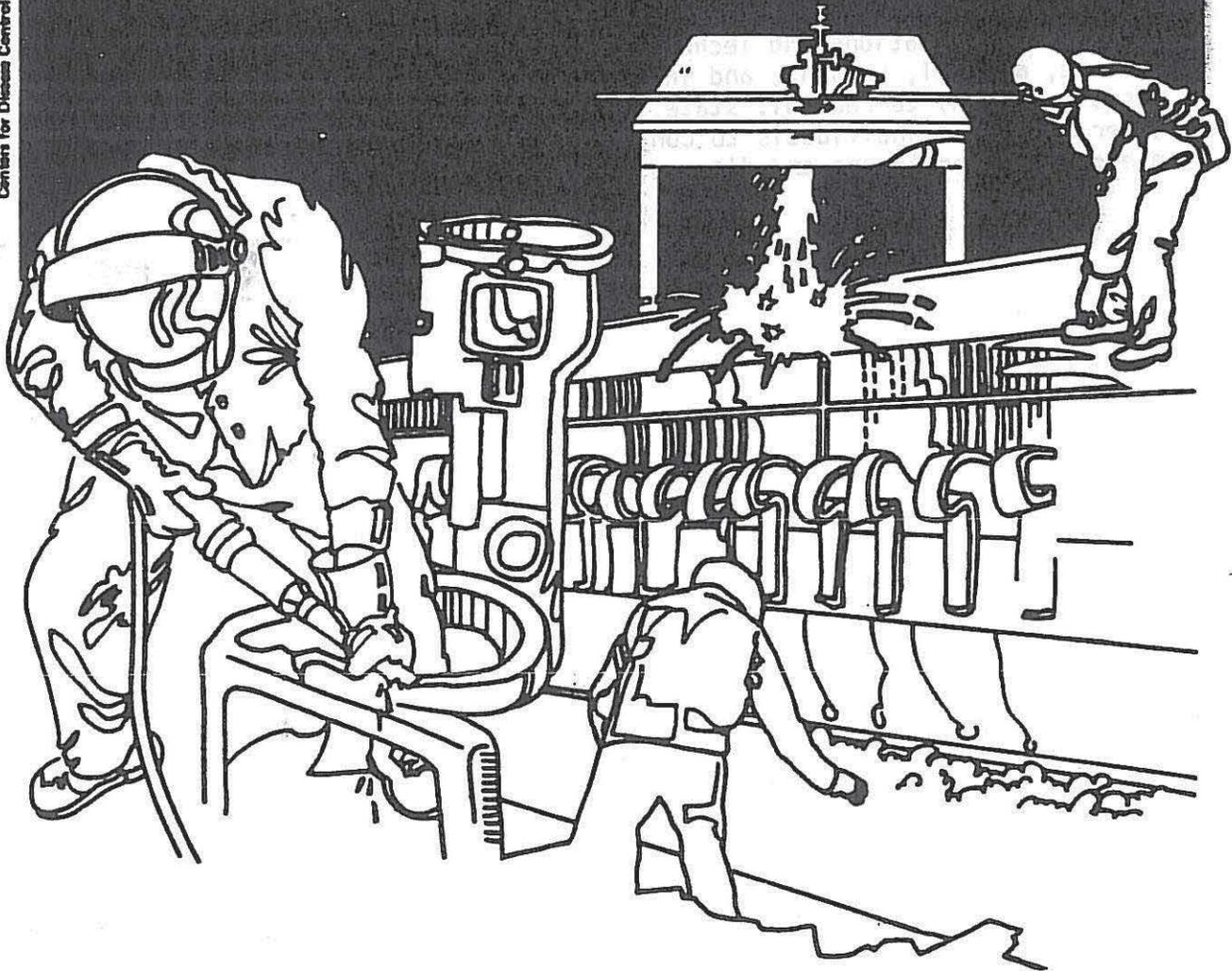


NIOSH



Health Hazard Evaluation Report

HETA 82-067-1253
ANCHOR HOCKING GLASS COMPANY,
ROOFING SITE
LANCASTER, OHIO

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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 82-067-1253
JANUARY 1983
ANCHOR HOCKING GLASS COMPANY, ROOFING SITE
LANCASTER, OHIO

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I. SUMMARY

In November 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the United Union of Roofers, Waterproofers, and Allied Workers to evaluate the tear-off operations of an old coal tar pitch roof at the Anchor Hocking Glass Company, Lancaster, Ohio.

On December 9-10, 1981, NIOSH conducted an evaluation of a coal tar pitch roof tear-off, and the application of hot asphalt at Anchor Hocking Glass Company, Lancaster, Ohio. The tear-off involved the manual removal of an old coal tar pitch roof. Approximately seven workers were involved in the manual prying, scraping and hand removal of the old roof; the same workers then applied a new roof with hot asphalt.

A total of 16 personal breathing zone total dust samples were collected on seven workers using glass fiber/silver membrane filters at a flow rate of 1.5 liters per minute. These personal samples were used to measure roofing worker exposures to benzene soluble fractions and polynuclear aromatic hydrocarbons (PNA's). A bulk sample of the tear-off dust and hot asphalt were collected for analyses of cyclohexane solubles, PNA, and asbestos content.

Analyses of the bulk tear-off dust indicated 0.07 milligrams (7%) of cyclohexane solubles per milligram of bulk material. The bulk dust analysis revealed the presence of several PNA's including phenanthrene, anthracene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene. In addition to the PNA's, the bulk dust sample analysis revealed trace amounts of quartz and asbestos. The bulk sample of asphalt indicated 0.92 milligrams (92%) of cyclohexane solubles per milligram of bulk material, but no PNA's were detected.

For the three to four-hour sampling period, worker exposure to the benzene soluble fraction of the dusts from the roof tear-off operation ranged from 0.3 milligrams per cubic meter (mg/m^3) to 1.1 mg/m^3 . Concentrations of the PNA's in the tear-off dust ranged from 0.2 to 39.5 micrograms per cubic meter (ug/m^3). For the hot asphalt application, the PNA concentrations ranged from 0.2 to 6.3 ug/m^3 .

NIOSH recommends that employees not be exposed to coal tar products in concentrations greater than 0.1 mg/m^3 measured as the cyclohexane soluble fraction averaged over an eight to ten-hour workshift (analytical data indicates that benzene soluble and cyclohexane soluble results are similar for air samples). NIOSH considers coal tar products carcinogenic and this environmental limit should be regarded as the upper limit of exposure and conditions should be made to keep exposures as low as possible. Presently NIOSH recommends that employees not be exposed to asphalt fume in concentrations greater than 5.0 mg/m^3 during any 15-minute period. However, current NIOSH research indicates that asphalt products are carcinogenic to laboratory animals and, therefore, may be more toxic to humans than previously believed.

Workers reported experiencing phototoxic effects including skin erythema, photophobia, and conjunctivitis.

Based on the data collected during the roof tear-off operation, workers were exposed to excessive levels of coal tar pitch dust containing PNA's. Bulk sample analyses also indicated the potential for quartz and asbestos exposure. Recommendations for improving controls for exposure to roofing tear-off dust are made in Section VIII of this report.

KEYWORDS: SIC 1761 (Roofing and Sheet Metal Work); coal tar pitch, PNA's, cyclohexane solubles, benzene solubles, asphalt

II. INTRODUCTION

In August, 1981, the United Union of Roofers, Waterproofers, and Allied Workers submitted a request to NIOSH to evaluate potential exposures resulting from the tear-off of old coal tar pitch roofs. They identified a site in Lancaster, Ohio where workers were to remove an old coal tar pitch roof and apply a new asphalt roof. Environmental sampling was conducted at the Lancaster, Ohio roofing site on December 9-10, 1981.

III. BACKGROUND

The coal tar pitch roof tear-off operation involved several operations. First, loose gravel was collected and removed from the roof surface. A power cutter was then used to breakup the pitch layer down to the insulation. The loosened material then was shoveled into a wheelbarrow and discarded over the edge of the building. Finally, small pieces of debris and dust were swept from the roof surface. Approximately seven workers were involved in the tear-off process; the same workers then applied a new roof with hot asphalt.

IV. EVALUATION DESIGN AND METHODS

Environmental sampling was conducted at the Lancaster, Ohio, roofing site on December 9-10, 1981. Personal breathing zone air samples for total particulates were collected on glass fiber/silver membrane filters at a flow rate of 1.5 liters per minute (lpm). A total of 16 personal breathing zone samples were collected on seven workers and analyzed to determine the PNA content and benzene soluble fractions. Eleven of these 16 samples were collected during the coal tar pitch roof tear-off. The remaining five were collected during the new roof application. The samples were analyzed for benzene* soluble fractions according to NIOSH Method P&CAM 217. The PNA's were analyzed by liquid chromatography.

A bulk sample for the tear-off dust was analyzed to identify which individual PNA's were present. This information was used to specify the analyses on the personal samples. The bulk dust sample also was analyzed for asbestos fibers.

A bulk sample of asphalt was analyzed for PNA content and cyclohexane soluble fraction.

V. EVALUATION CRITERIA

Coal Tar Products The term "coal tar product" as used in the NIOSH recommended standard, includes coal tar, coal tar pitch and creosote. Exposure to coal tar products has been reported to produce phototoxic

* NIOSH has recommended that cyclohexane be substituted for benzene due to the high toxicity of benzene. At the time of this writing, analytical data suggests that benzene soluble and cyclohexane soluble results are similar for air samples.

effects, such as skin erythema (irritation), burning and itching of the skin, photophobia (visual intolerance to light), and conjunctivitis (eye inflammation). From the epidemiologic and experimental toxicologic evidence on coal tar products, NIOSH has concluded that they are carcinogenic and can increase the risk of lung and skin cancer in workers. Coal tar products often contain identifiable components which by themselves are carcinogenic such as benzo(a)pyrene, benzanthracene and chrysene.

NIOSH recommends that occupational exposure to coal tar products be controlled so that workers are not exposed to coal tar, coal tar pitch, creosote or mixtures of these substances at concentrations greater than 0.1 mg/m^3 of the cyclohexane - extractable fraction of the sample as a time-weighted average (TWA) concentration for up to a 10 hour shift in a 40-hour workweek. This limit was recommended because it was the lowest concentration that could be reliably detected by the recommended method of environmental monitoring. NIOSH has stated that while compliance with the limit should reduce the incidence of cancer, no absolute safe concentration can be established for a carcinogen at this time. Therefore, the recommended limit should be regarded as an upper limit of exposure and every effort should be made to keep exposures as low as is technically feasible. The OSHA standard for coal tar pitch volatiles is 0.2 mg/m^3 averaged over the workshift.

Evidence indicates that the same recommended level or a lower level should apply to coal tar pitch tear-off dust produced during the removal of old coal tar pitch roofing material. Data collected to date indicates that the pitch tear-off dust produces similar acute health effects as exposure to other coal tar products. This was evident in the results reported by Hervin and Emmett in 1976¹ where exposure to pitch dust resulting from a tear-off operation was associated with severe symptoms of photosensitivity. There is also evidence to suggest that the carcinogenic potential of the coal tar products and pitch dust are similar. A report published in the Journal of Industrial Medicine (1981), "A Carcinogenic Bioassay of Certain Roofing Materials"³ reported on a study designed to evaluate the carcinogenic potential on mouse skin of materials to which present day roofers are exposed, including traditional coal tar pitch, coal tar bitumen, standard asphalt, and dust produced during the removal of an old coal tar pitch containing roof. The results of the study demonstrated that tear-off pitch dust is strongly carcinogenic to mouse skin and under the circumstances of the experiment was associated with the shortest latent period to cancer observed in any group. There was also no statistically significant difference between the carcinogenicity of the tear-off dust and the coal tar pitch from which it was presumably derived.

Asphalt Fumes: Presently, NIOSH recommends that employees not be exposed to asphalt fumes in concentrations greater than 5.0 mg/m^3 determined during any 15-minute period. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends an 8-hour TWA exposure limit of 5 mg/m^3 and a short-term exposure limit (15 min. - STEL) of $10.0 \text{ (mg/m}^3)$. However, current NIOSH research indicates that asphalt products are carcinogenic to laboratory animals and, therefore, may be more toxic to humans than previously believed.

VI. RESULTS AND DISCUSSION

Analyses of the bulk dust indicated 0.07 milligrams (7%) of cyclohexane solubles per milligram of bulk material. The bulk dust analysis revealed the presence of several PNA's including phenanthrene, anthracene, pyrene, benz(a)anthracene, chrysene, benzo(p)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene. The bulk coal tar pitch dust analysis revealed the presence of some inorganic, as well as organic, material. In addition to coal tar, major components included gypsum, aluminum silicates, calcite/dolomite minerals, and cellulose wood fibers. Minor components included amphibole minerals (a common crystalline substance), iron particles, quartz, and amosite asbestos fibers. The bulk sample of asphalt indicated 0.92 milligrams (92%) of cyclohexane solubles per milligram of bulk material. No PNA's were detected in the bulk sample of asphalt.

For the samples collected during the roof tear-off operation, the benzene soluble fractions ranged from 0.3 to 1.1 mg/m³. Individual PNA concentrations for these samples ranged from 0.2 to 39.5 ug/m³. For comparison purposes, the levels of benzene soluble fractions and PNA's were also measured on employees working with hot asphalt. Employees working with hot asphalt had PNA exposures ranging from 0.2 to 6.3 ug/m³. The benzene soluble fractions and PNA sample results are listed in Tables 1 and 2.

NIOSH recommends that workers not be exposed to cyclohexane* solubles greater than 0.1 mg/m³. Although sampling periods were less than 8 hours, workers typically performed the sampled task for 4-8 hours per day. Based on this information, considering the sampled time as representative of complete task exposures, workers exposures would still exceed the recommended 0.1 mg/m³ level on an 8 hour basis. In addition workers were documented as being exposed to levels of known carcinogens, PNA's, for which no safe level of exposure is known.

Although limited sampling was conducted during this evaluation, the results indicate that workers exposed to tear-off dust are exposed to higher concentrations of cyclohexane solubles and PNA's than workers involved with application of hot asphalt or coal tar pitch. These data also support the findings of Herwin and Emmett in 1976^{1,2} which documented the same relative exposure levels of cyclohexane solubles for tear-off and application processes.

Informal interviews with workers also indicated that they experience the same type of symptoms during tear-offs as they do with application of hot coal tar pitch. Workers reported phototoxic effects including skin erythema, photophobia and conjunctivitis. Symptoms are usually

* Analytical data suggests that benzene soluble and cyclohexane soluble results are similar for air samples.

experienced only during tear-off of coal tar pitch roofs. Similar problems are not experienced with asphalt roofs. (Asphalt exposures are usually associated with higher cyclohexane soluble exposures but lower or non-detectable PNA exposures). Again a similar pattern of symptoms was reported and documented by the Herwin & Emmett studies.

These findings are of particular interest and concern for four reasons: (1) the reported and documented acute health effects of skin erythema, photophobia and conjunctivitis, (2) the recent data on the carcinogenic potential of tear-off dust, (3) the relatively high exposure levels measured, and (4) the fact that workers were not aware of the effects associated with exposure to tear-off dusts.

VII. CONCLUSIONS

The data collected during this study and supported by past evaluations indicate that workers are exposed to excessive levels of coal tar pitch dust during tear-off operations. Exposures do result in acute health effects, photosensitization, and have a potential for long-term carcinogenic effects.

VIII. RECOMMENDATIONS

1. Water should be used to thoroughly wet and dampen the surface of the roof prior to and during tear-off operations.
2. The use of power brooms and power blowers to remove small debris and dust should be replaced with a vacuum system to reduce dust levels.
3. Workers should stay upwind of pitch dust whenever possible.
4. Workers should wear safety goggles to prevent coal tar pitch dust exposure to the eyes and to protect workers from eye injury from flying debris during cutting operations.
5. Workers should shower and wash thoroughly with soap and water at the end of each work shift. Clean work clothes should be worn daily. Clothing contaminated with coal tar pitch dust should not be laundered at home with other family clothing.
6. Highly exposed individuals should wear respiratory protection. Due to the effects on eyes, skin and the respiratory tract, along with the high temperatures encountered during the summer months, protection and comfort may best be provided by using powered air-purifying helmet respirators. Respirators should be selected, used and maintained in accordance with OSHA regulations (29 CFR 1910.134).

7. Workers who experience skin photosensitivity should use a sunscreen which blocks out ultraviolet light, such as Uval Sunscreen Lotion[™] (sulisobenzone, 10%) applied 1/4 - 1/2 hour before the shift starts.

IX. REFERENCES

1. National Institute for Occupational Safety and Health. Health hazard evaluation report no. HETA 75-194-324. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1976.
2. National Institute for Occupational Safety and Health. Health hazard evaluation report no. HETA 75-102-304. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1976.
3. Emmett, E.A., Bingham, E. and Barkley, W. "A Carcinogenic Bioassay of Certain Roofing Materials, "American Journal of Industrial Medicine 2:59-64 (1981).
4. National Institute for Occupational Safety and Health. Health hazard evaluation report no. HETA 81-432-1105. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1982.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. 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. United Union of Roofers, Waterproofers and Allied Workers,
Washington, D.C.
2. NIOSH, Region II
3. OSHA, Region II

For the purpose of informing 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 1

ANCHOR HOCKING GLASS COMPANY, ROOFING SITE
LANCASTER, OHIO

HETA 82-067

COAL TAR PITCH ROOF TEAR-OFF

<u>Date</u>	<u>Job</u>	<u>Sampling Period</u>	<u>Benzene Solubles</u> (mg/m ³)	<u>Phenanthrene</u> (ug/m ³)	<u>Anthracene</u> (ug/m ³)	<u>Fluoranthene</u> (ug/m ³)	<u>Pyrene</u> (ug/m ³)	<u>B(a)A</u> (ug/m ³)	<u>Chrysene</u> (ug/m ³)	<u>B(a)P</u> (ug/m ³)
12/9/81	Tear-off	10:22-13:00	0.9	5.7	1.1	10.4	8.9	3.9	4.9	3.5
12/9/81	Foreman	10:35-12:21	0.8	1.2	0.5	2.3	2.1	0.8	1.6	0.7
12/9/81	Tear-off	10:32-12:21	0.7	11.6	2.0	20.6	19.6	8.5	9.0	9.0
12/9/81	Tear-off	10:26-13:26	0.7	9.3	2.0	15.6	13.8	6.2	6.7	6.7
12/9/81	Tear-off	10:23-12:21	1.0	22.0	6.2	23.5	18.9	7.6	9.1	6.0
12/9/81	Tear-off	10:30-12:21	0.8	0.8	0.2	1.5	1.0	0.5	0.6	0.4
12/10/81	Tear-off	9:08-13:50	1.1	5.2	6.7	9.6	10.7	13.3	13.9	15.7
12/10/81	Tear-off	8:35-10:30	0.7	4.2	1.2	6.2	5.3	1.9	2.6	1.0
12/10/81	Tear-off	8:38-14:12	0.3	3.6	0.8	6.5	5.6	2.4	2.9	2.7
12/10/81	Foreman	8:42-10:33	0.5	21.6	4.3	39.5	34.7	14.4	15.6	15.0
12/10/81	Tear-off	8:46-13:09	0.4	6.3	1.6	8.1	7.5	3.1	3.4	3.8

TABLE 2

ANCHOR HOCKING GLASS COMPANY, ROOFING SITE
LANCASTER, OHIO

HETA 82-067

HOT ASPHALT ROOF APPLICATION

<u>Date</u>	<u>Job</u>	<u>Sampling Period</u>	<u>Benzene Solubles</u> (mg/m ³)	<u>Phenanthrene</u> (ug/m ³)	<u>Anthracene</u> (ug/m ³)	<u>Fluoranthene</u> (ug/m ³)	<u>Pyrene</u> (ug/m ³)	<u>B(a)A</u> (ug/m ³)	<u>Chrysene</u> (ug/m ³)	<u>B(a)P</u> (ug/m ³)
2/9/81	Paper Roller	12:43-15:16	1.1	0.8	0.2	2.2	2.1	0.9	1.1	0.7
2/9/81	Paper Roller	12:43-15:16	1.0	0.4	0.1	1.1	1.1	0.5	0.7	0.4
12/9/81	Mopper	12:43-15:16	0.9	0.3	0.1	0.7	0.7	0.3	0.5	0.2
2/9/81	Kettle Operator	13:33-15:31	1.2	1.5	0.3	3.5	3.6	1.4	1.9	1.1
2/10/81	Kettle Operator	9:07-14:34	1.2	3.1	0.6	6.3	5.7	2.4	2.7	2.4