

Industrial Hygiene Survey Report

CONTRACTOR: Asbestos Roofing Company
8060 Armour Street
San Diego, California
(714) 278-3230

SITE: La Jolla Village Condominium

DATE OF SURVEY: November 10, 1977

PERSONS CONDUCTING SURVEY: Jane Brown
John Fajen

UNION: United State, Tile & Composition Roofers,
Damp & Waterproof Workers Association
Local 45
San Diego, California

UNION REPRESENTATIVE: Mr. Milton L. Van Dyke
Business Agent

PURPOSE:

The roofing and sheet metal contract construction industry represents over 115,000 workers with potential for exposure to roofing hazards in the U.S. (Bureau of Labor Statistics Bulletin 1830, 1974). Both asphalt and coal tar pitch are in common use in roofing operations. Following the publication of a study by Selikoff and Hammond (Annals of the New York Academy of Sciences, Vol 271, 1976) indicating increased mortality rates among roofers using coal tar pitch and asphalt, there was increased concern over health hazards in the roofing industry. The purpose of this survey was to define occupational exposures incurred by roofers, particularly exposures to coal tar pitch volatiles in both asphalt and coal tar fumes.

DESCRIPTION OF OPERATION:

New roofing was being applied to a very small, fragmented area, covering a three story condominium. The crew consisted of three men. One layer of felt was applied by hand. Asphalt was mopped on to seal the felt. Gravel was then applied. Hot asphalt was piped to the roof from a tanker at ground level. The tanker was generally left unattended, being checked periodically by one of the roofers.

Weather conditions were sunny, warm (90°F) and slightly windy. The small working area gave a similar exposure potential for all three men.

SAMPLING AND ANALYTICAL METHODS

The same sampling method was used for both coal tar pitch and asphalt roofs. Personal and area samples were taken using Model G MSA pumps at flow rates of between 1.5 and 2.0 liters per minute. The sampling apparatus consisted of a 37 mm diameter glass fiber filter followed by a 0.8 u pore size membrane filter and back-up pad. This filter cassette was followed by a solid sorbent (porous polymer) in an attempt to capture compounds lost by sublimation.

Sample analysis was performed by the Utah Biomedical Test Laboratory, Salt Lake City, Utah. Filters and tubes were analyzed separately. Both were analyzed utilizing ultrasonic extraction according to NIOSH method P&CAM Number 217. Particulate polycyclic organic matter levels were measured as total benzene solubles. The fraction of the sample remaining after the soluble analysis was analyzed by reversed phase liquid chromatography for five individual polynuclear aromatic hydrocarbons (PNA's). Those PNA's measured were benzo(a)pyrene (BaP), benz(a)anthracene (BaA), fluoranthene (Flu), pyrene (Pyr), and chrysene (Chr). The injection volume for the chromatography unit ranged from 1 to 50 microliters depending on the sample concentration. Sample chromatograms were compared with chromatograms from known standards for compound identification. Peak areas of several standard concentrations of each compound of interest were measured and standard curves were constructed. Quantitation data were obtained by comparison of the peak areas of the samples with the standard curves. The limits of detection for each PNA using a 1 ul injection are:

Fluoranthene	1 ug/sample
Pyrene	5 ug/sample
Benz(a)anthracene	2 ug/sample
Chrysene	3 ug/sample
Benzo(a)pyrene	1 ug/sample

The preceding detection limits apply to a 1 ul injection from a 1 ml sample. The detection limits listed in the table containing the field data are different from those listed above, because most samples were analyzed utilizing a larger injection volume to increase sensitivity. The reported limit of detection may vary between samples due to different injection volumes.

DISCUSSION AND PRESENTATION OF DATA

At present, occupational exposure to carcinogens within coal tar pitch and asphalt is regulated under the OSHA standard for coal tar pitch volatiles. While this standard was originally intended to protect individuals from exposure to coal tar products, the U.S. Department of Labor has ruled that employee exposure to polycyclic hydrocarbons volatilized from petroleum residues be controlled under the coal tar pitch volatile standard. The basis for this ruling was that many of the hazardous compounds found in coal tar pitch volatiles can be found in volatiles from petroleum residues. Thus, it is thought that petroleum volatiles can present a similar hazard to health.

The current occupational health standard promulgated by the U.S. Department of Labor limits allowable exposure to coal tar pitch volatiles to an 8-hour time-

weighted average of 0.2 milligrams of substance per cubic meter of air. Only the volatiles of particulates collected via total mass sampling which are soluble in benzene are reflected by this level. This standard is set at a level to protect workers from inhalation effects incurred from occupational exposure. The same limit is recommended as a Threshold Limit Value (TLV) for coal tar products by the ACGIH, while the TLV for asphalt fumes is 5 mg/m³.

NIOSH has recently completed criteria documents on coal tar products and asphalt fumes. The NIOSH recommended limit for exposure to coal tar products is 0.1 mg/m³ for up to a 10-hour workday, 40 hour week. The proposed limit for exposure to asphalt is 5 mg/m³ for any 15 minute period.

It should be noted that the legal (OSHA) standards for exposure to coal tar pitch volatiles relate to all benzene soluble materials in volatiles of coal tar products, petroleum residuals, and wood tars, and not merely the carcinogenic compounds in the volatiles. According to the ACGIH:

Since no "safe" limit of exposure can be established for carcinogens and because of instability in the composition of volatiles from coal tar pitch, a limit of 0.2 milligrams per cubic meter of air is recommended. A limit of 0.2 mg/m³ of total components present should minimize exposure to these carcinogens.

It is generally felt that the cancer causing agents within coal tar pitch volatiles include a group of compounds referred to as polynuclear aromatic hydrocarbons (PNA's). These are compounds consisting of fused carbon rings. Those PNA's in the five to six ring range are generally considered as most suspect of causing cancer in humans. Benzo(a)pyrene (BaP) in particular, is a potent cancer causing agent. In order to more fully characterize the constituents in the volatiles measured in the roofing industry, these samples were analyzed for total benzene solubles, and then fractionated the samples, to measure five individual PNA's, three of which are suspect carcinogens (BaP, benzanthracene, and chrysene).

Data obtained from bulk samples and air samples are presented in Tables I and II. Bulk sample analysis was done primarily to identify PNA constituents of the parent material. As can be seen in Table I, all five PNA's examined were reported as less than the detectable limit. As some PNA's were found in the air samples taken, and the temperature of the kettle was hardly high enough for PNA formation, problems with the bulk analysis were suspected. This was confirmed upon contact with the laboratory. The asphalt chromatogram yielded unidentifiable plateaus in the region, rather than isolated distinct peaks. Attempts were made to clean up the analysis but the bulk sample data remains suspect. The detectable limits reported for this analysis are high due in part to the problem mentioned here. This lessens the value of the data, as significant quantities of PNA's might be present, but not detected.

The data presented in Table II - Sampling Results reflects sample concentrations rather than 8-hour time weighted averages (TWA's). The variable nature of the work shift of roofers (often a twelve hour day, or more), as well as the variability of the work week (which is weather dependent) does not lend itself to extrapolation of the data to TWA's, as only one day's sample was taken. From observations made at this and numerous other worksites, it was apparent that ex-

posures to hot materials is fairly consistent throughout the work day, lasting from the beginning of the day, until the roof is finished. Most roofing jobs last only a short time, usually one day to perhaps a week or two.

Assuming an eight hour exposure at the levels measured in this survey, two of the three personal samples taken were well above the OSHA standard for the benzene soluble fraction from the filter portion of the sampling train. Benzenanthracene, pyrene and chrysene were found in the sample with the highest benzene soluble level.

It should be noted that two samples on men doing similar jobs showed very dissimilar benzene soluble exposure levels (0.08 mg/m³ vs. 0.78 mg/m³). Generally, work practices among all roofers observed were very variable. This factor, in combination with the fact that exposures vary with wind speed and direction, means that little can be said to connect job with exposure. The roofers change jobs day to day, or even within one day, so that such generalizations would not be worthwhile in terms of attempting to estimate chronic exposures.

CONCLUSIONS AND RECOMMENDATIONS

Some of the exposure levels measured here are sufficiently high to warrant concern over chronic exposures at such levels. Although PNA's were not consistently found on the personal samples, the potential for exposure was present, as evidenced by the sample taken on the foreman.

Little published work has been done to characterize the chemical constituents of asphalt fumes, particularly focusing on carcinogens. PNA's are known to be carcinogenic in other industries. As animal experiments have been done showing some tumor response from exposure to asphalt via skin painting, and one published epidemiologic study has shown increased cancer mortality in roofers, it is felt that a potential hazard exists.

It is recommended that further work be done toward developing engineering controls for the various pieces of equipment to reduce emissions. Standard work practices should be developed, as exposures could be drastically reduced using hygienic practices. Some type of training or indoctrination program should be set up to inform employees of the safety and health hazards that exist, and how to avoid them.

Table 1

BULK SAMPLE ANALYSIS

Company: Asbestos Roofing Company
 San Diego, California
 Date of Survey: November 10, 1977
 Roofing Material Used: Asphalt

Type of Bulk Sample	Total Benzene Solubles (mg/g)	Polynuclear Aromatic Hydrocarbons (µg/g)				
		BaP	BaA	Flu	Pyr	Chr
Hot asphalt - analyzed with benzene	903.8	<630	<130	<630	<320	<190
Hot asphalt - analyzed with cyclo- hexane	932.1	< 70	<150	< 70	<400	<200

Table II

SAMPLING RESULTS

Coal Tar Pitch Volatiles

Company: Asbestos Roofing Corp.
La Jolla Village/San Diego, Calif.

Date of Survey: 11-10-77

Roofing Material Used: Asphalt

Job Title	Sampling Medium *	Flow (l/min)	Time (min)	Volume (m ³)	Total Benzene Solubles (mg/m ³)	Polynuclear Aromatic Hydrocarbons (µg/m ³)				
						BaP	BaA	Flu	Pyr	Chr
Background	F	1.7	270	0.46	<0.04	<0.04 ✓	<0.09	<0.04 ✓	<0.22	<0.13
	T				<0.04	<0.11	<0.22	<0.65	**	<0.33
Laying felt	F	1.8	286	0.52	0.08	<0.04	<0.08 ✓	<0.04	<0.19 ✓	<0.12
	T				0.35	<0.10	<0.19	<0.58	**	<0.29
Laying felt	F	1.6	287	0.46	0.78	<0.11	<0.22	<0.12	<0.54	<0.33
	T				<0.04	<0.11	<0.22	<0.65 ✓	<0.65	<0.33
Foreman	F	1.9	284	0.54	2.1	<0.37 ✓	0.41 ✓	<0.37	1.4 ✓	1.0 ✓
	T				0.15	<0.09	<0.11	<0.56	<0.56	<0.28

** Interfering peaks render quantitation impossible

* F - silver membrane, glass fiber filter

T - solid sorbent tube