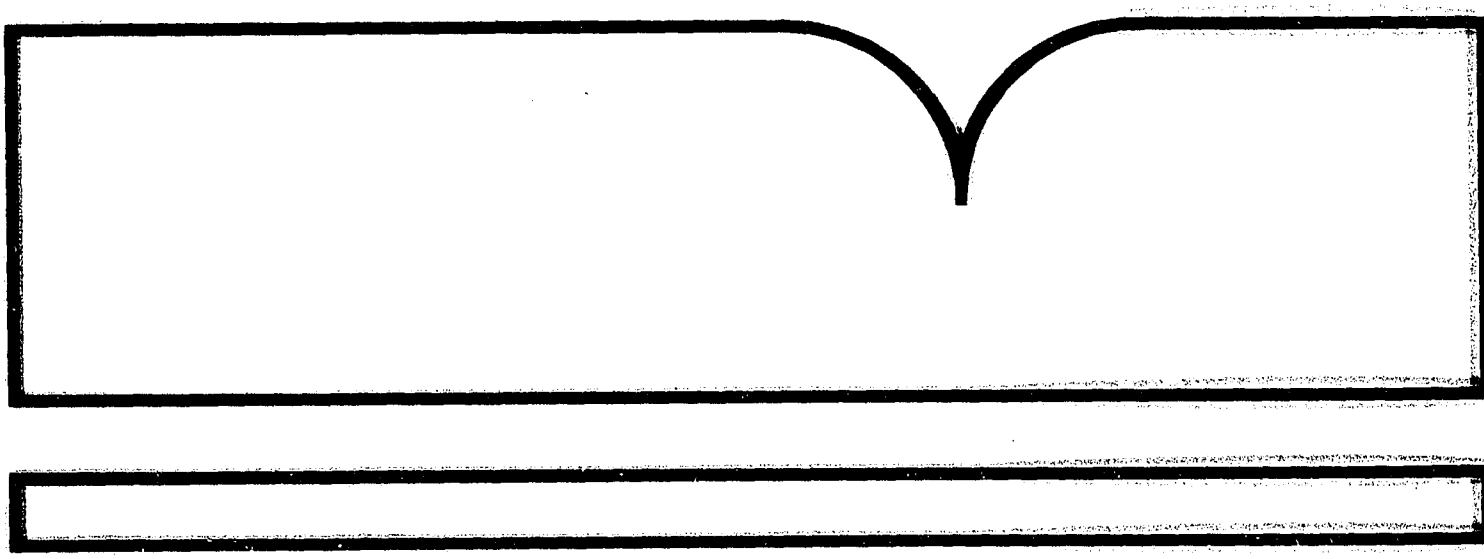
PB89-107775

Health Hazard Evaluation Report No. HETA-87-181-0000, Graphic Packaging Corporation, Paoli, Pennsylvania

(U.S.) National Inst. for Occupational Safety and Health, Cincinnati, OH

Jul 88



U.S. Department of Commerce
National Technical Information Service
NTIS

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. PB89-107775
4. Title and Subtitle Health Hazard Evaluation Report No. HETA-87-181-0000, Graphic Packaging Corporation, Paoli, Pennsylvania			5. Report Date 88/07/00 6.
7. Author(s) Crandall, M. S., and T. G. Wilcox			8. Performing Organization Rept. No. HETA-87-181-0000
9. Performing Organization Name and Address Division of Surveillance, Hazard Evaluations, and Field Studies, NIOSH, U.S. Department of Health and Human Services, Cincinnati, Ohio			10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered 14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

In response to a request from the United Paperworkers International Union, an evaluation was made of working conditions at the Graphic Packaging Corporation, Paoli, Pennsylvania. Particular attention was given to workers making microwave popcorn bags who reported swelling around the eyes and dermatitis. One employee also reported an asthma attack while working on the bags. Special water based epoxy adhesives were used for these bags as the product must withstand heating in a microwave oven. Environmental and personal breathing zone air samples were taken and medical questionnaires were filled out. Use of this adhesive was discontinued in May of 1987 and the symptoms have disappeared. Chemical analysis of the adhesive indicated the presence of several chemicals which are potential irritants or allergic sensitizers both to skin and the respiratory track. These irritants included formaldehyde (50000), acetaldehyde (75070), benzoic-acid (65850), 1,1,1-trichloroethane (79005), p-dioxane (123911), and ethyl-acetate (141786). Samples taken before the switch over to another adhesive was made did not indicate a hazardous level of any of these substances to be present.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

NIOSH-Publication, NIOSH-Author, NIOSH-Health-Hazard-Evaluation, NIOSH-Technical-Assistance-Report, HETA-87-181-0000, Region-3, Hazard-Unconfirmed, Assembly-line-workers, Contact-allergies, Allergic-reactions, Skin-exposure, Respiratory-system-disorders, Containers

c. COSATI Field/Group

18. Availability Statement	REPRODUCED BY U.S. DEPARTMENT OF COMMERCE NATIONAL TECHNICAL INFORMATION SERVICE SPRINGFIELD, VA. 22161	19. Security Class (This Report)	21. No. of Pages 12
		20. Security Class (This Page)	22. Price

(See ANSI-Z39.18) See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

HEALTH HAZARD EVALUATION REPORT
HETA 87-181-0000
GRAPHIC PACKAGING CORPORATION
PAOLI, PENNSYLVANIA
JULY 1988

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, Ohio 45226

HETA 87-181-0000
JULY 1988
GRAPHIC PACKAGING CORPORATION
PAOLI, PENNSYLVANIA

NIOSH INVESTIGATORS:
Michael S. Crandall, CIH
Thomas G. Wilcox, M.D.

On March 5, 1987, the National Institute for Occupatioal Safety and Health (NIOSH) received a request on behalf of the United Paperworkers International Union, to evaluate conditions at the Graphic Packaging Corporation in Paoli, Pennsylvania. The request was prompted by reports that several of the workers on the the production lines making microwave popcorn bags, the "popcorn lines," had experienced swelling around the eyes and dermatitis, and one employee had had an attack of asthma while working on those manufacturing lines.

The Graphic Packaging Corporation produces packaging material for numerous products and there are over 30 production lines in the plant. The production of microwave popcorn bags on 4 popcorn lines began in August 1986. Because the bags had to withstand being heated in a microwave oven, special water-based epoxy adhesives (H. B. Fuller #'s WB-3490 & WB-3499) were used to make the bags on the popcorn lines. The management reported these adhesives were not used in other production areas of the plant.

An initial visit was conducted on March 9, 1987 by NIOSH personnel Michael Crandall, CIH, and Thomas Wilcox M.D. During that visit the situation was discussed with union representatives, Graphic Packaging Management, and with representatives of the H.B. Fuller Co., the supplier of the adhesives used in the popcorn bag manufacturing process. Following this meeting, a walkthrough inspection of the plant was conducted, workers on the popcorn lines were interviewed, and discussions concerning the clinical presentation of the skin and respiratory conditions experienced by plant workers was discussed with the plant physician. In addition, air samples and bulk samples of the adhesives were obtained and submitted for analysis to the NIOSH analytical laboratory. Since rash and asthma have been reported to be caused by substances that are commonly found in epoxy resin systems, we considered it possible that the health effects experienced by the GP employees could be due to constituents of the special epoxy adhesive used on the popcorn line. In a letter of March 17, 1987 we advised that symptomatic workers be assigned to areas of the plant well removed from the popcorn lines. We also recommended the enforcement of good work practices on the popcorn lines that would minimize exposure of the remaining workers to the adhesive.

On April 14-15, 1987, a follow-up site visit was conducted at the Graphic Packaging Company. During that visit environmental air samples for constituents in the adhesives were collected. In addition to the environmental sampling, medical questionnaires were completed by 41 employees of Department 20, the bag production department at Graphic Packaging. Questionnaires were also filled out by 17 chute tenders who worked on all the bag production lines in the plant, including the four popcorn line machines.

Also, seven of the 21 employees of the steel tie section (Department 25) filled out questionnaires. The brief questionnaire inquired as to demographic information, (age, race, time having worked at the plant) and about any episodes of swelling of the tissues surrounding the eye or any rashes that the employees had experienced since April 1986. It also inquired as to any respiratory symptoms, such as shortness of breath or wheezing that the employees may have experienced since April of 1986.

Environmental Evaluation: Prior to the first NIOSH visit, the only contaminant which had been suspected was ozone (thought to be created by the electric arc in the corona treater). None was detected when monitoring was conducted by the company in February 1987. The local exhaust ventilation installed around the treater appeared to work effectively.

Because of the nature of the reported and observed symptoms (contact dermatitis and allergic responses of the skin and respiratory tract), it was postulated that both skin contact and inhalation exposures could be occurring to one or more toxic agents. The only potential exposure which appeared to be unique to this area of the plant was to the epoxy adhesives used in this process. The workers had a potential for skin contact with the adhesives and could inhale or have a skin exposure to its vapor.

During the initial survey, two air samples were collected on activated charcoal. One sample was collected over the adhesive pan where the film and paper portions of the bag are laminated (duplexing). The other air sample was collected over the heated drum roller where the two layers and a metalized-film patch were pressed together. In the laboratory these samples were desorbed with carbon disulfide and screened by gas chromatography (GC) using a flame ionization detector (FID). Further analysis by GC and mass spectrometry (MSD) was used to identify components.

Two bulk samples of the liquid adhesive were collected in glass jars for qualitative analyses. The bulk glues were analyzed two different ways. Portions of each were extracted directly with various solvents (CS_2, ethanol, tetrahydrofuran) and the extracts screened by GC-FID (DB-1 capillary column), with further analysis by GC-MSD.

Separate portions of the bulks were also heated (80-100°C) in a tube furnace. The oven effluent was sampled with ORBO-23 tubes as an aldehyde screening technique. Generated ORBO-23 samples were desorbed with toluene then screened by GC-FID (DB-WAX capillary column), with further analysis by GC-MSD to confirm the presence of certain aldehydes. While heating the bulks in the furnace, a clear liquid condensate formed on the oven tubing. This condensate was analyzed directly by GC-MSD.

Major organic solvent components of the qualitative charcoal tube analyses were ethyl acetate, 1,1,1-trichloroethane, and p-dioxane. These were not suspected to be from the adhesive, but from other plant sources. Compounds which were found in the qualitative analyses of the bulk liquid samples of the adhesive, and not included in a list of proprietary components provided to NIOSH by the manufacturer, were formaldehyde, acetaldehyde, and benzoic acid. The benzoic acid was found in appreciable amounts in the condensate from the furnace analyses. It is suspected that it was a reaction product from one of the proprietary ingredients possibly formed when the glue was subjected to heat.

Since the symptoms reported in the worker population may have been related to exposure to the compounds found in the proprietary paste, attempts were made to measure formaldehyde, acetaldehyde, benzoic acid, the proprietary components of the adhesive, and the three organic solvents during the follow-up evaluation. This follow-up evaluation was conducted on April 14, 1987. At that time, there was only one popcorn bag line in operation. The sampling strategy used during this survey was to collect air samples near the most likely emission points for the process, since high concentrations of air contaminants were not expected. Three points were chosen. These were: near the duplex adhesive roller, near the heated drum following duplexing, and near a heated metal block which makes a seam in the bag. The duplex roller is the point where the greatest amount of adhesive is used in the process. The other two points are where heat is used, which could drive vapor from the adhesive.

Seven different sampling media were used at each sampling point. There were eleven compounds of interest. Five of these were identified in the proprietary adhesive formula provided to NIOSH by its manufacturer. Air concentrations of these five compounds were not detected during the evaluation. Therefore sampling methods and results for these compounds will not be discussed. This letter will discuss the methods and results for the other six compounds (formaldehyde, acetaldehyde, benzoic acid, ethyl acetate, 1,1,1-trichloroethane, and p-dioxane).

Environmental Sampling Methods

Formaldehyde

Three air samples for formaldehyde were collected and analyzed using NIOSH Method 3500. Air was drawn through a glass impinger, containing 20 milliliters (ml) of a 1% sodium bisulfite solution, at a flow rate of 0.75 liters per minute (lpm). The samples were analyzed by visible spectroscopy. Color was developed by adding 0.1 ml of chromotropic acid and 6 ml of concentrated sulfuric acid to a 4 ml aliquot of the collected sample. The limit of detection (LOD) for the method was 0.3 micrograms per sample (ug/sample) and the limit af quantitation (LOQ) was 1.0 ug/sample. Values falling between these values are semi-quantitative data. The average sample volume was 205 liters (range, 190 to 215 l).

Acetaldehyde

Three air samples for acetaldehyde were collected on XAD-2 solid sorbent, coated with 5% dinitrophenyl hydrazine hydrochloride (DNPH), at a flow rate of 0.55 lpm. For analysis, the samples were transferred to scintillation vials and desorbed for 1 hour in 3.0 ml acetonitrile. The samples were then filtered through 0.45-um PTFE filters (Acrodisc-CR) directly into high pressure liquid chromatography (HPLC) sampling vials. The samples were then analyzed by HPLC using an ultraviolet detector (365 nanometers). The LOD for the method was 4.3 ug/sample and the LOQ was 13 ug/sample. The average sample volume was 175 liters (range, 161 to 184 l).

Benzoic Acid

Three air samples for qualitative analysis for benzoic acid were collected using 13-millimeter glass fiber filters followed by ORBO-42 sorbent tubes. Air was drawn through this apparatus at a flow rate of 0.75 lpm. The filters and solid sorbent were desorbed separately with 1 ml methanol in an ultrasonic bath for 30 minutes. Sample solutions were then analyzed by gas chromatography using a 15 meter DB-5 fused silica capillary column (splitless mode) and a flame ionization detector (FID). It should be noted that this method was not developed for benzoic acid. There is no NIOSH method for this compound. It was being used to detect two other compounds which were listed as proprietary and it was thought that it may also work for benzoic acid.

Organic solvents

Three air samples for ethyl acetate, 1,1,1-trichloroethane, and p-dioxane were collected and analyzed using NIOSH Methods 1003 and 1602 with modifications. The samples were collected on standard 150 mg charcoal tubes at a flow rate of 0.55 lpm. For analysis, the charcoal was desorbed for 30 minutes in 1.0 ml carbon disulfide containing 1 ul of benzene as an internal standard. The samples were analyzed by GC/FID. The GC used a 30 m x 0.32 mm fused silica capillary coated internally with 0.50 um of DB-WAX. The oven temperature was 35 °C (isothermal). The LOD for all three analytes was 0.01 mg/sample and the LOQ for all analytes was 0.04 mg/sample. The average sample volume was 170 liters (range, 153 to 187 l).

Sample results for all environmental air samples are presented in Table 1. All results were low. The results for the three solvents were uniform for all three sample locations and were most likely background concentrations for the plant (0.2 parts per million for 1,1,1-trichloroethane and p-dioxane, and 3.0 ppm for ethyl acetate). The results for the aldehydes appeared to be related to sample location. Both the formaldehyde and acetaldehyde concentrations at sample location 1, near the duplexing, were greater than the concentrations found at the other two locations. At sample location 1 the formaldehyde concentration was 0.19 parts per million (ppm) and the acetaldehyde concentration was 0.56 ppm. Otherwise, the concentrations of both were in the 0.03 to 0.04 range. Benzoic acid was not detected on any of the samples. However, these negative results for benzoic acid are inconclusive due to suspected stability problems with the standards used in the analysis.

Medical Results: During the initial visit, it was reported that in the period from August 1986 to March 1987, the popcorn lines had employed 20 operators and 6 machine adjusters who worked in close proximity to the package forming portion of the package line (electrostatic treater, steam drum, paste tray, etc.). The first report of a skin disorder in an employee who worked on the popcorn lines was recorded on December 16, 1986. At that time an adjuster for the popcorn machines was seen with rash and swelling around the eyes, and diagnosed as having a contact dermatitis. On February 12, 1987 an employee (with no previous history of asthma) experienced an attack of asthma while working on the popcorn line. In addition, on March 5, 1987, an employee from another area of the plant experienced a generalized urticarial reaction (hives) after spending about 5 minutes near one of the popcorn machines. Because of the illnesses experienced by workers while in proximity to the popcorn lines, on March 5, 1987 NIOSH was requested to conduct a health hazard evaluation. Since that time, three additional machine operators or adjusters employed on the popcorn line had been seen for rash with the most serious involvement being around the eyes.

At the time of the initial visit, 6 workers had been reported to have experienced skin or respiratory symptoms associated with presence in the area near the popcorn lines. Two of the employees with a history of rash around their eyes, reported that they had also had a papular rash ("little red bumps") on their arms. Two of the employees with skin involvement also reported that they had again experienced similar skin reactions when they returned to work on the popcorn line, after their initial rashes had cleared, while they worked elsewhere in the plant. During the first shift of the week that he returned to the popcorn line, one of these workers had experienced a burning sensation of the eyelids, followed by swelling of the tissues surrounding his eyes. The other worker did not experience symptoms the first day back to work on the popcorn line, but as the week progressed he developed a periorbital rash and swelling.

During the follow-up visit, forty-one of the fifty-one people who were currently working in Department 20 completed questionnaires. (Department 20 is the location of the popcorn line machines) Of the 41 Department 20 employees responding, 12 (29%) had experienced episodes of periorbital (around the eyes) swelling. In nine of these affected employees, the periorbital swelling was accompanied by reddening of the skin on their eyelids. Eleven of the twelve experienced periorbital swelling only when working in close proximity to the popcorn bag machines. One employee reported experiencing an inflammatory rash of the eyelids while working in the popcorn line area that was not accompanied by periorbital swelling. Seven workers who reported experiencing one or more episodes of periorbital swelling also reported that they had experienced marked symptoms of eye irritation, (burning, itching, and/or watering of the eyes) while at the Graphic Packaging Plant. Six of these seven people experienced the eye irritation only while in the area of the popcorn machines, while one experienced eye irritation throughout the plant.

Three Department 20 employees reported experiencing rashes of the arms, hands, or face, without periorbital swelling or eyelid involvement. Two of these employees did not associate the occurrence of their rash with work on any specific product line, while one had experienced his rash while working on the popcorn line machines.

Three Department 20 employees reported experiencing respiratory symptoms during the previous 12 months that were associated with work on the popcorn lines. During the winter of 1986-87, one employee, who had never experienced any skin symptoms while working on the popcorn lines, experienced a severe attack of asthma (no prior history of asthma) while working on the popcorn lines. The attack resolved with medical therapy and transfer to another section of the plant. This employee reported subsequently experiencing milder respiratory symptoms when he worked on or near the popcorn line machines. His symptoms subsided whenever he left the popcorn line area. His symptoms have not occurred while working in other areas of the plant. Another worker, who had experienced periorbital tissue swelling while on the popcorn lines without associated eyelid skin inflammation, also had experienced a several day bout of marked bronchitic symptoms (cough, sputum production, shortness of breath, etc.) while working on the popcorn line several months prior to the questionnaire. His symptoms resolved when he transferred to a job well removed from the popcorn lines. When he subsequently returned to work on the popcorn lines, he noted the return of marked cough, which again resolved upon transfer to another part of the plant. A third employee experienced a bout of shortness of breath while working in unusually close contact with the epoxy paste used on the popcorn lines (when cleaning the epoxy paste from the interior of the machines). This worker had also commonly experienced skin rashes and mild chest discomfort while working on the popcorn line when not in close contact with epoxy paste.

Five other Department 20 employees reported respiratory symptoms. One worker experienced one episode of shortness of breath while working on one of the popcorn lines, but has since been able to work on the popcorn lines without experiencing respiratory symptoms. The respiratory symptoms of the other four, one with recurrent episodes of nocturnal shortness of breath and cough and three with occasional episodes of chest tightness at work, were not clearly associated with work on a particular product line.

Seventeen chute tenders who intermittently worked on the popcorn line machines of Department 20 submitted questionnaires. Eight of these were asymptomatic. Four chute tenders reported episodes of periorbital swelling that occurred while working on the popcorn line. Four reported experiencing eye irritation while working on the popcorn lines.

Seven workers in Department 25 (steel tie) submitted questionnaires. One Department 25 employee reported experiencing periorbital swelling while working directly behind the popcorn line and one experienced irritation of the nose and eyes while working on the popcorn lines.

Discussion: As was reported at the closing conference of the second site visit on April 15, 1987, the vast majority of the reported workers' symptomatologies were associated with working in close proximity to the popcorn lines. Twenty of the 41 questionnaire respondents from Department 20 reported experiencing work associated skin or respiratory symptoms. Of these 20 symptomatic respondents, all but three workers (one with a rash on arms, one with episodic chest tightness, and one employee with throat and laryngeal irritation), associated some or all of their symptoms solely with work on the popcorn line. The occurrence of respiratory symptoms and/or skin rash among many Department 20 employees while they were working in close proximity to the popcorn line machines, suggests that some substance used on the popcorn line machines caused irritative or allergic reactions among Department 20 workers. Reports from chute tenders and steel tie department employees of the occurrence of irritative or allergic symptoms when working near the popcorn lines also suggest that some substance emanating from the popcorn lines had affected workers. Interviews with symptomatic workers suggest that they had been affected both by skin contact and by airborne spread of potentially irritating or allergenic substances.

The most significant difference between the 4 popcorn line machines and the many other bag-making machines in use at the Graphic Packaging Plant was the epoxy adhesive used in the popcorn line machines. The fact that the skin and respiratory symptoms have not occurred since the use of the adhesive was discontinued in May 1987, indicates that constituents of the paste may have been affecting workers. Chemical analyses performed by NIOSH to determine the constituents of the epoxy adhesives used on the popcorn lines, revealed the presence of several chemicals that are potential irritants or allergic sensitizers, both to the skin and to the respiratory system (e.g. formaldehyde - asthma or skin allergy, acetaldehyde - skin irritant or allergy, benzoic acid - contact urticaria or skin allergy).

While the environmental sampling done on April 14, 1987 found low or non-detectable airborne concentrations of the constituents of the epoxy pastes used on the popcorn lines, it is possible that one or more of the potential irritants or sensitizers in the paste were associated with the respiratory and skin symptoms experienced by the Graphic Packaging employees. Low airborne concentrations of the potentially allergenic substances in the glue may be unlikely to sensitize workers, but they might produce allergic affects if a worker has become sensitized by skin contact with the glue or when working in close proximity to the glue while repairing or cleaning the machines.

It is fortunate that Graphic Packaging was able to stop using the adhesive in question. However, if the use of this adhesive is reinstituted in the future, the environmental controls and work practices to be used should be established with great care. It would be advisable to use work practices that minimize employees direct skin contact with the paste and ventilation that would prevent airborne dispersal of paste constituents. Worker's use of vinyl gloves should be required whenever there is a chance of contact with the adhesives. Should accidental contact occur, workers should be instructed to immediately wash off any paste they may have encountered.

DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address.

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.

Table 1

Environmental Air Sample Results
Graphic Packaging Corporation
Paoli, Pennsylvania
April 14, 1987

HETA 87-181

Analyte	Concentration, ppm		
	Location 1	Location 2	Location 3
Formaldehyde	0.19	0.03	0.04
Acetaldehyde	0.56	0.04	(0.03)*
Benzoic Acid	ND**	ND	ND
1,1,1-Trichloroethane	0.2	0.2	0.2
p-Dioxane	0.2	ND	ND
Ethyl Acetate	3.2	2.9	2.7

* - Values in parentheses are between the analytical LOD and LOQ given in the text of the report and are considered to be semi-quantitative

** - None detected