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
HE 77-123-493

JOHNNY'S CARPET AND TILE
540 S. Main street
NAZARETH, PENNSYLVANIA 18064

MAY 1978

I. TOXICITY DETERMINATION

Based on results of environmental air samples, medical examinations, and review of current toxicity information, it is judged that employees were not exposed to potentially toxic concentrations of organic solvents during tile installations on October 12, 1977.

The present study could find no proof of an occupational etiology for one installer's hematologic abnormalities. The possibility exists, however, that the leukopenia resulted from an idiosyncratic reaction to organic solvents or to possible previous benzene contamination of the organic solvents used in his profession. A recommendation to minimize exposures to organic vapors during carpet and tile installation is suggested through the use of natural ventilation.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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 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 NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

a) Johnny's Carpet and Tile, Nazareth, Pa.
b) U.S. Department of Labor - Region III
c) NIOSH - Region III

For the purpose of informing the "affected employees" the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place(s) near where exposed employees work.

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.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an employer of a carpet and tile shop. The request claimed that since June 1977, an installer's white blood cell count had been abnormally low, ranging from 1200 to 1900 with lymphocyte predominance. A bone marrow examination was unremarkable except for decreased cellularity. An accompanying physical examination was within normal limits except for a moderately enlarged spleen. His physician's opinion was that exposure to certain chemicals in his occupation was the cause of the present conditions.

A SHEFS I Report was issued on January 5, 1978 indicating preliminary NIOSH evaluation results.

IV. HEALTH HAZARD EVALUATION

A. Conditions of Use

For approximately 17 years, the installer has been involved with the installation of carpets and tiles, usually in residential applications. The tiles and related flooring are of vinyl and/or vinyl with a urethane finish layer. While installing flooring in such places as kitchens and foyers, cements, seam sealers, and cleaners are used which may contain many organic compounds. A list of products was provided which has been used for installing various floorings. The products contained the following organic substances and possibly more: methyl ethyl ketone (MEK), tetrahydrofuran (THF), toluene (toluol), xylene (xyluol), hexane, perchloroethylene, organic isocyanates, methyl chloroform, petroleum naphtha, methyl alcohol (methanol), ethyl alcohol (ethanol), and acetone. The products may be used as much as once every few days to possibly only once per month. Natural ventilation would reduce employee exposures to organic vapors during summer, but would be less effective in winter when doors and windows are usually closed.

B. Evaluation Methods

1. Environmental

Two installations were arranged in order to collect air samples which might give an indication of the degree of exposure of workers to various organic substances. The two jobs involved:

a. Installation of a vinyl/urethane kitchen floor using a latex based all purpose cement and a seam sealer. According to the label of the seam sealer, it contained tetrahydrofuran, toluene, and organic isocyanates; a charcoal tube sample was collected on top of the kitchen sink during part of the installation. Air was drawn through the tube at a flow rate of approximately 200 cubic centimeters per minute by a vacuum pump.

b) Installation of ceramic tile using the appropriate adhesive in the foyer of a house. A charcoal tube sample was positioned near the breathing zone of the installer for the entire twenty minute job, and collected at the same flow rate as above.

The original laboratory analyses requested were for xylene, hexane, toluene, and benzene. Although a benzene exposure was indicated in the SHEFS I Report of January 5, 1978, benzene was not actually present. Due to analytical difficulties, it was reported to be present instead of tetrahydrofuran, which was actually in the seam sealer and the air sample.

2. Medical

The installer has been employed in carpet and tile work for 16 years. He was in excellent health until June 1977 when his white blood cell count (WBC) was found to be consistently below 2000 (normal >4000). His complete blood count (CBC) also showed mild anemia and a slightly decreased platelet concentration. His past medical history was unremarkable except for having taken a 5-day course of phenylbutazone for monoarticular arthritis in mid 1976. (Phenylbutazone is well known to cause a decreased white blood cell count in a small proportion of patients who take it.) He has continued to have a low white blood cell count. A physical examination was reported to be normal except for moderate splenomegaly. Bone marrow aspiration and biopsy were reported to show decreased cellularity and a diminution of white blood cell precursors.

To further evaluate a possible occupational etiology for the patient's hematologic abnormalities it was decided to examine other carpet and tile workers in the Nazareth, Pennsylvania area. Carpet and tile establishments and individual carpet and tile workers in the Nazareth, Pennsylvania area known to the requestor were contacted regarding participation in the study. The workers willing to participate answered a questionnaire about health problems, medications and occupational and avocational chemical exposures and their blood was examined for complete blood count (CBC) to detect hematologic abnormalities and Serum Multiphasic Analysis (SMA-12) to detect possible liver or renal disease.

C. Evaluation Criteria

1. Toxic Effects

Methyl Ethyl Ketone and Acetone[1] - These solvents may produce a dry scaly dermatitis after repeated exposure. High vapor concentrations may irritate the mucous membranes of the nose and throat, with possible symptoms of headache, nausea, light-headedness, and vomiting.

Toluene and Xylene[1] - The vapors of these solvents may cause irritation of the eyes, respiratory tract and skin. Repeated or prolonged contact with the liquid may cause removal of lipids from the skin, resulting in a dry fissured dermatitis . Both may lead to depression of the central nervous system following vapor inhalation, with symptoms such as dizziness, drowsiness, and headache. Reversible liver and kidney damage may occur following xylene vapor exposures. At least in previous years, products containing either of these may have been contaminated with benzene. NIOSH considers the accumulated evidence from clinical as well as epidemiological data to be conclusive that benzene is leukemogenic. Because it causes progressive malignant disease of the blood-forming organs, exposures to it should be kept as low as possible.

Hexane[1,2] - This chemical is one aliphatic hydrocarbon which can cause irritation of the mucous membranes of the upper respiratory tract. Repeated skin contact may result in dermatitis. It is a central nervous system depressant and has also been associated with the development of neurologic disorders.

Ethyl Alcohol/Methyl Alcohol[3] - Inhalation of high concentrations of ethyl alcohol can cause headache, drowsiness, tremors, and fatigue. Mild irritation of eye and nose occurs at very high concentrations. It may act to increase the toxicity of other inhaled, absorbed, or ingested chemicals. An exception is methyl alcohol, whose toxicity ethyl alcohol counteracts. Contact with liquid methyl alcohol can produce a mild dermatitis, but is almost non-irritating to the eyes or upper respiratory tract. Intoxication, optic nerve damage, and neuritis have been reported following inhalation, ingestion, and skin absorption. Other symptoms include nausea, vomiting, and headache.

Petroleum Naphtha [1,4] - It has a lower order of toxicity than that derived from coal tar. Exposures can cause central nervous system depression, with symptoms of inebriation, followed by headache and nausea. Dermal toxicity has been noted. Naphtha may contain hexane, which may have neurotoxic effects.

Perchloroethylene (Tetrachloroethylene)[5] - NIOSH recommends that this solvent be handled as though it is a human cancer-causing agent. This is based on a National Cancer Institute feeding study that resulted in liver cancer to laboratory mice. The vapor is also irritating to the eyes and respiratory tract. Direct contact with skin can cause burns, blisters, and prolonged contact can result in a dermatitis. Central nervous system effects are also possible with symptoms of vertigo, confusion, irritability, nausea, and vomiting.

Organic Isocyanates[1,6] - These are irritating to the mucous membranes of the eyes, nose, throat, and respiratory passages and can cause severe dermatitis. They can produce allergic skin sensitization and asthma-like reactions in some people. Future exposures of sensitized individuals to small amounts of isocyanates may result in severe respiratory attacks, with nausea, vomiting, and abdominal pain.

Tetrahydrofuran[6] - This solvent is a volatile, flammable liquid. It is irritating to the eyes and mucous membranes of the upper respiratory tract. Chromic exposures may lead to liver and kidney damage. Repeated or prolonged skin contact may result in a defatting action and possible dermatitis.

2. Environmental Criteria

Certain chemicals present in products used during the installations were sampled for, and the evaluation criteria for them will be given. Airborne exposure limits for the protection of the health of workers have been recommended or promulgated by several sources. These limits are established at levels designed to protect workers occupationally exposed to a substance on an 8-hour per day, 40-hour per week basis over a normal working lifetime. For this investigation, the criteria used to assess the degree of health hazards to workers were selected from three sources:

1) NIOSH: Criteria for a Recommended Standard....Occupational Exposure to various substances.

2) Threshold Limit Values (TLV): Guidelines for Airborne Exposures Recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for 1977.

3) OSHA Standard: The air contaminant standards enforced by the U.S. Department of Labor - Occupational Safety and Health Administration - as found in the Federal Register - 29 CFR 1910.1000 (Tables Z-1, Z-2).

	SOURCE		
	NIOSH	TLV	OSHA
Hexane	100(510)	100(125)	500
Toluene	100(200)	100(150)	200(300)
Xylene	100(200)	100(150)	100
Tetrahydrofuran	---	200(250)	200

*Concentrations, in parts of substance per million parts of air (ppm), are based often on an 8-hour time-weighted average exposure (TWA). Values in parentheses represent concentrations which should not be exceeded even instantaneously as commonly measured in a 10- or 15-minute period.

D. Evaluation Results and Discussion

1. Environmental

The results of atmospheric sampling are illustrated in Table I. These results are the same as were recorded in the SHEFS I Report of January 5, 1978, with one exception. The air contaminant reported as benzene in the

kitchen air sample was actually tetrahydrofuran (THF). Chemical analysis of the seam sealer used during the installation showed it contained 53 percent THF and 19 percent toluene, while the flooring cement contained only toluene. However, it is not now possible for the actual THF air concentrations in any of the samples to be reported. Samples for toluene and xylene (33 ppm and non-detectable, respectively) collected during this installation were below the evaluation criteria of 100 ppm for each. Both samples collected in the carpet shop were non-detectable for hexane, toluene, and xylene.

The air samples for toluene and xylene collected during the foyer tile installation (1 ppm and non-detectable, respectively) were below the evaluation criteria of 100 ppm for toluene and xylene. The concentration of hexane (154 ppm), though, did exceed the "short term exposure limit" (125 ppm) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for a 15-minute period. NIOSH's evaluation criteria for a ceiling concentration for hexane (510 ppm) was not exceeded. This criteria reflects more recent knowledge about the health effects of hexane. Several C_6H_{14} alkanes and small amounts of C_8-C_9 alkanes/alkenes were found. A bulk sample analysis of the adhesive used did not reveal the presence of benzene.

2. Medical

Unfortunately only eight workers in the Nazareth, Pennsylvania area wished to participate in the medical survey. The time they had spent in carpet and tile work ranged from three months to 25 years and averaged 11.6 years.

The results of the questionnaire and SMA_{12} analysis were unremarkable in all the workers. The CBC results (Table 2) were also normal except for one depressed white blood cell count and platelet concentration.

From this small number of workers, no firm conclusions can be drawn except that no evidence of occupational hazard was found in this limited sample. One installer's decreased white blood cell count could be caused by an idiosyncratic reaction to some chemical used in his work or possibly by a previous exposure to organic solvents contaminated with the benzene. (In previous years solvents such as toluene or xylene frequently had significant amounts of benzene as a contaminant.) It is also quite possible that exposure to phenylbutazone in 1976 has contributed to his depressed white blood cell count and platelet concentration or that his hematologic abnormalities are caused by a factor unrelated to his occupation.

V. RECOMMENDATIONS

Although the results of this study did not indicate any problems, overexposures to all of the chemicals contained in products used by a carpet and tile layer can cause potential illness in humans. Skin contact should

be avoided to prohibit disorders such as blistering or dermatitis. Inhalation of vapors should be minimized to prevent central nervous system, kidney, and liver effects. Protective clothing and local ventilation would be beneficial. In the summer months, ventilation is easy to provide with open windows and doors near kitchens, foyers, etc. Fans could be positioned in exit ways to remove solvent vapors from the interior; however, conditions must be arranged that contaminants are drawn away from the employee's breathing zone, not blown into the breathing zone.

Since the etiology of the installer's illness has not yet been established by his personal physician and the possibility exists that organic solvent exposure could have caused his leukopenia, decreased platelet concentrations and mild anemia, it can only be recommended that exposure to organic solvents be kept to the absolute minimum possible until the etiology of his illness is firmly established.

VI. REFERENCES

1. Occupational Diseases - A Guide to their Recognition, U.S. Department of HEW, PHS, NIOSH, Washington, D.C., June 1977.

2. Criteria for a Recommended Standard...Occupational Exposure to Alkanes (C5-C8), Pub. No. 77-151, National Institute for Occupational Safety and Health, March 1977.

3. Criteria for a Recommended Standard....Occupational Exposure to Methyl Alcohol, Pub. No. 76-148, National Institute for Occupational Safety and Health, March 1976.

4. Criteria for a Recommended Standard...Occupational Exposure to Refined Petroleum Solvents, Pub. No. 77-192, National Institute for Occupational Safety and Health, July 1977.

5. Current Intelligence Bulletin 20, National Institute for Occupational Safety and Health, January 20, 1978.

6. Documentation of Threshold Limit Values, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio . 3rd Ed., 1971.

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Table 1

Results of Sampling for Organic Compounds
Johnny's Carpet & Tile
Nazareth, Pennsylvania

October 12, 1977

Location	Type Sample	Sampling Time	Concentration (ppm)[1]		
			Hexane	Toluene	Xylene
Kitchen - on sink	Area	2:10pm-3:50pm	0.1	33	N.D.[2]
Foyer	Personal	3:00pm 3:20pm	154	1	N.D.
Shop - near vinyl flooring rolls	Area	1:30pm 4:00pm	N.D.	N.D.	N.D.
Shop - near desk	Area	1:30pm 4:00pm	N.D.	N.D.	N.D.

[1] ppm = parts of solvent vapor per million parts of air
[2] N.D. = non detectable

Hygienic Standards:

NIOSH			
1977 TLV	100(510)	100(200)	100(200)
OSHA	100(125)	100(150)	100(150)
	500	200(300)	100

Values in parentheses represent concentrations which should not be exceeded even instantaneously. These are commonly measured in a 15-minute period.

Table 2

Summary Blood Count (CBC) Results

Johnny's Carpet & Tile
Nazareth, Pennsylvania

Subject	WBC	% Segs	% Lymphs	Hgb	Platelets
1	5.1	71	24	14.5	242
2	8.9	36	60	16.8	419
3	10.6	52	46	15.9	199
4	7.1	65	30	16.1	243
5	8.2	61	38	18.2	216
6	8.8	62	36	15.4	208
7	2.0	28	71	14.3	86
8	6.4	54	46	17.1	298
Normals	(4.8-10.8x10^3/cc)			(14-18 gm/dl)	(200-400x10^3/cc)