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KP INDUSTRIES
DELPHOS, OHIO

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I. SUMMARY

In February 1986, the National Institute For Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation at KP Industries in Delphos, Ohio. NIOSH was requested to evaluate workers' exposures to carbon monoxide (CO) fumes in the shipping and warehouse area, and to lead in the can-line area. NIOSH investigators conducted environmental and ventilation evaluations on March 10, 11, 24, and 25, 1986.

On March 11, long-term indicator tube samples for CO were collected in five areas. The 8-hour time weighted average (TWA) CO levels ranged from 64 to 74 parts per million (ppm). The Occupational Safety and Health Administration's (OSHA) 8-hour TWA permissible exposure limit (PEL) is 50 ppm, while the NIOSH recommended exposure limit is 35 ppm (8-hour TWA). The source of the CO was six propane forklift trucks which were in need of fine tuning (through carbon monoxide analysis of exhaust gases) and inadequate distribution of airflow in the building. Airborne concentrations of CO measured directly behind the forklifts were as high as 350 ppm. The six lift trucks were given tuneups on March 13, 1986, and the CO levels were reduced.

On March 13, airborne concentrations of inorganic lead for four personal and three area samples collected at the can line were less than the detectable limit (2 micrograms/sample or approximately less than 2 ug/m^3 based upon the sampled air volume). The OSHA TWA PEL for lead is 50 ug/m^3.

The follow-up survey on March 24 and 25 concentrated on ventilation measurements and CO levels in the plant. The CO levels measured in this survey ranged from 5 to 10 ppm which is below the NIOSH recommended level of 35 ppm 8-hour TWA.

The face velocity for several hoods and booths in the plant were measured using a thermal anemometer and smoke tubes. The average face velocities in the hoods and booths were determined to be adequate to capture the generated fumes.

There are two problems with the general ventilation system. First, the exhaust air is below the recommended ventilation (30,000 cfm) for use of six propane forklift trucks. Second, the supply air system is grossly inadequate to balance the recommended exhaust ventilation.

Five of the six warehouse workers privately interviewed on March 11 and 13, 1986, reported experiencing headache, and eye and throat irritation, which they attributed to fumes from the propane forklift trucks. The four employees interviewed on the tin and lead-line reported no health problems which were job related.

Based on the air sampling results and medical interviews on March 11 and 13, 1986, it was concluded that overexposure to CO did occur in the shipping and warehouse area. We have determined that a health hazard did not exist from employee exposure to inorganic lead at the can line on March 13, 1986. The ventilation survey showed deficiencies with the general ventilation system. Recommendations to aid in providing a safe and healthful working environment are presented in Section VIII of this report.

KEYWORDS: SIC 3714 (Automotive Parts and Accessories), carbon monoxide, lead, ventilation.

II. INTRODUCTION

In February 1986, NIOSH received a request from The United Auto Workers, Local 1556 for a health hazard evaluation at KP Industries, Delphos, Ohio. The primary concern was workers' exposure to CO fumes in the shipping and warehouse area, and lead exposures in the can-line area.

On March 11, 1986, NIOSH investigators conducted an environmental survey for CO. On March 13, 1986, environmental samples were collected for CO and airborne inorganic lead. A follow-up survey on March 24 and 25 concentrated on ventilation measurements and CO levels in the plant.

On April 29, 1986, notification of the airborne concentration of lead exposure at the can-line was made to management and the local union by telephone.

III. BACKGROUND

This plant employs approximately 90 workers to manufacture a wide array of automotive products.

Shipping and Warehouse Area

The shipping and warehouse area is approximately 41,000 square feet with a 25 foot ceiling. The area is used to store finished products.

Can-Line Area

The bodymaker process forms two-gallon gasoline cans from coated sheets. Sheets are slit into body-size blanks and fed into a bodymaker, which forms the body blank into a cylinder. The seam is soldered with 50/50 lead/tin alloy. The bottoms and tops are added with rolled seams and a screwneck installed. Four persons per shift operate this process.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

NIOSH investigators collected seven area and personal breathing-zone air samples on March 13, 1986, to evaluate worker exposure to lead. The samples were collected on mixed cellulose ester filters using battery-powered sampling pumps operating at 2.0 liters per minute. Analysis was by atomic absorption spectroscopy according to NIOSH Method 7082.[1]
Area air samples for CO were collected with long and short-term indicator tubes and an Ecolyzer Hipster Model 6000 direct reading instrument.

Local exhaust ventilation in the plant was evaluated using a thermal anemometer and smoke tubes.

B. Medical

Private medical interviews were conducted with ten workers to elicit symptomatology possibly related to exposure to CO and inorganic lead.

V. EVALUATION CRITERIA

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 ACHIG 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 primarily 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 those levels specified by an OSHA standard. A time-weighted average (TWA) exposure refers to the average airborne 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. Evaluation criteria for CO and lead are listed in Table I.

1. Carbon Monoxide

Carbon monoxide combines with hemoglobin in the blood reducing the oxygen carrying capacity of the blood. Symptoms of CO poisoning are headache, dizziness, drowsiness, nausea, vomiting, collapse, coma, and death. Long term low level exposure to CO can increase the risk of heart attack for some people.

2. Lead[2,3]

Inhalation (breathing) of lead dust and fume is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion (swallowing) of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. Absorbed lead interferes with red blood cell production and can damage the kidneys, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, mental deficiency, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.

VI. RESULTS AND DISCUSSION

A. Environmental

Results of long term indicator tube samples taken on March 11,13, 24, and 25 for CO are presented in Table II. On March 11, 1986, long-term indicator tube samples for CO were collected in five areas. The 8-hour TWA CO levels ranged from 64 to 74 ppm. The OSHA 8-hour TWA PEL for CO is 50 ppm; the NIOSH recommended exposure limit is 35 ppm as an 8-hour TWA. The elevated CO levels were caused by six propane lift trucks which were in need of fine tuning (through carbon monoxide analysis of exhaust gases) and inadequate distribution of airflow in the building. Airborne concentrations of CO measured directly behind the fork lifts were as high as 350 ppm. The six lift trucks were tuned up on March 13, 1986, and the CO levels were reduced below the OSHA standard. On March 24 and 25, 1986, the CO levels were below the OSHA and NIOSH recommended exposure limit.

Results of the environmental samples taken for inorganic lead are presented in Table III. Airborne concentrations of inorganic lead for four personal and three area samples collected at the can-line were less than the detectable limit (2 micrograms/sample). The OSHA TWA PEL is 50 ug/m^3.
The follow-up survey on March 24-25, 1986 concentrated on CO levels and ventilation measurements. In this second survey, the CO levels ranged from 5 to 10 ppm which was below the NIOSH recommended level of 35 ppm 8-hour TWA.

B. Ventilation

The American Conference of Governmental Industrial Hygienists (ACGIH) indicates a need for 5,000 cubic feet per minute (cfm) ventilation per propane-fired fork lift truck. This would mean that 30,000 cfm would be needed for the six forklift trucks. The volume of building space recommended for each forklift truck is 150,000 cubic feet (CF). The total building volume of the warehouse at K-P Industries is 1,025,000 CF and the total building volume of the production building (20 foot ceiling) is 1,900,000 CF. Both of these volumes sufficiently meet the 900,000 CF recommended for six forklift trucks.

The ventilation exhaust rates were measured for several exhaust hoods in the production area. The flow rates measured were:

DESCRIPTION OF EXHAUST	FLOW RATE, CFM	FACE VELOCITY, FPM
Tin & Lead Can Line Hood	2,415	613
Wall Exhaust Fan Near Tin & Lead Can Line	960	1,520
Curing Exhaust hood	870	138
Solder Exhaust Hood	565	71
Exhaust Hood on Curing Oven	700	170
Exhaust On Paint Spray Booth	14,150	119
TOTAL EXHAUST MEASURED IN PRODUCTION AREA	19,660	

In addition to the measured flow rates, there are fans in the building that provide ventilation to specific areas.

ADDITIONAL FANS AND ESTIMATED (OR RATED) FLOWS:

	EXHAUST	SUPPLY
Three Wall Fans in Screw Machine Area	2,850 CFM	
Ceiling Fan Near Office	750 CFM	
Wall Fan Near Office	950 CFM	
Warehouse Wall Fans	950 CFM	950 CFM
TOTAL SUPPLY AND EXHAUST RATED FLOWS	5,500 CFM	950 CFM

The total building exhaust air flow therefore is 25,160 cfm which leaves the building 4,840 cfm shy of the 30,000 cfm recommended for use with six propane fuel fork lift trucks. The make-up air deficiency is 25,160 - 950 = 24,210 cfm. The lack of a supply air system means that infiltrating make-up air is not supplied at the point where it can displace or disperse the CO. When the 24,210 cfm of make-up air needed to balance the system is installed, it should be introduced in the forklift high-traffic areas. It was observed that air movement in the warehouse area was very sluggish. The use of air circulating fans within the warehouse area would help mix the CO to lower the average concentration. This approach should not preempt the use of adequate exhaust and supply air ventilation.

C. Medical

Five of the six warehouse workers privately interviewed reported experiencing headache, and eye and throat irritation which they attributed to fumes from the propane forklift trucks. The four employees interviewed on the tin and lead line reported no health problems which were job related.

VII. CONCLUSION

Based on the air sampling results and medical interviews on March 11 and 13, 1986, it was concluded that overexposure to CO did occur in the shipping and warehouse area. We also determined that a health hazard did not exist from employee exposure to inorganic lead at the can-line on March 13, 1986. The ventilation survey showed there are two problems with the ventilation system. First, the exhaust air is below the recommended ventilation (30,000 cfm) for use of six propane fired forklift trucks. Second, the supply air system is grossly inadequate to balance the recommended exhaust ventilation.

VIII. RECOMMENDATIONS

1. The American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation Manual should be consulted for fuel-powered lift truck ventilation design criteria and the operating specifications of the existing system modified accordingly. The ACGIH guidelines are summarized below.

   BASIC DESIGN VENTILATION RATES

   - 5000 cfm per propane fueled lift truck
   - 8000 cfm per gasoline fueled lift truck

CONDITIONS UNDER WHICH BASIC DESIGN RATES APPLY

- A regular maintenance program incorporating final engine tuning through carbon monoxide analysis of exhaust gases must be provided. CO concentration of exhaust gases should be limited to 1 percent for propane fueled trucks, 2 percent for gasoline fueled trucks.

- Actual operating time of lift trucks must be 50 percent or less of total exposure time.

- A reasonably good distribution of air flow must be provided.

- The volume of space must amount to 150,000 cu. ft. per lift truck or more.

CORRECTIONS FOR CONDITIONS OTHER THAN THOSE ABOVE

- No regular maintenance program - multiply the basic design ventilation rate by three.

- Operating time greater than 50 percent - multiply the basic design ventilation rate by the actual operating time in percent divided by 50.

- Poor distribution of air flow - lift truck operation not recommended.

- Volume of space less than 150,000 cu. ft. per lift truck - multiply the basic design ventilation rate by a suitable factor based on the following:

  1.5 times design rate for 75,000 cu. ft.; 2.0 times design rate for 30,000 cu. ft. Lift truck operation in spaces of less than 25,000 cu. ft. is not recommended.

- Lift truck engine horsepower greater than 60 - multiply the basic design ventilation rate by the actual horsepower divided by 60.

2. Increase the supply air system to balance the air flow in the building rather than relying on infiltration of make-up air.

3. The supply air should be directed at the points of heavy forklift use to disperse CO fumes.

4. The installation of overhead air circulating fans within the warehouse area would help reduce the average CO concentration.

5. The use of direct reading monitoring equipment should be used to monitor airborne concentrations of CO in the warehouse and shipping areas.

IX. REFERENCES

1. National Institute For Occupational Safety and Health. NIOSH Manual of Analytical Methods. Vol. 2, 3rd ed. Cincinnati, Ohio: National Institute For Occupational Safety and Health, 1984. (DHHS (NIOSH) Publication No. 84-100).

2. National Institute For Occupational Safety and Health. Occupational Diseases: A Guide To Their Recognition. Cincinnati, Ohio: National Institute For Occupational Safety and Health, 1977. (DHEW (NIOSH) Publication No. 77-181).

3. International Labour Office. Encyclopedia Of Occupational Health and Safety, New York: McGraw Hill Book Company, 1972.

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1. KP Industries
2. United Auto Workers, Local 1556
3. NIOSH, Region V
4. OSHA, Region V

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TABLE I

Evaluation Criteria For Hazardous Substances
KP Industries
Delphos, Ohio
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Contaminant	OSHA Permissible Exposure Limit	ACGIH Threshold Limit Value	NIOSH Recommended Standard
Carbon Monoxide	50 ppm* 200 ppm ceiling	50 ppm	35 ppm
Lead	50 ug/m^3**	150 ug/m^3	50 ug/m^3

*ppm - parts of organic vapor per million parts of air by volume

**ug/m^3 - micrograms of lead per cubic meter of air sampled

TABLE II

Results Of Longterm Indicator Tube Samples For Carbon Monoxide (CO)
KP Industries
Delphos, Ohio
HETA 86-173

Sample Type and Location	Concentraions of CO in ppm*				
		Date			
	3/11	3/13 AM	3/13 PM	3/24	3/25
Area Sample Shipping and Receiving Door #3	64	46	13	10	10
Area Sample Shipping and Receiving Door #7	65	55	21	10	10
Area Sample Finished Goods I-5	68	73	47	10	10
Area Sample Bulk Can Area	74	54	34	10	5
Area Sample Intercompressor Storage Area	65	62	39	10	10

Evaluation Criteria (ppm)

NIOSH Recommended Exposure Limit is 35 ppm 8-Hour TWA
OSHA 8-Hour TWA PEL is 50 ppm

*ppm - parts of organic vapor per million parts of air by volume

TABLE III

Results of Environmental Air Samples For Lead
KP Industries
Delphos, Ohio
HETA 86-173
March 13, 1986

Sample Type Job and/or Location	Sample Time	Sample Volume (Liters)	Lead Concentration ug/m^{3*}
Personal Sample Assembler Operator	0714-1503	938	LD**
Personal Sample Group Leader	0715-1509	948	LD
Personal Sample Assembler	0719-1505	932	LD
Personal Sample Assembler Operator	0722-1507	930	LD
Area Sample 10' West of Lead & Tin Bath	0727-1502	910	LD
Area Sample 20' East of Lead & Tin Bath	0729-1500	902	LD
Area Sample 20' West of Lead & Tin Bath	0730-1511	922	LD
Evaluation Criteria (ug/m^3)			50
Limit of Detection (ug/sample)			2

*ug/m^3 = micrograms of lead per cubic meter of air sampled
**LD = Less than detectable limits