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MILLER BRANDS INC.
DENVER, COLORADO

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I. Summary

In May, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Operations Manager of Miller Brands, Denver, Colorado to evaluate the carbon monoxide (CO) exposures in their beer distributorship and storage facilities. The CO is produced by gasoline powered beer trucks and fork lifts used inside large buildings.

On May 15, and 29, 1986 NIOSH conducted an environmental evaluation of two large facilities. One of the facilities stores beer at either room temperature or at 38 degrees F. CO exposures occur when the gasoline powered beer trucks run their engines inside the beer warehouse. After the beer trucks have been filled with the next day's order they are driven next door to another large building where they are parked until the following morning. When the truck engines are started inside the building the next morning, CO exposures also occur. The only other area where over exposure to CO occurs is in the 38 degree F. beer keg storage area. This area is located inside the beer storage warehouse. The keg storage room is refrigerated and has no dilution ventilation. Kegs of beer are removed from rail cars with a gasoline fork lift truck and brought into the keg room. Continuous air monitoring for carbon monoxide was performed in all these areas where CO was generated with an Ecolyzer CO monitor and recorder. Levels of CO reached 200 parts per million 20 minutes after the fork lift truck started stacking the beer barrels and remained at this level for the duration of the procedure. This procedure normally lasts from 2 to 4 hours a day. On the day of this evaluation it lasted for 2.5 hours. After all the beer kegs were stored the door was closed. One hour later the level of CO was still 150 parts per million. The door was then opened and levels declined to 50 ppm in about one hour. The current OSHA standard for CO is 50 ppm as a TWA. NIOSH recommends that CO exposures not exceed 35 ppm TWA.

The area where the beer trucks are filled and the building where the trucks are kept overnight were monitored for CO during an entire work shift. No overexposures were observed in these two areas. The highest level recorded was 40 ppm which lasted for 3 minutes. The average concentration was 22 ppm.

On the basis of the environmental data, it was concluded that a health hazard existed from overexposures to CO in the beer keg cool storage area. Recommendations are included in this report that will eliminate this hazard.

Keywords: SIC (5181) beer storage, carbon monoxide, refrigerated storage, gas powered fork lift trucks.

II. INTRODUCTION

The operations manager of Miller Brands was concerned with CO exposures generated by the operation of gasoline engines inside beer warehouses. NIOSH was asked to do an evaluation of the two facilities in May, 1986. On May 15, and 29, 1986 NIOSH conducted an environmental evaluation of this facility. The findings were discussed with the operations manager and methods on how to eliminate the health hazard were also discussed.

III. Evaluation Design and Methods

Continuous air monitoring for carbon monoxide was performed with an Ecolyzer CO analyzer and recorder. The CO analyzer was calibrated every hour during its actual operating time. The sampling periods lasted for the entire work time in the three areas where CO was generated. These areas included: 1. the beer warehouse; 2. the refrigerated keg storage room; and 3. the building where the filled beer trucks were dispatched.

IV. Evaluation Criteria

A. Environmental

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 solely 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 only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average air-borne 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.

				<u>Environmental Exposure Limits</u>		
				<u>8-Hour Time-Weighted Average (TWA)</u>		
				mg/m ³	ppm	Source
Carbon Monoxide (CO).....				(40)	35*	NIOSH
				C 200		
				55	50	ACGIH
				55	50	OSHA

mg/m³ = milligrams of substance per cubic meter of air.
 ppm = parts of contaminant per million parts of air.
 C = ceiling concentration-should never be exceeded

Toxicological

Carbon Monoxide¹ – The signs and symptoms of carbon monoxide (CO) poisoning may include headache, nausea, vomiting, dizziness, drowsiness, and collapse. Carbon monoxide rapidly binds to the oxygen-carrying molecule of the red blood cells, hemoglobin, forming "carboxyhemoglobin" (COHb). When CO binds with hemoglobin to form COHb, it reduces the oxygen-carrying capacity of the blood. The more COHb is formed, the more significant the symptoms are. Heart disease may be made worse in workers who have coronary heart disease and are exposed to CO, particularly concentrations high enough to produce a COHb level greater than 5% of total hemo-globin (referred to as % saturation).

There is also important evidence that exposure to lower CO concentrations, producing COHb levels below 5%, affects the nervous system and causes changes in visual alertness, response time, and fine judgment.

Non-smoking, non-exposed persons have an average COHb level of 1%. Non-smokers exposed to 50 ppm (50 parts per million of CO, the OSHA standard) for six to eight hours have COHb levels of 8 to 10%. NIOSH recommends an exposure limit of 35 ppm for an 8-hour time-weighted average, and a ceiling limit of 200 ppm. This recommendation is based on the concentration necessary to produce a COHb level of not more than 5%. At "very high altitudes (e.g., 5,000 - 8,000 feet above sea level), the permissible exposure stated in the recommended standard should be appropriately lowered to compensate for loss in the oxygen-carrying capacity of the blood." Symptoms such as headache and nausea may be seen above 15% saturation, but usually not at lower levels. At 25%, there may be electrocardiographic evidence of heart effects, and 40% usually results in collapse.

At lower altitudes exposure at the current OSHA standard for CO of 50 ppm for 90 minutes may cause chest pain for persons with angina (chest pain related to heart disease); exposure for 2 hours may make leg cramps worse for persons who have leg cramping associated with vascular disease. The effects of CO exposure, including the more common symptoms of headache, dizziness, and nausea, are made worse by heavy labor and a high temperature in the work area.

These recommendations do not consider the smoking habits of workers since the COHb levels in smokers has generally been found to be in the 4 to 5% range, but may run as high as 10 to 15% in heavy smokers. Therefore, smokers who already have a blood level of 5%, and then are exposed in a work place with an average concentration of 35 ppm will have a total COHb of about 10%.

Although CO binds to the hemoglobin over 200 times as strongly as does oxygen, when exposure ceases, the CO will slowly be replaced by oxygen from the air restoring the oxygen carrying capacity of the hemoglobin. Even with fairly severe exposures, prompt removal to fresh air (oxygen if available) will usually be followed by complete recovery.

V. Results and Conclusions

Carbon monoxide (CO) measurements were taken throughout the three areas of concern: 1. the beer storage warehouse, 2. the beer keg refrigerated storage room and 3. the building where the filled trucks were dispatched. All CO concentrations were within acceptable concentrations in all areas except the refrigerated keg storage room. Levels in this room reached 200 parts per million of carbon monoxide after the fork lift truck had been coming in and out of the room for about 20 minutes. The level stayed at 200 to 230 parts per million for the duration of the procedure which lasted about 2.5 hours. After the beer had all been unloaded from the rail car and stored in the cool storage the door to the room was closed. The CO level was still at 150 ppm one hour later. The door was then opened and the CO level reached an OSHA acceptable level of 50 ppm one hour later. An acceptable method for eliminating the CO hazard is to only use electric fork lift trucks in the beer key cool room. There are numerous electric fork lift trucks available at the facility and one should be immediately designated and used in this area. There

is no way to eliminate the CO hazard unless the gasoline fork lift truck is replaced with an electric fork lift. The gasoline forklifts could also pose a problem in other areas of these facilities in cold weather when all the doors are closed. When replacing wornout forklift trucks, electric ones should be purchased.

VI. Recommendations

1. Gas powered fork lift trucks should not be used in the beer keg refrigerated storage area.
2. All gas powered fork lift trucks should be replaced with electric fork lift trucks as they wear out.
3. Beer trucks should not be left running at any time and they should leave the facility as soon as the engines are started.

VII. REFERENCES

1. Turiel, I., and Rudy, J.V. "Occupant-Generated CO₂ as an Indicator of Ventilation Rate." American Society of Heating, Refrigerating, and AirConditioning Engineers Transactions. Volume 88, Part 1, 1982.
2. Criteria for a Recommended Standard ... Occupational Exposure to Carbon Monoxide, NIOSH, HSM Publication No. 73-11000, 1972.
3. Dean, J.A., Ed., Lange's Handbook of Chemistry, 12th Ed. New York: McGraw-Hill Book Company, 1979.

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IX. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 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:

1. Miller Brands Inc.
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado State Health Department.

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.