed the following:

1. The major component of the refractory is free silica in the form of quartz. No other forms of crystalline silica were detected.
2. No asbestos was present in this material.

The manufacturer of the refractory material indicated that no fibrous glass is used in the manufacture of the refractory. The fiber-like material present in the refractory is mineral wool fiber, which is a monocalcium silicate mineral fiber produced from molten furnace slag. Presumably, exposure to mineral wool fiber was responsible for the skin irritation experienced by the pithand employees.

The results of twelve confidential employee interviews revealed four complaints related to exposure to the refractory powder. A listing of the complaints and the percentage of workers affected is given below:

<u>COMPLAINT</u>	<u>% of WORKERS AFFECTED</u>
1. Coughing, with production of black flecks and refractory powder.	65%
2. Dermal irritation of the neck, arms, and face.	50%
3. Irritation of the eyes.	25%
4. Occasional shortness of breath.	12%

Based on the results of the personal air sampling conducted on May 21, 1979, it has been determined that the pithand employees were exposed to hazardous levels of free silica. Results from the personal breathing zone air samples collected are shown in Table 1. All five full shift TWA exposures to free silica were in excess of the 50 ug/M^3 NIOSH recommended criteria. Concentrations of quartz ranged from 160 ug/M^3 to 370 ug/M^3 ,

while the average exposure was 280 ug/M³. Also, all five exposures to quartz were in excess of the OSHA standard (Table 2).

An inadequate respiratory protection program utilizing air purifying dust and mist respirators was in effect at the time of this survey. In order to determine the type of respirator to be used by the pithands, the employer should initially measure the atmospheric concentration of all contaminants and thereafter whenever process, workload, climate, or control changes occur which are likely to affect the free silica concentration. Management was unable to produce any documentation of pithand exposure levels to free silica in the stripper building at the time of this survey.

The results of the personal air sampling for coal tar pitch volatiles conducted on May 21, 1979, indicated levels of benzene extractables which were below the 0.2 mg/M³ evaluation criteria. Concentration of benzene extractables ranged from 0.030 mg/M³ to 0.118 mg/M³, while the average exposure was 0.066 mg/M³. Results are shown in Table 3.

Laboratory analysis of the powdered coal tar pitch mixture identified benzo(a)pyrene, benzanthracene, chrysene, fluoranthene, and pyrene as components of the mixture. Presumably, these carcinogenic and suspected carcinogenic chemicals are present in the water based coal tar slurry.

F. Conclusions

1. Pithand employees were exposed to hazardous levels of free silica at the time of this survey.
2. A inadequate respiratory protection program was in effect at the time of this survey.
3. Exposure of pithand employees to coal tar pitch volatiles were below the evaluation criteria, yet, laboratory analyses of the powdered coal tar pitch mixture identified known and suspected carcinogens as components of this mixture. No safe concentration can be established for carcinogens, therefore, in order to substantially reduce the risk of cancer produced by coal tar products, the employer and employees should make every effort to keep exposures as low as possible.
4. Laboratory analysis revealed that the bulk refractory material did not contain asbestos or fibrous glass; consequently, the potential for exposure to these materials did not exist.

G. Recommendations

1. Employee exposure to free silica, mineral wool fiber, and coal tar pitch volatiles should be reduced to the lowest extent possible through effective engineering and administrative controls. Consideration should be given to the feasibility of replacing the positive pressure compressed air method of mold cleanout with a negative pressure vacuum system. This would substantially reduce employee exposure to free silica and mineral wool fibers.

2. Respirators as a means of control should be used in the interim period when effective engineering controls are being implemented. The company should evaluate and modify the existing respiratory protection program to ensure that it is in compliance with the requirements described in the NIOSH Criteria for a Recommended Standard... Occupational Exposure to Crystalline Silica⁵ and the requirements described and outlined as 11 criteria for a minimal acceptable program in the Occupational Safety and Health Administration Standards, Title 29 of the Code of Federal Regulations, Part 1910, Section 134.

3. A medical surveillance program for all employees who regularly work in the stripper building should be implemented as soon as possible. These employees should be given pre-employment and periodic physical examinations with particular attention given to the oral cavity, skin, and respiratory system. Pulmonary function tests, chest x-rays, a complete blood count and a sputum cytology examination should be provided as a part of the physical examination.

4. An environmental monitoring program should be developed to accurately assess each employee's occupational exposure to free silica, mineral wool fiber, and CTPV's and other known or suspected carcinogens including benzo (a) pyrene, benzanthracene, chrysene, fluoranthene, and pyrene.

5. Stripper building employees should be informed of the health hazards associated with free silica, mineral wool fiber, and CTPV's. They should receive training by a qualified person to ensure that each employee has a current understanding of the job hazards, proper maintenance and clean up procedures, the correct use of respirators, and

the need for employee cooperation, support, and participation in a medical and environmental surveillance program.

6. Employees responsible for handling and application of the water based coal tar slurry should be required to wear disposable protective coveralls, gloves, and head cover. In areas lacking adequate engineering controls use of respirators should also be required as an interim measure.

7. Good personal hygiene is of prime importance. Employees should shower and wash thoroughly with soap and water at the end of a shift. Attention should be given to flushing of the eyes with water at this time. A complete change of clothing should be made after showering. Freshly laundered work clothes should be worn daily.

8. Skin contaminated with the coal tar pitch dust or coal tar pitch slurry should be washed promptly with soap or a waterless hand cleaner. To prevent skin absorption of coal tar pitch, employees should not use solvent to clean their hands.

V. REFERENCES

1. P&CA Method No. 109: NIOSH Manual of Analytic Methods, Volume 1, DHEW(NIOSH) Publication No. 77-157-A, (April 1977).
2. P&CA Method No. 217: NIOSH Manual of Analytic METHODS, Volume 1, DHEW(NIOSH) Publication No. 77-157-A, (April 1977).
3. General Industry Standards: Occupational Safety and Health Administration Safety and Health Standards (29 CFR 1910) revised January 1976.
4. American Conference of Governmental Industrial Hygienist: Documentation of Threshold Limit Values, 3rd Printing, 1976.
5. Criteria for a Recommended Standard.. Occupational Exposure to Crystalline Silica: NIOSH Publication No. 75-120 (1974).
6. Criteria for a Recommended Standard.. Occupational Exposure to Coal Tar Products: NIOSH Publication No. 78-107, September, 1977.

7. Bjornberg, A., and G. B. Lowhagen, "Patch Testing with Mineral Wool (Rockwool)," ACTA Dermato-Venereologica, Vol. 57, No. 3, Pages 257-260.

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TABLE 1
 RESULTS OF BREATHING ZONE AIR SAMPLES FOR RESPIRABLE FREE SILICA
 5/21/79

<u>JOB/LOCATION</u>	<u>SAMPLE NUMBER</u>	<u>TIME OF SAMPLE</u>	<u>TOTAL VOLUME SAMPLED(M³)</u>	<u>RESPIRABLE QUARTZ (ug/M³)</u>
Pithand/Stripper building	4002	1604-2337	0.770	160
Pithand/Stripper building	4012	1606-2335	0.763	210
Pithand/Stripper building	4006	1608-2336	0.762	370
Pithand/Stripper building	4007	1610-2333	0.753	310
Pithand/Stripper building	4005	1612-2332	0.748	350
Pithand/Stripper building	4004	1620-2334	*	*

NIOSH EVALUATION CRITERIA (ug/M³) 50

NIOSH LIMIT OF DETECTION(ug/sample) 30

ABBREVIATIONS:

M³ = cubic meter

ug/M³ = micrograms of substance per cubic meter of air

* = results invalidated due to improperly functioning pump

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TABLE 2
 RESULTS OF ENVIRONMENTAL SAMPLING ON MAY 21, 1979
 FOR RESPIRABLE FREE SILICA

<u>JOB/LOCATION</u>	<u>SAMPLE NUMBER</u>	<u>TIME OF SAMPLE</u>	<u>TOTAL VOLUME SAMPLED(M³)*</u>	<u>% QUARTZ</u>	Calculated** OSHA Respirable dust permissible exposure limit (ug/M ³)	<u>Respirable dust(ug/M³)</u>
Pithand/Stripper building	4002	1604-2337	0.770	33	286	470
Pithand/Stripper building	4012	1606-2335	0.763	70	139	300
Pithand/Stripper building	4006	1608-2336	0.762	72	135	510
Pithand/Stripper building	4007	1610-2333	0.753	68	143	450
Pithand/Stripper building	4005	1612-2332	0.748	79	123	440
Pithand/Stripper building	4004	1620-2334	****	***	***	***

ABBREVIATIONS:

* = breathing zone samples
 ** = OSHA respirable dust permissible = 10 milligrams per cubic meter exposure limit divided by the % Quartz + 2
 ***= results invalidated due to improperly functioning pump
 M³ = cubic meter
 ug/M³ = micrograms per cubic meter

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TABLE 3
 RESULTS OF BREATHING ZONE AIR SAMPLING ON MAY 21, 1979
 FOR COAL TAR PITCH VOLATILES (BENZENE EXTRACTABLES)

<u>JOB/LOCATION</u>	<u>SAMPLE NUMBER</u>	<u>TIME OF SAMPLE</u>	<u>TOTAL VOLUME SAMPLED (M3)</u>	<u>BENZENE EXTRACTABLES (mg/M3)</u>
Pithand/Stripper building	1	1604-2337	0.676	0.118
Pithand/Stripper building	2	1606-2335	0.670	0.060
Pithand/Stripper building	3	1608-2336	0.669	0.060
Pithand/Stripper building	4	1610-2333	0.661	0.060
Pithand/Stripper building	5	1622-1920	*	*
Pithand/Stripper building	6	1620-2334	0.651	0.030
--	BLANK	--	--	0.02
OSHA EVALUATION CRITERIA:			0.20	
LIMIT OF DETECTION:				0.02

ABBREVIATIONS: M³ = cubic meters
 mg/M³ = milligrams per cubic meter of air
 * = results invalidated