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NIOSH HEALTH HAZARD EVALUATION REPORT:

HETA #2001-0150-2917
IKI Manufacturing
Edgerton, Wisconsin

December 2003

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Erin Snyder of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Brad King of HETAB. Analytical support was provided by DataChem Laboratories. Desktop publishing was performed by Shawna Watts. Review and preparation for printing were performed by Penny Arthur.

Copies of this report have been sent to employee and management representatives at IKI Manufacturing and the OSHA Regional Office. This report is not copyrighted and may be freely reproduced. Single copies of this report will be available for a period of three years from the date of this report. To expedite your request, include a self-addressed mailing label along with your written request to:

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

Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Exposures to Aerosol Filling Line Workers

NIOSH investigators conducted a health hazard evaluation to investigate employee concerns that headaches and dizziness were related to exposure from aerosols used in the Heet® windshield de-icer filling line.

What NIOSH Did

- We collected personal breathing zone samples from five employees to test for toluene, heptane, trichloroethylene, ethyl ether, and total hydrocarbons.
- We talked to employees about their jobs, the facility, and any health problems they felt may be associated with working at IKI.
- We observed employees and their jobs in all areas of the Heet® windshield de-icer line.

What NIOSH Found

- Low concentrations of toluene, heptane, trichloroethylene, ethyl ether, and total hydrocarbons were detected. All concentrations were below health guidelines.
- Controls such as plastic guarding are currently in place to reduce potential exposures to workers on the filling line.
- Employees did not report any concerns with health effects related to working on the filling line.

What IKI Manufacturing Managers Can Do

- Encourage employees to stand behind plastic shielding on the filling line as much as possible to reduce potential exposure.
- Improve communication between employees and management. Employees should be made aware of problems within the facility and decisions made by management to address those problems.
- Conduct periodic air sampling for substances of concern, especially when a process changes because of new equipment or a new formula is introduced to the filling line.

What the IKI Manufacturing Employees Can Do

- Stand behind plastic shielding as much as possible to reduce potential exposures on the filling line.
- Report all health and safety concerns to management.
- Practice good hygiene, such as hand-washing before eating or drinking, to reduce the possibility of exposure.

What To Do For More Information:

We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report # 2001-0150-2917

Health Hazard Evaluation Report 2001-0150-2917
IKI Manufacturing
Edgerton, Wisconsin
November 2003

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SUMMARY

On January 26, 2001, the National Institute for Occupational Safety and Health (NIOSH) received an employee request to conduct a health hazard evaluation (HHE) at IKI Manufacturing in Edgerton, Wisconsin. The requestor cited concerns regarding worker exposure to ethyl ether, methanol, and propylene glycol on a Heet® windshield de-icer filling line. Health concerns listed on the HHE request included headaches and dizziness. On October 21-22, 2002, two NIOSH industrial hygienists visited IKI Manufacturing to conduct an industrial hygiene survey.

NIOSH investigators first met with the IKI health and safety director, the production manager, and an employee representative to discuss the HHE request. Afterwards, the investigators toured the IKI facility, observed the de-icer filling line, and collected area air samples in the filling room and the water bath room for volatile organic compounds. Personal breathing zone (PBZ) samples were also collected on five workers on the de-icer filling line to assess employee exposure to toluene, heptane, trichloroethylene, ethyl ether, and total hydrocarbons. General area samples for ethyl ether were also collected in these locations.

Results for toluene, heptane, trichloroethylene, total hydrocarbons, and ethyl ether indicated concentrations below evaluation criteria. Ambient levels of ethyl ether, measured using a Dräger™ pump with a colorimetric detector tube, were well below established occupational exposure limits for all samples.

Exposures to toluene, heptane, trichloroethylene, and ethyl ether were well below established occupational exposure limits on the day of the survey. Administrative controls and safeguarding technology currently in place at IKI help to limit employee exposure to the Heet® windshield de-icer fluid on the filling line. Recommendations to further reduce exposures and improve working conditions are presented in this report.

Keywords: SIC 7389 (Filling pressure containers [aerosol] with hair spray, insecticides, etc.,)
Ethyl ether, methanol, starting fluid, windshield fluid

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INTRODUCTION

On January 26, 2001, the National Institute for Occupational Safety and Health (NIOSH) received an employee request to conduct a health hazard evaluation (HHE) at IKI Manufacturing (IKI) in Edgerton, Wisconsin. The request cited concerns regarding worker exposure to ethyl ether, methanol, and propylene glycol on a de-icer filling line. Health concerns listed on the HHE request included headaches and dizziness. On October 21-22, 2002, two NIOSH industrial hygienists visited IKI Manufacturing to conduct an industrial hygiene survey. Based upon discussions with management regarding the process and product ingredients, personal breathing zone (PBZ) air samples were collected to assess employee exposure to toluene, heptane, trichloroethylene, and ethyl ether.

BACKGROUND

IKI Manufacturing is a privately owned company that fills specialty aerosol containers for industrial and medical contracts. The facility is comprised of numerous buildings and above ground and below ground chemical storage tanks. Raw materials from these tanks are blended in a separate building then refrigerated below 20°F and filtered prior to being pumped to the various filling lines. Seven filling lines run simultaneously at the facility; the filling line of focus during the NIOSH survey was the Heet® windshield de-icer filling line. This line runs sporadically, typically August through October, dictated by the customer's needs.

The filling process begins by removing cans supplied by the customer from pallets and sending them via magnetic conveyor belt into the filling room. In this process, the cans pass through a building where they are inverted to remove any debris that may have been inside. Once in the filling room, a machine pumps the de-icer blend into three upright cans at one time. A valve is then placed by machine into each can as it continues down the conveyor belt. An employee observes this step to ensure each can receives a valve. He/she is also responsible for restocking the valve machine as necessary. The valve is then crimped and carbon dioxide, which acts as the aerosol propellent, is added. An employee stationed at this point ensures each can is crimped and stops the line when a can becomes stuck. Lastly, the can is shaken by a machine.

During the filling process, quality control (QC) technicians perform tests on the cans. One QC technician removes three cans at a time from the filler and weighs the cans. The cans are then replaced in the line; when emerging from the shaker, they are removed again to be weighed with filled product. A second QC technician measures the depth and diameter of the crimp on the can. This technician also removes the valve nozzle and uses a pressure gauge to record the pressure in the can, then replaces the valve nozzle, and returns the can to the line. The QC checks are performed every 15 minutes.

Once the can is shaken and the QC tests have been performed, it is sent via conveyor belt through an opening in the wall into another building where it is immersed in a water bath. To fulfill a U.S. Department of Transportation requirement, the can is heated to 130°F in the water bath to check the integrity of the can. If the can leaks, it is removed from the line when it comes out of the bath. One employee sits across from the water bath and records the water bath temperature every 15 minutes. After the can has passed through the water bath, it is sent into another building to be coded. A cap is then placed on the can and it is packaged into cartons that are coded and sealed. Lastly, the cartons are flipped and stacked on pallets to be wrapped and sent to the warehouse for shipping.

The Heet® de-icer filling line runs only first shift from 6:00 a.m. to 4:00 p.m. each day. Depending upon customer demand, occasional overtime is necessary. Nine to ten employees rotate within the production line throughout the day, spending one hour at each position. They spend two hours in the filling room working two separate tasks; however, employees work for one hour in a different area between these tasks. Two QC technicians who are specially trained remain in the filling room for the

duration of their shift. An average of 55,000 cans are filled during a normal production day.

METHODS

On October 21, 2002, NIOSH investigators met with the IKI health and safety director, the production manager, and an employee representative to discuss the HHE request. Afterwards, the investigators toured the IKI facility and observed the Heet® windshield de-icer filling line.

The following day, area air samples in the filling room and the water bath room were collected on thermal desorption tubes to identify volatile organic compounds (VOCs). The thermal desorption tubes were attached by Tygon® tubing to sampling pumps calibrated at a flow rate of 50 cubic centimeters per minute (cc/min). Each thermal desorption tube contained three beds of sorbent material: a front layer of Carbopack Y™, a middle layer of Carbopak B™, and a back section of Carboxen 1003™. The thermal desorption tubes for low level VOCs were analyzed by the NIOSH laboratory using stainless steel tubes configured for thermal desorption in a Perkin-Elmer ATD 400 automatic thermal desorption system using a gas chromatograph with a mass selective detector in accordance with NIOSH Method 2549.[1] Since the sampling and analytical techniques for this method have not been validated for these compounds, all results should be considered semi-quantitative.

Ambient levels of ethyl ether in the filling room and the water bath room were measured using a Dräger™ pump with a colorimetric detector tube. Air is drawn manually through the tube with a bellows-type pump and the resulting length of the stain in the tube (produced by a chemical reaction with the sorbent) is proportional to the concentration of ethyl ether.

PBZ samples were collected on five workers on the Heet® windshield de-icer filling line. Charcoal tubes were attached by Tygon® tubing to sampling pumps calibrated at a flow rate of 200 cc/min. The charcoal tubes were sent to DataChem Laboratories, Inc. (Salt Lake City, Utah) to be quantitatively analyzed for compounds of interest that were identified on the thermal tubes in accordance with NIOSH Method 1500.[2] A Hewlett-Packard model 5890A gas chromatograph equipped with a flame ionization detector was used for the analysis. Total hydrocarbons is the sum of all peaks in the chromatogram minus the solvent, methyl ethyl ketone, and requested analyte (trichloroethylene [TCE], heptane, and toluene) peaks. Total hydrocarbons were quantified against decane standards.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the 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 even though 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 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 increases 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 Recommended Exposure Limits (RELs),[2] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values

(TLVs®),[3] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[4] Employers are encouraged to follow the NIOSH RELs, the ACGIH TLVs, the OSHA limits, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

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 STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Toluene

Toluene is a highly flammable, volatile liquid. Approximately 7-10% of the total amount of toluene produced in the U.S. each year is used in paints, oils, adhesives, resins, and detergents, and the other 90% is used to formulate gasoline.[5,6,7]

Inhalation and skin absorption are the major routes of entry. Toluene can cause acute irritation of the eyes, respiratory tract, and skin.[8,9] The main effects reported with excessive inhalation exposure to toluene are central nervous system (CNS) depression and neurotoxicity.[10] Chronic CNS effects may include ataxia, tremors, visual impairment, deafness, and neurobehavioral abnormalities.[8]

The NIOSH REL for toluene is 100 ppm for an 10-hour TWA.[3] NIOSH has also set a recommended STEL of 150 ppm for a 15-minute sampling period. The OSHA PEL for toluene is 200 ppm for an 8-hour TWA and 300 as a ceiling limit.[5] The recently adopted ACGIH TLV is 50 ppm for an 8-hour average exposure level.[4] This ACGIH TLV carries a skin notation, indicating that cutaneous exposure contributes to the overall absorbed inhalation dose and potential systemic effects.

Heptane

Heptane is a volatile, flammable liquid at standard temperature and pressure. The industrial uses of heptane include serving as a fuel and solvent, as a raw material in organic chemical synthesis, and as a component in gasoline and some refined petroleum distillate fractions.[6]

Inhalation of n-heptane can cause loss of appetite, nausea, vertigo, incoordination, giddiness, and other symptoms of CNS depression.[6] Dermal contact is capable of producing immediate irritation.[6] The symptoms associated with n-heptane-induced CNS depression appear to be reversible acute effects as opposed to chronic neurotoxic effects.

The OSHA PEL and ACGIH TLV for n-heptane is 400 ppm TWA over an 8-hour workshift, with a corresponding STEL of 500 ppm averaged over 15 minutes.[5,4] The NIOSH REL for n-heptane is 85 ppm TWA over 10-hours and the NIOSH STEL is 440 ppm for a 15-minute duration.[3]

Trichloroethylene

TCE is a colorless liquid that is used as a degreasing solvent, a chemical intermediate, and in the dry cleaning industry.[6] The primary route of occupational exposure is inhalation, but dermal exposure is also mildly irritating to the skin. TCE acts primarily as a CNS depressant, eliciting effects such as headaches, dizziness, fatigue, and vertigo.[6]

NIOSH considers TCE to be a potential occupational carcinogen and recommends a REL of 2 ppm (as a 60-minute ceiling) during the usage of TCE as an anesthetic agent and 25 ppm (as a 10-hour TWA) during all other exposures.[10] The OSHA PEL for

TCE is 100 ppm TWA with a ceiling of 200 ppm.[5] The ACGIH TLV for TCE is 50 ppm with a corresponding STEL of 100 ppm.[4]

Ethyl Ether

Ethyl ether is a colorless liquid used in the manufacturing of dyes, plastics, and cellulose acetate rayon; it is also used as an anesthetic.[6] Ethyl ether is irritating to the skin and its vapors are irritating to the eyes. Acute overexposure to ethyl ether results in vomiting, headaches, and respiratory tract irritation.[6]

The OSHA PEL and ACGIH TLV for ethyl ether is 400 ppm TWA over an 8-hour workshift, with a corresponding STEL of 500 ppm.[5,4] A NIOSH REL for ethyl ether has not yet been determined.

Total Hydrocarbons

Total hydrocarbon results cannot be compared to any relevant evaluation criteria because none exist. However, OSHA, NIOSH, and ACGIH have evaluation criteria for Stoddard solvent (a similarly refined petroleum solvent). The 8-hour TWA criteria for Stoddard solvent are as follows: the OSHA PEL is 2900 milligrams per cubic meter of air (mg/m^3) the NIOSH REL is 350 mg/m^3 with a 15-minute ceiling of 1800 mg/m^3, and the ACGIH TLV is 525 mg/m^3.[5,3,4]

RESULTS

Six thermal tube area air samples were collected; three were collected in the filling room and three were collected in the water bath room. Analysis of these tubes identified the major compounds present as propylene glycol, methanol, and TCE. Other compounds included toluene, xylene, methyl ethyl ketone, ethyl ether, ethanol, acetone, isopropanol, and butyl cellosolve.

Five PBZ air samples were collected on IKI employees, including the two QC techs. Based upon results from the thermal tubes, the personal air samples were analyzed for toluene, heptane, trichloroethylene, ethyl ether, and total hydrocarbons. Propylene glycol and methanol could not be analyzed from the charcoal tubes due to differing analytical methodologies. Results for all sampled substances indicate concentrations below evaluation criteria (**Table 1**). Trichloroethylene levels were higher for the two QC techs than the other three employees sampled; however, the results were still well below occupational exposure criteria. Total hydrocarbon levels were much lower than relevant evaluation criteria for Stoddard solvent.

Ambient levels of ether were measured using a Dräger pump with a colorimetric detector tube. The areas sampled included the water bath room, in the filling room near the filling machine, near the crimper, and on the line after the cans leave the shaker. Colorimetric readings were well below 100 ppm for all samples.

DISCUSSION & CONCLUSIONS

Exposures to the substances sampled were below occupational exposure limits on the day of the survey. Although propylene glycol and methanol were not specifically monitored, the other air sampling results combined with the lack of health concerns among employees, suggest that exposures are not at levels that are associated with clinical effects (signs or symptoms) in humans. The results from the QC technicians, who do not participate in the job rotation, did not indicate any difference in exposure compared with rotating employees. Conversations with employees did not indicate the presence of a concern with health effects related to working on the filling line, such as headaches and dizziness described in the HHE request.

Occasionally, a problem occurs on the filling line, such as a leaking can or a machinery malfunction that overfills a can. When one of these events occur, employees have been instructed to leave the area until a trained mechanic or QC technician can repair the machinery. Removing employees from the area of a leaking or over-flowing can will limit their exposure to the potentially hazardous ingredients of

the Heet® windshield de-icer. In addition, clear plastic shielding has been erected in front of the filling machine and surrounding the shaker machine to avoid sprays reaching the employees from punctured or over-filled cans.

The work practices of IKI employees, in combination with safeguarding in place on the filling line, limit potential exposures to toluene, heptane, TCE, ethyl ether, and hydrocarbons in general.

RECOMMENDATIONS

The following recommendations are provided to further reduce employee exposures and improve working conditions:

1. Although all air sample results were below relevant evaluation criteria, air sampling should be conducted when there is a process change such as new machinery or new filling products being used or when employees express health concerns potentially related to workplace exposures.

2. The safeguarding in place on the filling line serves to protect the workers from inadvertent sprays or leaks from damaged or over-filled cans. However, employees should still be instructed not to stand near those areas where splashes are more likely to occur, such as the can shaker and the filler.

3. Communication between management and employees should be expanded through the existing safety committee. It should be appropriately supported with resources and meet on a regular basis. The responsibility of the committee should include involvement in decisions on appropriate interventions affecting employees. Communication is key to addressing health and safety concerns as they develop.

4. When the QC technician stationed in the filling room performs a pressure check on a can, the valve nozzle is removed. Upon completing the check, the nozzle is replaced, resulting in the can spraying some of the product. It should be reinforced that the nozzle should be pointed away from the QC technician to avoid spraying aerosol at themselves.

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Table 1. PBZ Sampling Data
IKI manufacturing, Edgerton, Wisconsin
HETA 2001-0150-2917
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Analyte sampled	Concentration Range	Evaluation Criteria
Toluene	0.0025 - 0.0186 ppm	NIOSH REL 100 ppm OSHA PEL 200 ppm ACGIH TLV 50 ppm
Heptane	0.0045 - 0.03 ppm	NIOSH REL 85 ppm OSHA PEL 400 ppm ACGIH TLV 400 ppm
Trichloroethylene	0.045 - 1.5 ppm	NIOSH REL 25 ppm OSHA PEL 100 ppm ACGIH TLV 50 ppm
Ethyl ether	0.034 - 0.054 ppm	NIOSH REL undetermined OSHA PEL 400 ppm ACGIH TLV 400 ppm
Total Hydrocarbons	0.45 - 8.4 mg/m^3	As Stoddard solvent: NIOSH REL 350 mg/m^3 OSHA PEL 2900 mg/m^3 ACGIH TLV 525 mg/m^3

ppm = parts per million
mg/m^3 = milligrams contaminant per cubic meter of air
NIOSH REL = recommended exposure limit
OSHA PEL = permissible exposure limit
ACHIG TLV = threshold limit value

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