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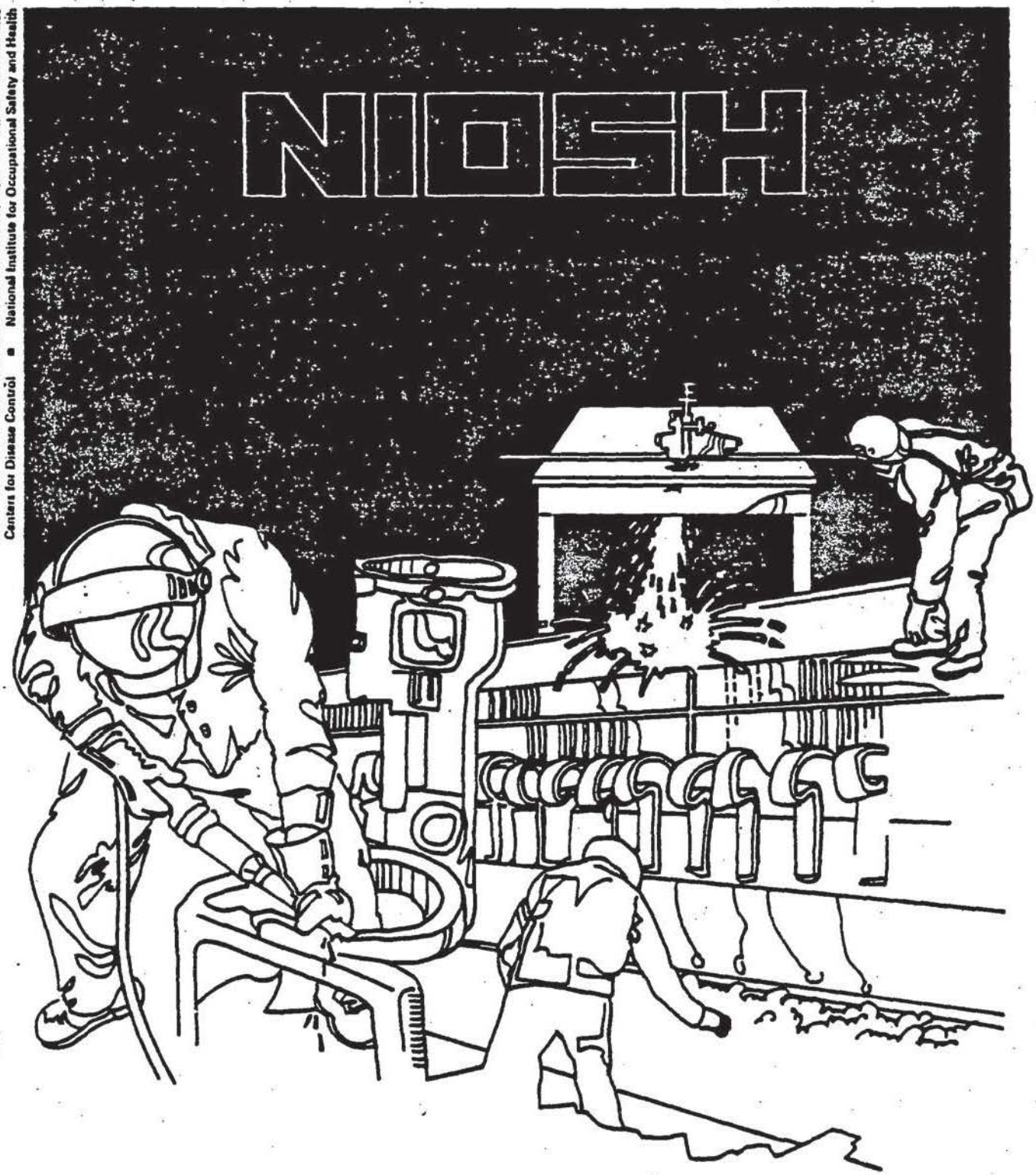

Health Hazard Evaluation Report

HETA 83-380-1671
ROOFING SITES
DAYTON, 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.

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ROOFING SITES
DAYTON, OHIO

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I. SUMMARY

In August 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the United Union of Roofers, Waterproofers and Allied Workers to evaluate tear-off operations of old roofs and application of new roofs, including single-ply systems. Concern was expressed over worker exposure to coal tar products and asphalt during tear-off and application procedures, and to solvents during the application of the single-ply systems.

In August and September 1983, NIOSH conducted evaluations of a petroleum pitch tear-off operation, an asphalt roof application and a Firestone single-ply application in the Dayton, Ohio area. Personal breathing zone samples to determine worker exposures to total particulates, benzene solubles and polynuclear aromatic hydrocarbons (PNAs) were collected during the tear-off operation. Personal samples for benzene solubles and PNAs were also collected during the asphalt application procedure. Personal breathing zone and area samples for xylene, toluene, acetone, ethyl benzene and hexane were collected on workers applying the Firestone single-ply systems. These solvents were components of the various washes, sealants and adhesives used for application.

Total particulate exposures measured during tear-off procedures ranged from 0.76 milligrams per cubic meter (mg/M^3) to 2.8 mg/M^3 and benzene solubles from non-detected (N.D.) to 0.32 mg/M^3. None of the 17 PNAs analyzed for were found. During the asphalt application no benzene solubles or PNAs were detected. (No recommended exposure limit has been established for benzene solubles associated with petroleum pitch.)

The thirteen breathing zone samples for solvents collected during single-ply application procedures showed low level exposures. The maximum exposure to any individual solvent (toluene) was only 26% of its respective 8-hour TWA recommended exposure limit. (Actual sampling periods were much shorter than 8 hours.)

Based on the data collected during this survey, it was concluded that workers were not exposed to PNAs during the petroleum pitch roofing tear-off or application, nor were workers found to be overexposed to solvent vapors during the single-ply application. Good work practice, however, indicates that exposure to petroleum pitch dust and solvents be kept as low as possible. Recommendations for reducing exposures are made in Section VII of this report.

KEYWORDS: SIC 1761 (Roofing and Sheet Metal Work); petroleum pitch, PNAs, benzene solubles, xylene, toluene, acetone, hexane, ethyl benzene.

II. INTRODUCTION

In August 1983, the National Institute for Occupational Safety and Health responded to a request from the United Union of Roofers, Waterproofers and Allied Workers to evaluate potential worker exposures resulting from the; tear-off of old roofs, application of new coal-tar pitch or petroleum pitch roofs, and application of single-ply roofing systems. During this survey, a tear-off of an old petroleum pitch roof was evaluated. Also evaluated was the application of a new petroleum pitch roof at the same site. In addition, at another location, workers were applying a Firestone single-ply roofing system and were studied to determine exposure levels resulting from solvents present in the adhesives.

III. BACKGROUND

The tear-off operation was conducted by using a power cutter to break up the petroleum pitch layer down to the insulation. The old roof was then pried and scraped from the surface and transported to the edge of the building for discarding. Following completion of the tear-off of a section of roof, a new roof was applied using hot petroleum pitch. Approximately 6 workers were involved in these operations.

The application of the single-ply roofing system involved the application of sheets of rubber membrane material to the roof surface. A solvent-based adhesive was used to secure the membrane to the roof and secure adjacent membranes together. The edges of adjacent membranes were cleaned and sealed together by an adhesive. Open sides of the membrane received a bead of lap sealant with a caulking gun. Anywhere from 2 to 6 employees were involved in application procedures on the four days of the evaluation.

IV. EVALUATION DESIGN AND METHODS

Personal breathing zone air samples for determination of total particulate levels, benzene solubles and PNAs were collected on preweighed Teflon filters at a flowrate of 2 liters per minute (lpm) during tear-off operations. All filters were first analyzed gravemetrically. Samples were then anaylzed for benzene solubles and PNAs following NIOSH Technical Bulletin, TB-001. The PNA analyses included the following compounds: acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(c)phenanthrene, benzo(a)anthracene, chrysene, benzo(e)pyrene, benzo(b)fluoranthlene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, benz(g,h,i)perylene and indeno(1,2,3-cd)pyrene.

Personal breathing zone air samples for determination of benzene solubles and PNAs during petroleum pitch application were collected using Teflon filters in series with XAD-2 tubes at a flowrate of 2 liters per minutes. Samples were analyzed as described above (TB-001).

Bulk samples of three adhesives used on the single-ply system were collected and analyzed by gas chromatography/mass spectrometry to identify major solvent components. The results were used to specify analytes on the personal samples.

Personal breathing zone air samples for solvents were collected on the workers applying adhesives. Samples were collected on charcoal tubes at a flowrate of 100 cc/minute and analyzed by gas chromatography according to NIOSH Method P&CAM 127.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Listed below are the evaluation criteria used for the sampled substances in this evaluation.

Substance	Recommended Exposure Limit	Source	OSHA Standard
Total Particulate	10 mg/M^3	ACGIH	15 mg/M^3
Asphalt Fumes	5 mg/M^3* ceiling	NIOSH	0.2 mg/M^3**
Xylene	435 mg/M^3	NIOSH	435 mg/M^3
Toluene	375 mg/M^3	NIOSH	750 mg/M^3
Acetone	590 mg/M^3	NIOSH	2400 mg/M^3
Ethyl Benzene	435 mg/M^3	ACGIH	435 mg/M^3
Hexane	350 mg/M^3	NIOSH	1800 mg/M^3

*Measured as total particulate or as soluble
**Benzene soluble fractions

Petroleum Pitch and Polynuclear Aromatic Hydrocarbons

Petroleum pitch, often referred to as asphalt, is the residue from the fractional distillation of petroleum products. The reported biological effects of petroleum pitch have been viewed as confusing and contradictory due to the failure to distinguish between petroleum pitch and coal tar pitch.[1] There is general agreement that petroleum pitch is substantially less toxic than coal tar pitch, presumably because the petroleum pitch has fewer identifiable PNAs and in lower concentrations. None of the reports in the literature which were cited in the NIOSH Criteria Documents on Asphalt Fume demonstrated conclusively that petroleum pitch fume has carcinogenic potential in man or animals. Skin, eye and respiratory effects have been reported by individuals involved in paving and roofing operations but to a much lesser extent than operations associated with coal tar pitch.

The chemicals of major concern in petroleum or coal tar pitch are large molecular, polycyclic hydrocarbons commonly referred to as polynuclear aromatic hydrocarbons (PNAs). Several PNAs are known carcinogens and there are potentially thousands of PNAs in pitch. The PNAs that have been identified are soluble in benzene. By limiting exposure to benzene solubles, PNA exposures and therefore, cancer risks are thought to be minimized.

Most of the available criteria for pitch has been generated and applied for work exposure situations where a material is heated thereby volatilizing the pitch. As a result, the selection of exposure criteria for the tear-off material in not as straightforward as with many other substances. Therefore, the criteria for asphalt fume (5 mg/M^3) can be used as a guide in evaluating employee exposure to tear-off material, however, analysis for specific PNAs should influence interpretation of exposure data.

VI. RESULTS AND DISCUSSION

A total of six personal samples were collected during tear-off operations. Sampling durations were approximately 3 hours. Total particulate concentrations ranged from 0.76 mg/M^3 to 2.84 mg/^{3} (Table I). Exposures to benzene solubles during tear-off procedures were found to range from N.D. to 0.32 mg/M^3. None of the 17 PNAs analyzed for were found at detectable concentrations (LOD = 0.5 ug/sample).

Six personal breathing zone samples were collected for benzene solubles and PNAs during the petroleum pitch application. Sampling periods were approximately 4 hours. No detectable levels of benzene solubles or PNAs were found.

Workers typically conducted tear-off operations in the morning and application in the afternoon. The combination of the above sampling results would therefore represent the total exposures for the work day.

A solvent screen of the bulk samples of the adhesives used for lap sealing and bonding and the splice wash indicated the major solvents present were toluene, xylene, acetone, ethyl benzene and hexane.

A total of thirteen personal breathing zone samples were collected to evaluate solvent exposures during the various tasks involved in applying the single-ply system. Exposure levels were determined for xylene (Range N.D. - 5.3 mg/M^3, Recommended Exposure Limit (REL) - 435 mg/m^3), toluene (6.0 - 96 mg/M^3, REL - 375 mg/M^3), acetone (N.D., REL - 590 mg/M^3), ethyl benzene (N.D. - 1.3 mg/M^3, REL - 435 mg/M^3), hexane (3.5 - 72 mg/M^3, REL - 350 mg/M^3) and other hydrocarbons (N.D. - 0.59 mg/M^3). Sampling durations were generally short, ranging from less than 1 hour to approximately 3 hours. Therefore, if one assumes no other exposure to solvents during the work day, the 8-hour time weighted average (TWA) exposures would be much less than the values reported. All solvent exposures, both short term and TWA values are below levels expected to cause any health effects.

VII. RECOMMENDATIONS

1. Water should be used to thoroughly dampen the surface of the roof prior to and during tear-off operations.

2. Workers should stay upwind of pitch dust whenever possible. When this is not possible, workers should wear protective eyewear (goggles), NIOSH approved particulate filter respirators and protective coveralls.

3. Workers should avoid skin contact with solvents or solvent based adhesives. Based on current information, Viton® glove material may be chemically resistant to the solvents. These gloves should be worn when handling any of these materials where skin contact is likely to occur.

VIII. REFERENCES

1. National Institute for Occupational Safety and Health Criteria for a recommended standard - occupational exposure to coal tar products. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. (DHEW publication no. (NIOSH) 78-107).

2. National Institute for Occupational Safety and Health Criteria for a recommended standard - occupational exposure to asphalt fumes. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. (DHEW publication no. (NIOSH) 78-106).

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).

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 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 IV.
3. OSHA, Region IV

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 I
Roofing Site
Dayton, Ohio

Roofing Tear-Off (Asphalt)
August 16, 1983

Job	Sampling Period	Total Particulate (mg/M^3)	Benzene Solubles (mg/M^3)	Total PNAs (ug/M^3)
Hoist & Cart Operator	6:38-9:15	1.67	0.32	N.D.**
Cutter	6:35-9:31	2.84	N.D.*	N.D.
Cart Operator	6:34-9:31	2.20	0.17	N.D.
Tear-Off	6:36-9:06	1.50	N.D.	N.D.
Hoist Operator	6:39-9.31	2.21	N.D.	N.D.
Tear-Off	6:39-9:31	0.76	0.17	N.D.

Asphalt Application
August 16, 1983

Kettle Operator	11:00-15:50	-	N.D.	N.D.
Roller	10:40-14:50	-	N.D.	N.D.
Roller	12:37-14:50	-	N.D.	N.D.
Mopper	12:38-14:50	-	N.D.	N.D.
Mopper	10:41-14:50	-	N.D.	N.D.
Roller/Cutter	12:40-14:50	-	N.D.	N.D.

*LOD = 0.05 mg/sample
**LOD = 0.25 ug/sample

Table II
Roofing Site
Firestone Single-Ply Application
Dayton, Ohio

Worker	Sampling Period	Xylene (mg/M^3)	Toluene (mg/M^3)	Acetone (mg/M^3)	Ethyl Benzene (mg/M^3)	Hexane (mg/M^3)	Other Hydrocarbons (mg/M^3)
			August 16, 1983				
A	10:50-14:28	1.9	9.7	-	N.D.	4.3	N.D.
B	10:50-14:30	5.3	96	-	N.D.	72	N.D.
C	10:50-14:28	3.1	61	-	N.D.	31	N.D.
			August 17, 1983				
A	12:44-13:35	N.D.	74	-	N.D.	3.8	N.D.
B	12:43-13:37	N.D.	42	-	N.D.	38	N.D.
C	12:48-13:35	N.D.	33	-	N.D.	28	N.D.
D	13:00-13:35	N.D.	65	-	N.D.	15	N.D.
E	12:54-13:35	N.D.	7.7	-	N.D.	5.1	N.D.
F	12:47-13:35	N.D.	25	-	N.D.	20	N.D.
Area	12:45-13:40	0.36	6.9	N.D.	N.D.	5.8	N.D.
Area	12:45-13:40	0.36	6.2	N.D.	N.D.	4.9	N.D.
Area	12:45-13:40	0.19	6.0	N.D.	N.D.	4.4	N.D.
Area	12:45-13:40	0.37	7.0	N.D.	N.D.	5.3	N.D.
			September 6, 1983				
A	9:58-14:00	N.D.	8.2	-	N.D.	3.5	N.D.
B	10:00-14:07	0.58	18	-	N.D.	15	N.D.
Area	10:08-14:20	0.87	11	0.40	0.26	4.8	2.0
			September 8, 1983				
A	10:50-14:38	4.0	43	-	1.3	46	N.D.
B	10:50-14:38	1.8	46	-	0.59	17	0.59
Criteria		435	375	590	435	350	-

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