U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
Cincinnati, Ohio 45226

HEALTH HAZARD EVALUATION DETERMINATION REPORT
HE 79-143-671

SHOREWOOD PACKAGING CORPORATION
FARMINGDALE, NEW YORK

MARCH 1980

I. SUMMARY

On September 25, and again on November 21, 1979, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation at the Shorewood Packaging Corporation in Farmingdale, New York, to evaluate possible hazards in the ultraviolet-cured coating operations of the offset print area. A comprehensive walk-through survey was conducted, ventilation measurements were taken, and non-directed medical questionnaire interviews were performed to determine possible employee exposures to phototoxic chemicals used in the coating process, and to ozone gas produced by ultraviolet lamps.

Detector tube samples for ozone exposure were taken at the breathing zone of the operators. A Gastec manual pump and ozone detector tubes (0.05-1.4 ppm range) were used for sampling. Air velocity measurements were taken at the local exhaust ventilation units used for exhausting ozone and any vapors of coating materials. An Alnor Sr. Velometer was used in conjunction with a MSA smoke tube assembly kit for this measurement.

On the basis of the data obtained in this investigation, NIOSH determined that a hazard of exposure to phototoxic chemicals existed at the Shorewood Packaging Corporation. Worker exposure to these chemicals had caused photosensitive reactions (burning, swelling, erythema, and dermatitis) to the skin, particularly to the hands and arms. Detector tube air samples did not detect any ozone gas in the workers breathing zone. As observed on a follow-up visit to this plant (November 21, 1979), improved work practices, hygienic measures, and medical treatment appear to have brought these problems under control. To assist in the control of this hazard, NIOSH recommendations are listed in the last section of this report.

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970*, NIOSH investigates the toxic effects of substances found in the workplace. The Amalgamated Lithographers of America Union, Local #1, requested such an investigation from NIOSH on September 10, 1979, to evaluate possible hazards present in the press areas using ultraviolet-cured coatings. Employees in the press room had experienced skin rashes since the advent of this new coating process and were very concerned about their health. NIOSH met with management and union representatives for the opening and closing conferences, performed a walk-through survey, and took ventilation measurements on September 25, and again on November 21, 1979. The second visit was requested by the union for the purpose of surveying a new press line that had recently opened. Discussions with management and union representatives involved the process description, engineering controls, personal protective equipment and clothing, work and hygiene practices, training programs, recordkeeping, medical surveillance, and air monitoring. Non-direct medical questionnaires were given to six employees.

III. BACKGROUND

The press room at Shorewood Packaging Corporation consisted of numerous offset printing lines, two of which used the new ultraviolet-cured coating process. In this new process, the ultraviolet-cured coating was offset to the final print, and then the print was cured under ultraviolet lamps. The use of the new coating allows a water solvent rather than organic solvent to be used in the inks. The process was enclosed, under negative pressure, and used local exhaust for ventilation.

Ultraviolet coatings consist of: (1) photoinitiators (benzophenone, amyl dimethylamino-benzoate) which are chemicals that, upon exposure to ultraviolet light, break down into active free-radical molecules capable of triggering a polymerization reaction, (2) oligomers (acrylated urethane polyester oligomer, acrylated epoxy resin oligomer) which are low molecular weight polymers that react with free radicals to form high molecular weight polymers, (3) monomers (trimethylol propane triacrylate, pentaerythitol triacrylate, 1,6-hexanediol diacrylate) which are chemicals that react with free radicals and oligomers to produce cross-linked polymer networks, and (4) fillers and additives (stabilizers, surfactants flattening agents, and polymerization inhibitors).

The curing process involves the adsorption of ultraviolet radiation (through medium pressure mercury arc lamps) by the photoinitiator, thus resulting in the generation of free radicals which, in turn, causes polymerization of the coating and top surface ink.[1,2,3]

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* Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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.

IV. EVALUATION DESIGN AND METHODS

Detector tube air samples for ozone and air velocity measurements were taken to ascertain whether problems from ozone exposure might be present near the ultraviolet curing operations. Ventilation measurements were also taken where local exhaust ventilation was used over the coating material reservoirs.

Detector tube samples for ozone exposure were taken at the breathing zone of the operators. A Gastec manual pump and ozone detector tubes (0.05-1.4 ppm range) were used. Air velocity measurements were taken at the local exhaust ventilation units used for exhausting ozone and any vapors of coating materials. An Alnor Sr. Velometer was used in conjunction with a MSA smoke tube assembly kit for this measurement.

V. EVALUATION CRITERIA[4,5]

Ozone is a gas that is irritating to the eyes and mucous membranes. Exposure to ozone may elicit the following symptoms: dryness of upper respiratory system; nose and throat irritation; choking, coughing, and severe fatigue; bronchial irritation; substernal soreness and cough; delayed pulmonary edema; and, in severe cases, fatal pulmonary edema. Chronic exposures to lab animals have shown that ozone may cause chronic bronchitis, bronchiolitis, emphysematous and fibrotic changes, aging effects, and increased susceptibliity towards lung cancer. Experimentally produced chromosomal aberrations have also been seen.[1,2,3,4,5,6]

ENVIRONMENTAL CRITERIA

Substance	OSHA	ACGIH	NIOSH
Ozone	0.1 ppm 8-hr TWA	0.1 ppm - 8-hr TWA 0.3 ppm - STEL	____

TWA = time weighted average
STEL= short-term exposure limit

In vivo studies show the acrylic monomers and oligomers to be allergic contact sensitizers, and in vivo and in vitro studies show the photoinitiators to be phototoxic. A sensitizer causes no visible changes on the skin following the first contact, but after several contacts, which may require days or months, it causes specific changes in the skin so that further contact on the same or other parts of the body will induce a dermatitis. Phototoxic chemicals are those that react with selected wavelengths of light (for example, ultraviolet) to cause a dermatitis. The effects upon the skin take the form of burning, itching, swelling, redness, dry or cracked skin, and eruptions or papules.

VI. RESULTS

Ozone detector tubes showed "none detected" in the breathing zones of the operators. Ventilation measurements showed 150 to 175 ft./min. exhaust velocity at point of emission of coating and ozone gas. The appearance of the skin on the fingertips and hands of workers, along with the employees' doctors' diagnoses, confirmed the phototoxicity problem of these materials. When the materials were first handled, precautions were not taken--no gloves were worn and soilage, frequent spillage, and poor hygiene habits were common. By the time of the second visit, conditions had improved largely through medical attention, improved hygiene, and the use of lanolin after hand washing.

VII. RECOMMENDATIONS[1,2,3]

In general, employees should avoid skin contact with the ultraviolet-cured coating materials. Specifically:

1. Safety glasses, impervious gloves, overalls or protective coats with long sleeves, and aprons (rubber/neoprene) should be used when handling coating materials or associated machinery. These items should be washed carefully before reuse.

2. If any of these substances come in contact with the skin, they should be removed immediately with a "gritty" soap followed by washing with a lanolin-based soap. This is important because of the speed at which these materials bind to the skin components. Under no circumstances should organic solvents (for example, toluene, methy ethyl, ketone, kerosene, xylene) be used for washing.

3. If employees are exposed, immediate and careful wash-up/showering and avoidance of sun exposure for 24 hours (or use of a sunscreen) will minimize the phototoxic reaction.

4. A medical surveillance program to screen out particularly "sensitive" individuals should also be implemented.

5. NIOSH also recommends that "effective" local exhausts (> 120 ft./min.) be used over all ultraviolet lamp banks (for ozone), coating material rollers, and reservoirs in order to capture any gases and vapors that could be given off.

6. Clear labeling of all containers of these materials should warn that skin contact may be hazardous.

7. Smoking, drinking, and eating should not be permitted near these materials or associated machinery.

8. The cured coating may still have uncured residuals on the final print surface--therefore, "feeling" the surface should be done with finger cots in order to avoid possible skin contact.

9. Although less effective, an alternative to rubber gloves is barrier creams.

10. An eyewash and/or safety shower should be located in a readily available area in case of splashes or spills of these materials.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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IX. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available, upon request, from NIOSH, Division of Technical Services, Publications Dissemination, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161.

Copies of this report have been sent to:

1. Shorewood Packaging Corporation
2. Amalgamated Lithographers of America Union, Local #1
3. NIOSH, Region III
4. OSHA, Region II

For the purpose of informing the "affected employees," the employer shall promptly "post" the determination report for a period of 30 days in a prominent place near where exposed employees work.

X. REFERENCES

1. HHE 75-106-247, Inmont Corporation, Paddock Road Facility, Cincinnati, Ohio, December 1975.

2. "Allergic Contact Dermatitis from Ultraviolet-cured Inks," Emmett and Kominsky, Journal of Occupational Medicine, Vol. 19, No. 2, February 1977.

3. "Phototoxicity Occuring during the Manufacture of Ultraviolet-cured Ink," Emmett and Kominsky, Arch. Dermatol., Vol. 113, June 1977

4. General Industry, OSHA Safety and Health Standards, 29 CFR OSHA 2206. Revised January 1976.

5. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1978, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

6. Industrial Toxicology, Hamilton and Hardy, Third Edition, Publishing Scineces Group, 1974.