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 78-45-483

DOVE'S EXXON STATION
HARRISBURG, PENNSYLVANIA

APRIL 1978

I. TOXICITY DETERMINATION

It has been determined, based on environmental evidence and reported symptomatology, that a hazard to the health of workers exposed to carbon monoxide (CO) existed at Dove's Exxon Station, Harrisburg, Pennsylvania, during the period of a Health Hazard Evaluation conducted by NIOSH on March 8, 1978.

The evaluation revealed that there is no exhaust ventilation and once an automobile is driven inside and turned off, the levels of CO as determined by area measurements exceeded the NIOSH recommended standard, and it takes hours for the levels to finally drop below the recommended criteria. Personal samples for CO and estimates of carboxyhemoglobin were also in excess of NIOSH recommended limits.

Recommendations for improving the occupational environment are contained in the text of this report.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this determination report are currently available upon request from NIOSH, Division of Technical Services, Information 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, Publication Office at the Cincinnati address.

Copies of this report have been sent to:

a) Dove's Exxon Station, Harrisburg, Pennsylvania
b) Exxon District Manager, Harrisburg, Pennsylvania
c) U.S. Department of Labor - Region III
d) NIOSH - Region III

For purposes of informing the 4 "affected employees", the employer shall promptly "post" for a period of thirty calendar days, this 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. (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 regarding worker exposures to automotive exhaust "fumes" at Dove's Exxon Service Station. The request stated that employees were getting headaches at work. NIOSH conducted an environmental survey, at the location, on March 8, 1978.

IV. HEALTH HAZARD EVALUATION

A. Facility/Process Description

Dove's Exxon Station is a typical gas station with two service islands, one self-service and the other full service, and three inside repair bays. The facility performs routine maintenance and repair on automobiles. There is also a customer waiting area, bookkeepers office and a storage/compressor room.

The work load at such stations is extremely variable and no particular service could be considered as "routine". The employees' work varies from servicing customers' cars outside to inside repair jobs.

B. Evaluation Procedure

1. Environmental

A calibrated continuous monitoring CO Ecolyzer* was set up on the workbench at approximately the midpoint of the "shop" area approximately 1 meter above the floor. The instrument was connected to a strip chart recorder for a permanent record of all readings. General area and personal samples for CO were obtained utilizing Draeger* sampling tubes and MDA* personal sampling pumps operated at airflows of 10cc per minute. Personal samples were obtained by clipping the detector tubes to the workers' collar to approximate their breathing zone. Instantaneous general area measurements for CO and Oxides of Nitrogen (NOx) were made with Draeger* gas detector tubes.

Temperature and relative humidity (R.H.) measurements were obtained with a Bendix*, battery powered psychrometer. Qualitative air movement checks were performed with Gastec* smoke tubes.

2. Interviews

Private interviews with employees were conducted and nondirected medical questionnaires were compiled.

Noninvasive determinations of carboxyhemoglobin (COHb) were made utilizing the Ecolyzer instrument in the following manner. The employees cleared their lungs three times and on the third time a deep breath was held 20 timed seconds, then approximately 1/2 of the air was vented to the atmosphere and the remaining pulmonary air was expired into a gas bag. The bag is then attached to the Ecolyzer inport and the aveolar CO concentration read from the instrument. This value is used to compute the approximate carboxyhemoglobin value: $\frac{\text{ppm CO}}{5} + 1.5 = \%\text{COHb}$. Pre-, mid-, and post-shift breath analysis samples were collected for each employee. Neither of the day shift employees smoked cigarettes or cigars.

C. Evaluation Criteria

1. Environmental

The following occupational exposure criteria were used in evaluating the carbon monoxide levels found in this survey: (1) National Institute for Occupational Safety and Health (NIOSH), Recommended Criteria for Occupational Exposures, (2) American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values for substances and physical agents in the workroom environment and supporting documentation, and (3) U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1910.100, Table 2-1).

*Mention of manufacturer's name does not constitute a NIOSH endorsement.

Source	8-hour Time Weighted Average Daily Exposure Limit (ppm)*	Ceiling Value (ppm)*
(1) NIOSH	35	200**
(2) TLV	50	400
(3) OSHA	50	

* Denotes parts of contaminant per million parts of air by volume(ppm).
** Designates ceiling value which should not be exceeded at any time.

These criteria are designed to protect the average worker for an eight or ten hour day, forty hour week, during a normal working lifetime. However, these are numerous factor's that may influenece an individual's response to a particular substance such as age, sex, health status, smoking habits, etc.

2. Medical

a. Toxic Properties of Carbon Monoxide[2-4]

Carbon monoxide is a colorless, odorless, tasteless gas and consequently gives no warning of its presence. Inhalation of CO interferes with the oxygen carrying capacity of the blood by combining with hemoglobin(Hb), which normally carries oxygen to the body, to form carboxyhemoglobin(COHb). The effects of CO exposure on man is increased by duration of exposure, high environmental temperatures, and work effort (oxygen demand). Symptoms such as headache, nausea, fatigue, and dizziness appear in healthy workers engaged in light labor near sea level when about 10 percent of the Hb is combined with CO. Such a degree of saturation could be achieved by continually breathing air contaminanted with 50 ppm CO for about six to eight hours. Disturbance of coordination, judgment, phsycomotor tasks and visual activity appear at about 2 percent COHb but do not become significant until about 5 percent COHb saturation is reached.

b. Criteria[2,5]

The medical criteria used to evaluate the breath analysis data was 5 percent COHb as recommended by NIOSH. The 5 percent COHb only applies to occupational exposure and does not take onto account smoking. The blood of cigarette smokers may contain between 3 and 10 percent COHb depending on the number of cigarettes smoked and the manner smoking, inhaling or not inhaling. The COHb of average nonsmokers is approximately 0.5-0.8 percent; also dependent upon ambient environmental CO concentrations.

D. Results/Discussion

1. Environmental

As indicated by the results of the environmental samples obtained (Table I) the employees were exposed to concentrations of CO that exceed the NIOSH criteria. These exposures were achieved even though there was very little activity (auto maintenance) on the day of the survey. The levels resulted from merely driving a car into one of the bays to perform a brake job and second car brought in for inspection. The cars did not run over 10 seconds in bringing them inside and the doors to the bay were open for approximately 1/2 -1 minute. The values could be expected to be considerably higher if more cars were worked on, on any given day, and if any engine work was to be performed which would require that the engine be running. Also, as with most service stations, the employees usually work more than 8 hours per day, 40 hours per week, thus their weekly exposures would easily exceed the criteria which is based upon a 40 hour work week. The primary reason for such high exposures is that the facility lacks any type of mechanical ventilation, thus the air is never diluted or exhausted to help keep the concentrations from building up. It took several hours after the initial peak, of over 500+ ppm, to recede back to levels less than 35 ppm and upon removing one of the vehicles, after working on it, the values soared up again for several more hours.

2. Medical

The employees complained of daily "pounding" headaches and nausea. As indicated, in Table II, the employees COHb exceeded the NIOSH criteria of 5 percent COHb by midday. Also, even though no cars were worked on in the afternoon the levels of COHb still had not receded below the 5 percent level at the end of the day.

V. RECOMMENDATIONS

The following recommendations are made to help improve the health and safety at this facility.

1. The exhaust ports for the automobile tail pipe hoses could be located on the roof so that exhausted air is not "blown/drawn" back into the building; particularly since the bays face the west from where the prevalent winds blow. This could be accomplished by running tubing from the roof down to the side of each bay. Then when cars are pulled into the bay the exhaust hose extension would be attached to the roof vent tube. Because of the ceiling height, the roof exhaust tubes will require a fan to insure removal of gases from the garage. NOTE: The exhaust ports will also require rain caps.

2. The garage bays need exhaust ventilation installed on either the North or East side to help ventilate the entire garage and prevent exhaust buildup.

3. Good work practices and personal hygiene are necessary to help reduce health and safety hazards.

4. Eye protection (i.e. goggles) should be required when any grinding or buffing is performed.

5. Never allow cars to idle inside the building without attaching the exhaust hoses. Also, keep bay doors open as much as possible to help ventilate the building.

6. Have the heating system checked periodically for proper performance to help reduce improper combustion which will contribute as a CO source.

VI. REFERENCES

1. Ringold, A., Estimating Recent Carbon Monoxide Exposures-A Rapid Method, Archives of Environmental Health, 5:308, 1962.

2. NIOSH Criteria for a Recommended Standard . . Occupational Exposure to Carbon Monoxide, HEW Publication No. (NIOSH) HSM 73-1100. Cincinnati, Ohio.

3. NIOSH Technical Information, CO In Vehicle Inspection Status, HEW Publication No. (NIOSH) 76-200, Cincinnati, Ohio.

4. NIOSH Technical Information, Effects of CO on Vigilance Performance, HEW Publication No. (NIOSH) 77-124, Cincinnati, Ohio.

5. Hutchison, M.D., A Guide to Work-Relatedness of Diseases, HEW Publication No. (NIOSH) 77123, Cincinnati, Ohio.

ACKNOWLEDGEMENTS

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Table I

Results of Air Sampling for Carbon Monoxide
Dove's Exxon Station
Harrisburg, Pennsylvania

March 8, 1978
HE 78-45

Environmental Conditions: Inside 55°F, R.H. 40% Outside 27-31°F, R.H. 30-40%, High Snow Flurries

Sample Number	Time	Description	Time Weighted Average Concentration of Carbon Monoxide (ppm)
C-1	0715-1533	Personal Sample, Mechanic/Attendant	44
C-2	0800-1515	" " " "	25
C-3	0902-1526	General Area Office	37
C-4	1000-1532	General Area Customer Waiting Area	4

Detector Tube Results				Ecolyzer Results		
Time	Location	Concentration CO (ppm)	Oxides of Nitrogen (ppm)	Time	Location	Concentration CO (ppm)
0750	Shop	N.D.	N.D.	0725	Shop	3 background
0755	Compressor Room	N.D.	N.D.	0812	"	500+
0940	Office	70	0.5	0826	"	83
1120	Shop	100	0.5	0853	"	55
1210	Shop	100	N.D.	0920	"	40
1250	Shop	50	N.D.	0925	"	45
1400	Shop	20	N.D.	1014	"	28
				1031	"	500+
				1037-1101	"	400-100
				1101-1500	"	100-20

*parts per million
1. Not Detected

The NIOSH Recommended Criteria for Occupational Exposure to Carbon Monoxide is 35 ppm for a eight hour. Time Weighted Average (TWA) daily exposure and a ceiling value of 200 ppm not to be exceeded.

TABLE II

Results of Carboxyhemoglobin (COHb) Levels
Dove's Exxon Station
Harrisburg, Pennsylvania

March 8, 1978
HE 78-45

	Pre Exposure		Mid Exposure		Post Exposure	
Job Classification	Time	% COHb	Time	% COHb	Time	% COHb
Mechanic	0740	3.3	1100	11.2	1530	7.3
Operator/Attendant	0753	2.9	1106	10.1	1508	7.7

1. Non-Smokers - Breath test timed 20 seconds then 1/3 air expired to atmosphere and the rest into an air bag; readings made with Ecolyzer. Then COHb calculated by $\frac{\text{ppm CO}}{5} + 1.5 = \%\text{COHb}$.

The NIOSH REcommended Criteria for Occupationally included COHb not to be exceeded is 5%.