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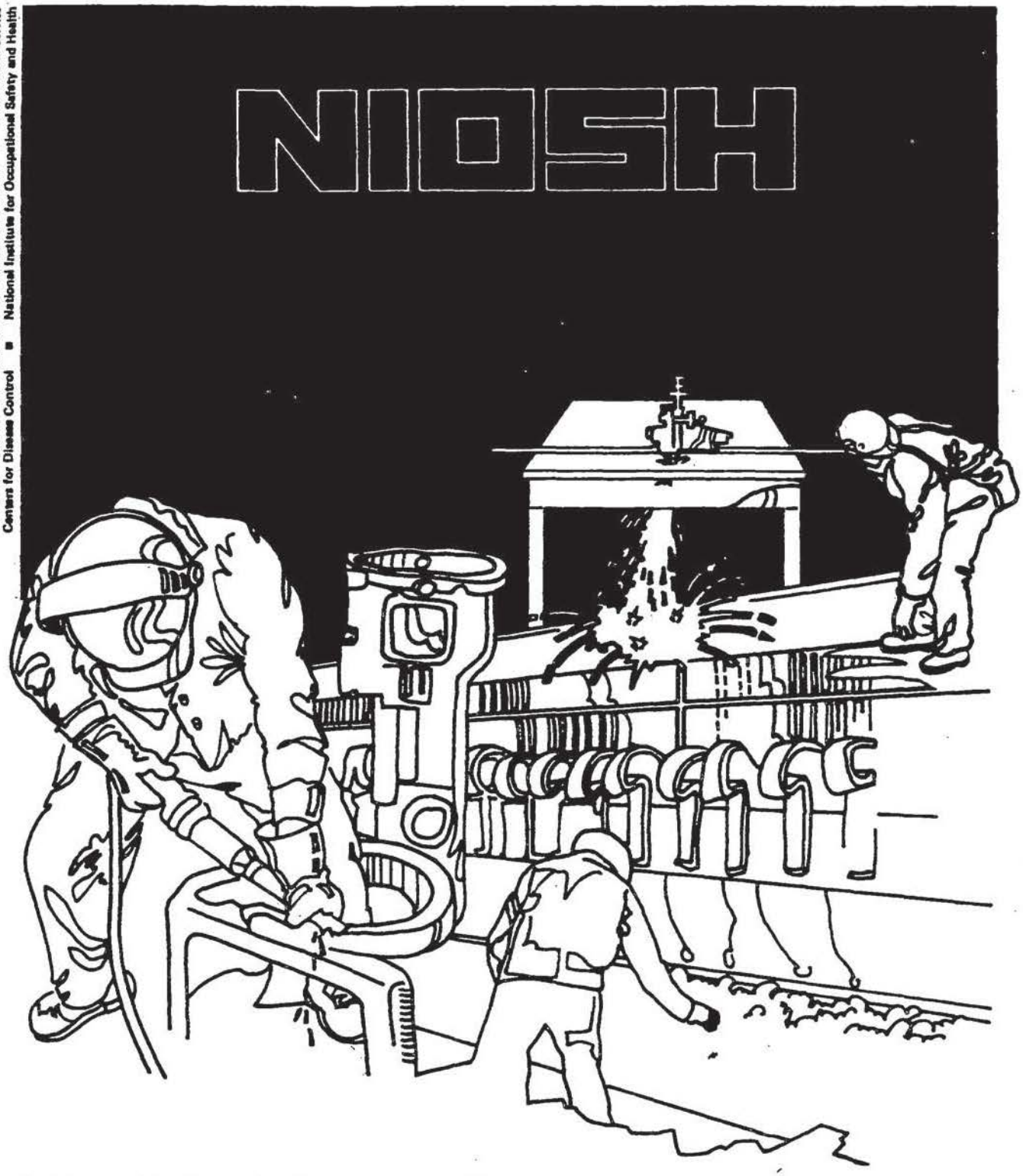

Health Hazard Evaluation Report

HETA 81-277-1089
INDIANA ARMY AMMUNITION PLANT
CHARLESTOWN, INDIANA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of 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 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.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) 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.

HETA 81-277-1089
APRIL 1982
INDIANA ARMY AMMUNITION PLANT
CHARLESTOWN, INDIANA

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SUMMARY

On April 13, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation at the Indiana Army Ammunition Plant (IAAP), Charlestown, Indiana. The request, which was submitted by an authorized representative of the International Chemical Workers Union, Local 692, stated that production workers were exposed to dibutyl phthalate (DBP) and that there was concern that this could cause adverse reproductive health effects.

On July 9, 1981, a NIOSH medical epidemiologist visited IAAP. A walk-through survey of pertinent areas was conducted and representatives of management and employees were interviewed. No definite reports of adverse reproductive outcomes were obtained.

On September 4, 1981, an environmental survey was performed in the production area where propellant containing DBP was processed. Personal and area samples for DBP and total and respirable dust were collected. Of the 4 samples collected for DBP (1 breathing zone and 3 area samples), one area sample contained DBP in an amount corresponding to an air concentration of 0.08 mg per cubic meter of air. The other three samples had showed levels of DBP below the limit of detection (0.01 mg/sample). The current OSHA standard for DBP is 5 mg/M^3.

The results of this survey show that employees are exposed to levels of dibutyl phthalate well below current standards. It is highly unlikely that the concentrations of dibutyl phthalate present in the work environment constitute a reproductive hazard. However, since the levels at which reproductive effects occur in humans are unknown, attempts should be made to further reduce exposure to dibutyl phthalate.

Recommendations to further control exposure are presented in Section VII of this Report.

KEY WORDS: SIC 3483, ammunition loading and assembly workers, dibutyl phthalate, reproductive hazards

II. INTRODUCTION

On April 13, 1981, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate possible adverse health effects among workers at the Indiana Army Ammunition Plant (IAAP), Charlestown, Indiana. The request, which was submitted by the International Chemical Workers Union, Local 692, stated that workers at IAAP were exposed to dibutyl phthalate, a substance that has been shown to cause birth defects in laboratory animals, and expressed concern that the exposed employees may be at increased risk of suffering adverse reproductive health effects.

Two Interim Reports pertaining to this evaluation have been issued, in July 1981, and November 1981.

III. BACKGROUND

The Indiana Army Ammunition Plant (IAAP) is approximately 40 years old and covers an area of more than 11,000 acres. The plant is owned and managed by the U.S. Department of Defense; however, since 1972 production has been contracted to ICI of Americus, Incorporated. IAAP manufactures ammunition in the form of cartridges and the number of employees varies with the current demand for the products. During periods of high demand the plant has had up to 20,000 employees, the current number is approximately 1600.

At IAAP dibutyl phthalate (DBP) has been used for several decades as a stabilizing substance incorporated in one of the propellants processed at the plant. Although the plant currently only handles the finished propellant and none of its constituents separately, there was concern among the employees that the dust from processing the propellent may contain DBP in concentrations high enough to cause adverse reproductive effects in exposed workers.

IAAP obtains bulk amounts of propellant from the Radford Army Ammunition Plant in Radford, Virginia. Only one of these contains DBP, at a concentration of 3 %. Approximately 25,000,000 lb. of this propellant are processed yearly.

The propellant is in the form of cylindrical pellets of various sizes, and is delivered to the plant in 150 lb. sealed fiber drums. The drums are opened and the contents dumped into holding bins. The pellets are gravity fed into cylindrical cloth bags, which are weighed, packed by vibrator and then sealed by sewing. These processes are usually performed manually and during the weighing, the operator may have skin contact with the propellant. The bags are then wrapped in corrugated paper and sealed in metal drums for transportation to storage facilities.

IV. EVALUATION DESIGN AND METHODS

MEDICAL

On July 9, 1981, a NIOSH medical epidemiologist visited IAAP in response to the request. A walk-through survey of pertinent areas was conducted and representatives of management and employees were interviewed. Information was sought concerning possible adverse reproductive and other health effects that had occurred among the employees, present and past production and usage of chemicals, changes in the production process and environmental controls, and the demographic characteristics and turn-over rate of the work-force.

ENVIRONMENTAL

On September 4, 1981, 4 DBP samples (3 area and 1 breathing zone) and 4 area dust samples (2 total dust and 2 respirable dust) were collected at load line 6 B, booths 2, 7, and 8. Since the propellant was known to contain only 3% DBP by weight, area high-volume air sampling techniques were used, since this technique would maximize the chance of detecting DBP in the samples. Although area sampling may not be directly representative of employee exposure, it does give an indication of maximum exposure.

DBP was collected on AA filters (0.8 u pore size), using constant flow sampling pumps calibrated at 1-2 liters per minute. The quantity of DBP on the filters was determined by gas chromatography according to the modified NIOSH method S-33 (Appendix A). Respirable and total dusts were collected on pre-weighed filters. The respirable dust samples were obtained using a 10 mm cyclone separator with a flow rate of 1.7 liters per minute.

The amounts of respirable and total dust were determined by weighing the filters and samples on an electrobalance and subtracting the previously measured tare weights of the filters.

V. EVALUATION CRITERIA

Dibutyl phthalate (DBP, $C_{16}H_{22}O_4$) is a viscous liquid with a molecular weight of 278.34 and a vapor pressure of 2 mm Hg at 150° C. It is compatible with a great number of resins and is widely used as a plasticizer for cellulose containing compounds. DBP is also used in leather varnishes and mixed lacquers and in clothing as an insect repellent. It is not absorbed through skin and enters the body only by ingestion or inhalation.

DBP has been widely used for several decades and until a few years ago its toxicity, apart from mucous membrane irritating properties, was considered low. Due to its low vapor pressure, inhalation of significant amounts can only occur by spray or mist exposures. The wide-spread use of DBP as an insect repellent during WW II did not result in reports of toxic effects. No carcinogenic effects have been observed in animal studies. The current OSHA standard is 5 mg/M^3 (TWA).

However, during the last few years studies have shown that DBP induces birth defects and testicular atrophy when administered to laboratory animals in relatively high oral doses[1]. The testicular effects of DBP may be exerted by an interference with zinc metabolism; the concurrent administration of zinc has been shown to protect DBP exposed animals from developing testicular atrophy.

Among workers exposed to DBP, women in the synthetic leather industry have reported higher incidence of spontaneous abortions and menstrual disorders in Russian studies[1]. Reduced gestation and anovulatory cycles were also observed in these studies in women occupationally exposed to DBP[4]. The air-levels of DBP at which these effects occurred are not known but were probably in excess of 10 mg/M^3. The studies also indicated that multiple exposures among the women were common, and the characteristics and origins of the referent groups used for determination of excess risk were not clearly stated.

VI. EVALUATION RESULTS AND DISCUSSION

At the time of the evaluation there were 1567 hourly employees at the plant, approximately 50 % were women. The proportion of various racial groups was not determined. Due to the drastic decrease in the number of employees during the last few years, the median age was high, about 50 years and the turn-over low. Due to considerable mobility between various production areas it is impossible to determine the exact number of workers with potential DBP exposure.

The plant does not currently have a policy of removing pregnant employees from production areas with potential exposure to DBP. Such a policy was in effect during a short period of time but was rescinded based on results of personal sampling performed by ICI. Two samples in the packing-room showed total dust levels of 3 mg/M^3.

Since the pellets are in a sealed bag during most of the process, only the persons involved in measuring, packing and sewing the bags would have the potential for exposure to DBP. In the area that was investigated, most of the 30-40 employees engaged in these tasks were women, and according to reports from both management and union, 70-80 % of the employees with possible exposure are women. In the past, the number of employees exposed to DBP containing propellents may have been far greater.

Neither management nor union representatives had received reports of definite reproductive or other health effects among the production employees that could be associated with exposure to DBP. One infant death, reportedly due to respiratory disease, had occurred among the offspring of the female employees.

The environmental controls in the packing-room consist of a re-circulating system where the air passes through filters. It had not been altered or improved during the last few years and the production process has been virtually unchanged since the plant was built. The production areas are air-conditioned and the employees are provided with coveralls and other protective equipment. Respirators were not used in the packing-room. Smoking is obviously not allowed in the production areas.

DBP was non-detectable (limit of detection of 0.01 mg/sample) except for one area sample in Booth #2 which contained DBP corresponding to an air level of 0.08 mg/M^3 (Table 1). All three area samplers were positioned at the weigher location in the booths, since that would probably be the location with the highest levels of DBP.

Total dust/respirable dust concentrations in Booths 7 and 8 were 0.35/0.09 and 0.95/0.16 mg/M^3 respectively (Table II), indicating that approximately 20 % of the dust sampled was of respirable size.

DBP, total dust, and respirable dust were well below respective OSHA 8 hour standards (5 mg/M^3 for DBP and respirable dust and 15 mg/M^3 for total dust). As stated earlier the DBP standard does not consider the teratogenic effects that have been associated with exposure. Accordingly, the standard may not be appropriate in this case. The concentrations at which DBP causes reproductive effects in laboratory animals is quite high, in excess of 200 mg/kg body weight, and the concentrations at which exposed women experienced increased incidence of spontaneous abortions and menstrual disorders occurred in an occupational environment, the synthetic leather industry, where air levels of DBP may have been in excess of 10 mg/M^3. It is also likely that these women had other exposures with potential reproductive effects.

Due to lack of information regarding at which levels of exposure reproductive effects may occur, it is impossible to determine whether the employees at IAAP are at increased risk of experiencing adverse reproductive outcomes. While it is possible that current airlevels of DBP in the area surveyed present a reproductive hazard to exposed employees, this appears unlikely in view of the limited exposure.

The paucity of reported reproductive health effects indicate that an epidemiologic study of the workers at IAAP regarding spontaneous abortions and birth defects most likely would yield inconclusive results.

In addition, due to the relatively high background incidence of adverse reproductive outcomes in the general population, the exposure to DBP would have to have dramatic effects for it to be demonstrated in an epidemiologic study in a population of such small size, limited exposures, and low incidence of pregnancy. However, due to the possibility that the current levels of DBP may still present a reproductive hazard, vigorous attempts should be made to further decrease concentrations of dust containing DBP.

VII. RECOMMENDATIONS

1. During the evaluation it was observed that compressed air was used to clean work areas. This practice may cause high exposure to dust and should thus be eliminated. It is recommended that a vacuum system be used instead.

2. It was noted during the survey that one of the propellant barrels caused a 2-3 inch spark against the concrete floor when handled in the upper aisle. Due to the highly explosive characteristics of the propellant, grounding of all processing equipment with conductive potential should be mandatory.

3. In order for the air circulation system in the booths to be effective, the system must be cleaned and the filters changed regularly.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENT

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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 ninety (90) days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

International Chemical Workers Union, Local 692
Indiana Army Ammunition Plant
ICI of Americus, Incorporated
U.S. Department of Labor, Region V
NIOSH Region V
Designated State Agencies

For the purpose of informing the employees, the employer will promptly "post" this report for a period of thirty (30) calender days in prominent places near where the employees work.

X. REFERENCES

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TABLE I

DIBUTYL PHTHALATE RESULTS
INDIANA ARMY AMMUNITION PLANT
SEPTEMBER 4, 1981

LOCATION/ JOB DESCRIPTION	SAMPLE TYPE	SAMPLE VOLUME (L)	SAMPLE TIME	CONCENTRATION mg/m^3(1)
Load Line 6B				
Booth 7	Area	257	1047-1504	ND(2)
Booth 8	Area	262	1051-1513	ND
Booth 2	Area	502	1059-1510	0.08
Material Handler Upper Aisle	Breathing Zone	205	1057-1155 1235-1502	ND
OSHA Standard (8 hour TWA)				5.0(3)

(1) mg/m^3: milligram of DBP per cubic meter of air
(2) ND: Non-detectable, Limit of detection: 0.01 mg/sample
(3) Teratogenic effects not considered in setting this level. reference ACGIH TLV documentation.

TABLE II

AREA DUST RESULTS
INDIANA ARMY AMMUNITION PLANT
SEPTEMBER 4, 1981

LOCATION	SAMPLE TYPE	SAMPLE VOLUME (L)	SAMPLE TIME	CONCENTRATION mg/m^3(1)
Booth 7	Total dust	514	1047-1504	0.35
Booth 7	Resp. dust	436	1047-1504	0.09
Booth 8	Total dust	524	1051-1513	0.95
Booth 8	Resp. dust	446	1051-1513	0.16
OSHA Standard	Total dust			15.0(2)
	Resp. dust			5.0(2)

(1) mg/m^3: milligrams of dust per cubic meter of air
(2) These standards do not consider possible reproductive health effects of DBP which is a component of the dust.

APPENDIX A

MODIFICATIONS TO NIOSH METHOD S-33 FOR DIBUTYL PHTHALATE

Desorption Process:	Somication for 15 minutes in 15 ml of CS_2
Chromatograph:	HP 5731 with FID
Column:	30m x 0.5 mm (ID) nickel WCOT capillary coated with AT 1000
Oven Condition:	200°C, isothermal
Other:	Splitless operation mode was used in the analysis.

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