U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 73-176-163

FILE COPY

BRISTOL FLOWED GASKET COMPANY
WATERBURY, CONNECTICUT
DECEMBER 1974

I. TOXICITY DETERMINATION

It has been determined that the exposure of gasketing machine operators, inspectors, mechanics, and press operators to toluene was not toxic at the concentrations measured during the NIOSH evaluation based upon (1) generally low air concentrations of toluene measured during the evaluation, (2) urine hippuric acid results suggesting an air concentration of toluene less than 100 ppm, (3) low proportion of workers reporting symptoms, (4) for workers reporting symptoms the low air concentrations and low hippuric acid suggest these responses may be due to factors other than toluene exposure and (5) review the literature regarding toxicity of toluene. Methyl chloroform and xylene were found not toxic in these workers since a low proportion of workers reported symptoms which would be expected as measured air concentrations were very far below generally accepted standards for workroom air.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a) Bristol Flowed Gasket Company, Waterbury, Connecticut
b) U. S. Department of Labor - Region I
c) NIOSH - Region I

For the purposes of informing the approximately 20 "affected employees" the employer shall promptly "post" the Determination Report in a prominent place(s) near where exposed employees work for a period of 30 calendar days.

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 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 National Institute for Occupational Safety and Health received such a request from the employer regarding exposure of workers to toluene vapors.

The request stated there were no known toxic effects on employees, but a concern was expressed for possible long range effects. Information regarding steps to protect employees from a possible potential health hazard was also requested.

IV. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

The main product of this plant is an aerosol mounting cup which is supplied to manufacturers who fill and finish assembly of various types of aerosol containers. The mounting cup contains a hole in the center into which the valve assembly is inserted after the can has been filled. The aerosol mounting cups are manufactured by first stamping them from metal strips in hydraulic presses. The cups are then loaded into a machine which automatically applies a gasketing material around the rim of the cup. The gasketing substance is a neoprene rubber based material containing toluene to give proper fluid properties during the application. This material serves as a seal when the cup is assembled on the top of an aerosol can. After application of the gasket, the cups are placed on trays and stacked on a conveyor for drying in a forced ventilated oven. The stacked trays are conveyed through the oven and inspected prior to packaging for shipment. Normally two such lines as described are in operation as was the case on the day of the evaluation. Xylene is used in an area remote from the gasketing machines although all operations are contained in one large room.

The greatest potential exposure is to the gasketing machine operators. In addition to toluene from the gasketing machine there is potential exposure from the drying ovens which are in close proximity. A utility man works in the gasketing area although his exposure is for a lesser period. Inspectors work at the terminal end of the drying ovens opposite the gasketing machine operators and normally would have lower exposure to toluene. Gasketing machine operators and inspectors alternate duties each half-shift which serves to lower their time-weighted exposures. A weigher and a packer work in the same general area as the inspectors for the entire shift.

B. Evaluation Design

The area designated by the request was observed with an employer representative. Employees primarily exposed were judged to be the gasketing machine operators, inspectors and mechanics with lesser exposure for potential for the utility man, weigher, packer and press operators. It was decided to monitor the gasketing machine operators, inspectors, mechanics and a press operator with personal air samples during the first shift. First shift employees so

monitored were asked to provide urine specimens for hippuric acid determination. Gasketing machine operators and the mechanics were monitored during the second shift. Each employee being monitored was interviewed in a non-directed manner concerning possible symptoms of toluene exposure.

C. Evaluation Methods

1. Organic vapor sampling

Employee exposures to toluene, methyl chloroform, and xylene were measured using personal air sampling equipment. The vapor concentrations were determined by adsorbing the organic vapors onto charcoal air sampling tubes and analyzing the tubes by the gas chromatographic method of White et al.[1]

2. Urine specimen analysis

Urine specimens were obtained at the end of the shift from first shift workers who participated in air sampling. Urine specimens were also obtained from office workers who were not thought to be exposed to toluene. The urine specimens were analyzed for hippuric acid using the method of Tomokuni and Ogata.[2]

3. Employee interviews

Employees were asked non-directed questions to obtain any work related symptoms of toluene exposure. Employees were also asked whether they had experienced symptoms in the past and during the day of the investigation. If employees stated they had not noticed any symptoms, they were then asked if they had experienced any of the common symptoms of toluene overexposures, i.e., headache, nausea, dizziness, or eye irritation.

D. Evaluation criteria

1. Toxic effects of substances investigated[3,4,5,6]

The following discussion describes the toxicological effects that may occur to workers exposed to the substances of this evaluation. These effects are described so workers will know the symptoms and health consequences of overexposure. The effects described depend upon a number of factors such as concentration, length of exposure, and individual susceptibility.

Toluene

For an 8-hour exposure at 50-100 ppm, slight drowsiness, and possibly slight headache may be noticed by some workers. At a 200 ppm level

unconditioned workers may complain of fatigue, some muscular weakness with burning, itching or "crawling" skin. There may also be complaints of headaches and some nausea among unconditioned workers. A few individuals may experience restless sleep. At concentration between 200 to 500 ppm impairment or coordination, momentary loss of memory and loss of appetite has been reported with no significant physical or laboratory findings present. At the 500-1000 ppm level, toluene is strongly irritating to the eyes and respiratory system. In even higher concentrations which could probably only be experienced in an enclosed space such as a tank, toluene acts as a narcotic and the signs of acute poisoning are headache, drunkeness, nausea, vomiting and ultimately unconsciousness. Skin contact with the liquid may cause dermatitis.

A part of the absorbed toluene is eliminated in exhaled breath, but about eighty percent is oxidized to benzoic acid, conjugated with glycine and excreted in the urine as hippuric acid. An indication of exposure can then be determined by measuring urine hippuric acid.

Xylene

Excessive xylene exposure may result in headache, fatigue, lassitude, irritability and gastrointestinal disturbances such as nausea, and loss of appetite. These symptoms are quite similar to those of toluene although more pronounced. It is believed no significant chronic injury will result from continued occupational exposure at 100 ppm or less.[7]

Methyl Chloroform (1,1,1-Trichloroethane)

Men exposed at concentrations of 900 to 1000 ppm have noticed mild irritation and minimal impairment of coordination. No injury at concentrations below 500 ppm has been reported even after repeated exposures. With the exception of methylene chloride, this substance is the least likely of the common chlorinated hydrocarbons to cause liver damage.[8]

2. Biological criteria

The determination of hippuric acid in the urine of exposed workers has been used as an index to toluene exposure by several investigators, and some results from other studies are compiled in Table 1 below. The concentration of hippuric acid is reported as grams hippuric acid per liter of urine adjusted to a specific gravity of 1.024 and or grams hippuric acid per gram creatinine. The average air concentration of toluene in parts per million associated with the hippuric acid determination is also shown.

Table I - Results of Hippuric Acid in Urine for Workers Exposed to Toluene

Toluene Air Concentration ppm	Hippuric Acid Concentration gms/liter of Urine*		gms/g Creatinine		Reference
	Controls	Exposed	Controls	Exposed	
A. Previous Studies					
53	0.80	2.38	-	1.50	Pagnotto and Lieberman[9]
65	0.44	2.81	0.24	1.51	Ikeda and Ohtsuji[10]
73	0.80	3.66	-	2.40	Pagnotto and Lieberman[9]
80	0.44	2.81	0.24	1.64	Ikeda and Ohtsuji[10]
125	0.44	4.26	0.24	3.17	Ikeda and Ohtsuji[10]
125	1.43	3.15	-	-	Cappellini and Alessio[11]
B. Present Study					
42**	1.46	2.94	0.97	2.34	12/12/73 Bristol Flowed Gasket

E. Discussion of Results - Medical and Environmental

A total of thirteen workers were questioned regarding possible symptoms of toluene overexposure near the end of their shift. Six workers mentioned having experienced at least one symptom possibly due to toluene exposure in the past. However, only two of the workers mentioned symptoms which could be regarded as possibly due to toluene exposure on the day of the evaluation: one worker described eye irritation and another had a headache.

The means of controls and exposed groups as shown in Table I(B) of urine hippuric acid as grams/liter* and grams/gram of creatinine were statistically tested using the Student t test and both found to be significantly different ($p \leq 0.05$). The means of specific gravity, creatinine level, and grams hippuric acid/liter urine uncorrected for specific gravity for the two groups were also tested and the difference between the two groups were not significant ($p > 0.05$). It can be concluded that the increased level of hippuric acid in the workers' urine is due to their exposure to toluene and xylene.

The average hippuric acid results of 2.94 grams/liter of urine or 2.34 grams/gram of creatinine at an average toluene concentration of 42 ppm compares with the results reported by Pagnatto and Lieberman[9] at 53 ppm and 73 ppm and with those of Ikeda and Ohtsuji[10] at 65 ppm and 80 ppm. In the present study the hippuric acid levels seem to be slightly higher especially when expressed as grams/gram creatinine than might be expected due to toluene exposure alone. Xylene is also metabolized to hippuric acid and in this study

* Adjusted to a specific gravity of 1.024

** Workers were simultaneously exposed to an average xylene concentration of 4ppm.

the average concentration of xylene for the workers in question was 4ppm which would partly explain the somewhat higher results found. The average concentration of urine hippuric acid of controls is also somewhat higher than reported in other studies. The results suggest an average toluene and xylene level of considerably less than less than 100 ppm.

The worker who reported having eye irritation on the day of the evaluation had a urine hippuric acid level of 2.0 grams/liter and 1.9 grams/gram creatinine (Table II) which are less than the average levels of the exposed group and considerably lower than the highest individual levels of 6.0 and 4.0 respectively at which no symptoms were reported. This worker was exposed to a toluene level of 31 ppm. A urine specimen was not obtained from the second worker who reported a headache and was exposed to a toluene level of 48 ppm.

An analysis of the solvent obtained from the literature indicates a small amount of carbon disulfide may be present.[12] The urine specimens were analyzed by the iodine azide test of Djuric et. al.[13] for the presence of carbon disulfide metabolities. All the samples tested were found to be in the "normal" range, indicating no significant exposure to carbon disulfide.

Breathing zone samples were obtained for eight workers on the first shift and five workers on the second shift. A tabulation of the air samples and urine results are shown in Table II. The concentration of methyl chloroform and xylene were far lower than generally accepted individual standards for these substances. However, the three solvents have similar toxic effects in man, therefore they have also been presented in Table II as an equivalent exposure where a value of one represents a value equal to the equivalent standard for these substances. For computational purposes the TLVs of the ACGIH were used and the results did approach the equivalent standard for the three substances (Gasketing Machine Operator 3 and Inspector 2).

The average toluene concentration for all workers monitored during the first shift was 42 ppm with individual worker shift averages ranging from 9 to 92 ppm. Second shift workers were monitored for approximately the first half of the shift. Exposure levels ranged from 11 to 58 ppm with an average of 45 ppm which is comparable to the first shift average.

All charcoal tubes were analyzed to determine if workers were being exposed to benzene vapors. All benzene determinations were less than the minimum detectable limit of 1 ppm. The individual exposures to toluene were below the present 200 ppm Federal Standard although two exposures (Gasketing Machine Operator 3 and Inspector 2) approached the more restrictive TLV of 100 ppm of the American Conference of Governmental Industrial Hygienists which is also the standard air level recommended in the NIOSH Criteria Document. The results of the

hippuric acid determination in exposed workers' urine indicates an average exposure less than 100 ppm. The recent NIOSH study [14] of toluene and available information regarding industrial exposure to toluene were reviewed. In general very few health effects were noted at 100 ppm or less although several investigators reported minor adverse health effects at a 200 ppm concentration.

V. REFERENCES

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VI. AUTHORSHIP AND ACKNOWLEDGMENT

Report Prepared By:

Robert E. Rosensteel
Industrial Hygiene Engineer
Hazard Evaluation Services Branch
Cincinnati, Ohio

Originating Office:

Jerome P. Flesch, Chief
Hazard Evaluation Services Branch
Cincinnati, Ohio

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Table II - Results of Vapor Sampling and Hippuric Acid Determination of Exposed Workers
December 12, 1973

Job	CONCENTRATION PPM			HIPPURIC ACID			
	Methyl Chloroform	Toluene	Xylene	Equivalent Exposure	gms/liter*	gms/gm**	Symptoms Day of Evaluation
Gasketing Machine Operator 1	8	26	3	0.31	1.9	0.8	-
Gasketing Machine Operator 2	13	31	4	0.39	2.0	1.9	+
Gasketing Machine Operator 3	11	88	4	0.95	3.7	3.5	-
Gasketing Machine Operator 4	2	28	2	0.30	6.0	3.1	-
Inspector 1	12	26	4	0.33	2.4	2.9	-
Inspector 2	7	92	5	0.99	3.3	4.0	-
Press Operator and Mechanics	1 31 11	9 36 55	4 7 2	0.13 0.52 0.60	1.9 2.3	1.2 1.3	- - -
Gasketing Machine Operator 5	13	58	4	0.66			-
Gasketing Machine Operator 6	12	48	3	0.54			+
Gasketing Machine Operator 7	10	54	2	0.59			-
Gasketing Machine Operator 8	25	11	1	0.19			-
TLV	350	100	100	1.0			

*gms/liter - grams of hippuric acid per liter of urine adjusted to a specific gravity of 1.024.

**gms/gm - grams of hippuric acid per gram of creatinine