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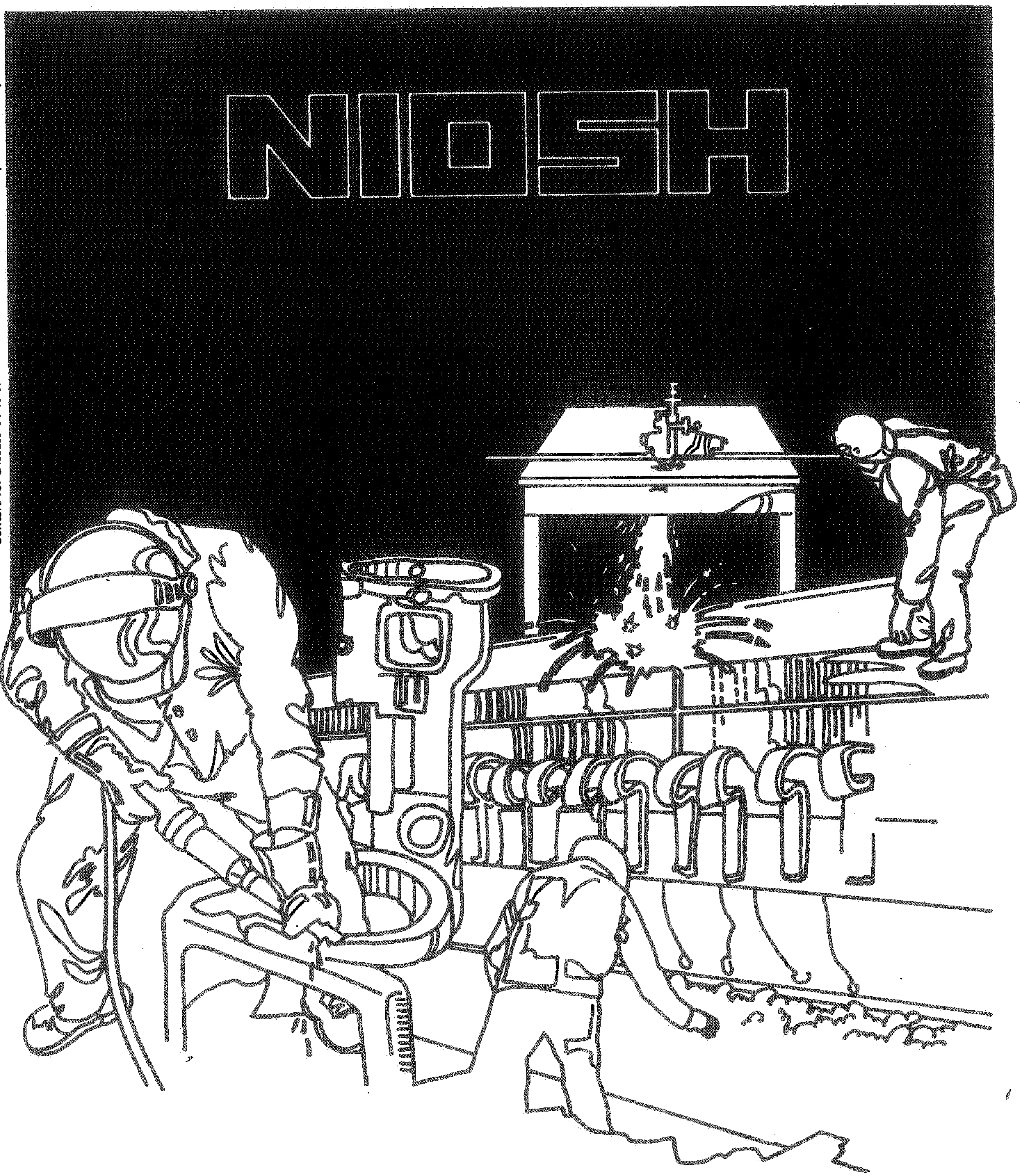

Health Hazard Evaluation Report

HETA 85-308-1829
KARDON INDUSTRIES
ST. PARIS, OHIO

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 85-308-1829
SEPTEMBER 1987
KARDON INDUSTRIES
ST. PARIS, OHIO

NIOSH INVESTIGATORS:
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I. SUMMARY

In April 1985 the National Institute for Occupational Safety and Health (NIOSH) received a request for an evaluation at Kardon Industries, St. Paris, Ohio to investigate employee complaints of headaches and eye and throat irritation associated with operation of the hand wax and auto wax lines. The hand wax line had been operational about 6 months and the auto wax line had just been installed. The request was submitted jointly by the plant manager and local 1467 of the United Paperworkers Union.

NIOSH investigators visited the facility on June 26-27, 1985 and on January 27-29, 1986. During these visits bulk samples of an amorphous polypropylene wax used in the hand and auto wax lines, and air samples for organic vapors, aldehydes, ketones, carbon monoxide (CO) and carbon dioxide (CO_2) were collected. Employees were administered non-directed questionnaires to determine if they were experiencing health problems.

On the second visit an evaluation was made of a local exhaust ventilation system which had been installed on the auto wax line after the initial NIOSH visit.

Air sample results from the initial survey showed relatively low levels of a number of hydrocarbons with n-hexane being present in the highest amount when compared to occupational exposure criteria. Hexane was measured in one sample at 28.7 milligrams per cubic meter of air (mg/m^3) which is 16% of the lowest occupational exposure criteria of 180 mg/m^3 (ACGIH). Based on the employee interviews the NIOSH investigator suspected aldehydes and specifically furfural were likely causative agents. Air samples collected during the follow-up visit contained no furfural but formaldehyde and acetaldehyde were detected in all air samples. The analytical technique, specific for furfural, was not capable of exact quantitations of formaldehyde or acetaldehyde. The laboratory analysis provided a range of each aldehyde on the air samples. This resulted in estimated exposure concentration of 0.08 to 0.5 mg/m^3 for formaldehyde and 0.4 to 1 mg/m^3 for acetaldehyde on the field samples. Both aldehydes were also found as decomposition products of the amorphous polypropylene wax. NIOSH considers formaldehyde to be a potential human carcinogen and recommends that exposure be reduced to the lowest feasible limit.

Discussions with the chemical supplier indicated that when heated the wax gives off ketones, aldehydes and eventually carboxcylic acids. The engineering system installed after the initial site visit appeared to work relatively well, but could be improved through some modifications.

Symptoms reported by employees included, headache, burning eyes, throat and nose irritation, dizziness, and an altered taste sensation and nausea. Most of the employees associated their symptoms with the auto wax and/or hand wax operations.

Based on these results the NIOSH investigators believe that employee symptoms were due to aldehydes evolving as decomposition products from the amorphous polypropylene wax. NIOSH considers formaldehyde to be a potential human carcinogen and recommends reducing exposure to the lowest feasible limit. The NIOSH investigators also believe that the engineering control system had reduced concentrations but further improvements were possible. Recommendations are included in Section VIII of this report.

SIC 2655 (Fiber cans, tubes, drums, and similar products) composite cans, caulking tubes, aldehydes, ketones, amorphous polypropylene wax, headache, respiratory symptoms, altered taste sensation, eye, nose and throat irritation.

II. INTRODUCTION

On April 17, 1985 the National Institute for Occupational Safety and Health received a request for an evaluation of employee health complaints. According to the requestors, employees working with a heated wax material were reporting headaches and dry throats. The request was submitted jointly by Kardon Industries, Inc. and local 1467 of the United Paperworkers Union.

NIOSH investigators visited the facility on June 26-27, 1985 and January 27-29, 1986. During these site visits the investigators conducted air monitoring for adehydes, ketones, carbon monoxide, carbon dioxide, and hydrocarbons, evaluated an engineering control system, and questioned employees as to any health effects they were experiencing.

Initial findings and recommendations were presented to management and union representatives at the conclusion of both site visits. Subsequently, results, recommendations and/or status reports were distributed via letter on July 9, 1985; January 2, February 18, and October 21, 1986.

III. BACKGROUND

Kardon's Composite Can and Tube Division (CC&TD) represents two plants, one of which is the Saint Paris, Ohio facility. This one story facility produces cardboard caulking tubes. The facility includes a workforce of approximately 100 hourly employees with some departments operating three shifts per day. The plant was built in the early 1970's and Kardon Industries has occupied the plant since about 1975.

The structure of the composite can is three plies of paperboard, along with an inner liner and an outside label. These five plies are held together by a water-soluble glue. After the five plies are joined, an in-line process will cut the tube (cans) to a pré-determined length and the tube continues to flow, uninterrupted, down the production line. Depending on the inner liner used as dictated by customer specifications, a lubrication is applied (mineral spirits or mineral oil) to release the liner from the winding and/or cutting mandrel. The cans are then automatically seamed, placing a metal top with a plastic spout on the composite can. These are then packed in corrugated cartons to ship to the customer. The metal tops mentioned above are converted in the St. Paris plant on punch presses. Operations evaluated during the NIOSH visits were hand wax, auto wax, compounder, and line 2.

A. Hand Wax

An application of wax is sprayed by a machine in the back, open end of the composite can. This is done so that when Kardon Industry customers insert a closing device after the composite can is filled at their facility, it reduces air and moisture penetration. Approximately ten percent of the composite cans produced have the wax added. This manufacturing process was not a full-time production operation. The longest continuous mode of this process was six weeks, twenty-four hours a day, five-day work week.

B. Auto Wax

This is a second generation of the hand waxer. The auto waxer increased production by twenty times the amount realized on the hand waxer. All materials are consistent with the hand wax operation. Composite cans are automatically fed from the production lines to the auto wax operation. Two duplex spray heads operate simultaneously - spraying wax into the open end of the composite cans. The wax is preheated in a drum and then hand carried in open buckets to two melt tanks on the auto wax machine. Shortly before the follow-up visit the company began using mineral oil to cut the wax.

C. Compounder

This machine places a strip of compound material around the outer and inner circumferences of the caulk top (metal). This is required by some customers in order to prevent air or moisture from penetrating through the base of the plastic spout or the metal as it is joined to the composite can. This equipment may be scheduled one or two days, eight hours/shift, per week.

D. Line two (2)

This is one of the locations where paperboard plies, together with the inner liner and label, are joined.

IV. METHODS

June 1985 Survey

Employee symptoms were associated with the hand and auto wax lines. The NIOSH investigator was also asked to evaluate exposures at the compounder and line two areas.

During the initial site visit, area and personal breathing zone air samples for organic vapors were collected at hand and auto wax areas, the compounder, and line two. A bulk sample of the amorphous polypropylene wax was collected and informal interviews were administered to four employees who worked in the immediate area of the auto wax line.

An evaluation of symptoms reported by employees in conjuction with a literature search suggested that aldehydes were the likely causative agent. Based on some specific symptoms (e.g. altered taste sensation, throat irritation, headache) the NIOSH investigator believed that furfural was the principal causative agent.[2-3] Discussions with the wax supplier confirmed that as the temperature of the amorphous polypropylene wax was increased, decomposition products include ketones, aldehydes, and eventually carboxcylic acids. The supplier stated that at the temperatures reportedly used at the Kardon facility (approximately 200°C), aldehydes should not be evolved.

January 1986 Survey

Personal and/or area air samples for aldehydes, methyl ethyl ketone and other ketones, and hydrocarbons were collected with calibrated battery-operated pumps attached via flexible tubing to a corresponding sorbent tube. Bulk samples of the wax, both cut with mineral oil and uncut were collected and analyzed qualitatively to determine if aldehydes were present as thermal decomposition products when the samples were heated to 200°C. Direct-reading air samples were collected for carbon monoxide (CO), carbon dioxide (CO_2), n-hexane, and formaldehyde using Draeger detector tubes. Nine employees were administered non-directed questionnaires concerning health effects they were experiencing.

The local exhaust ventilation system was evaluated using smoke tubes and a TSI hot wire anemometer.

Sampling and analytical methods are presented in Table 1.

V. EVALUATION CRITERIA

A. General

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 Recommended Exposure Limits (RELs) 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA standards. Both NIOSH RELS and ACGIH TLVs 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.

B. Chemical Compounds

1. Aldehydes

Aldehydes are aliphatic or aromatic organic compounds which contain the carboxyl group, C=0. They are used primarily as chemical feedstock because of their relatively high reactivity. They are volatile, colorless liquids except for formaldehyde which is a gas. Typically, aldehydes are strongly irritating to the skin, eyes and respiratory tract. Acute exposure may cause pulmonary effects such as edema, bronchitis and bronchopneumonia. Skin and pulmonary sensitization may develop in some individuals and result in contact dermatitis and, more rarely asthmatic attacks. After hypersensitivity develops, individuals may develop symptoms due to other aldehydes.[3]

Current occupational exposure criteria for the two aldehydes detected in personal samples are for formaldehyde - the lowest feasible quantifiable concentration for NIOSH, 4.5 milligrams formaldehyde per cubic meter of air (mg/m^3) for OSHA, and 1.5 mg/m^3 for ACGIH.[5-8] NIOSH and ACGIH consider formaldehyde to be a potential human carcinogen. Occupational exposure criteria for acetaldehyde are 360 mg/m^3 for OSHA and 180 mg/m^3 for ACGIH. NIOSH currently has no criteria for acetaldehyde.[5-8]

2. Ketones

Ketones are similar in structure and toxicological properties to aldehydes. They are flammable, colorless liquids with a pungent odor similar to acetone. Prolonged exposure is usually precluded by the intense irritation of the eyes and respiratory tract. The current occupational exposure criteria for methyl ethyl ketone are 200 ppm for OSHA and NIOSH and ACGIH as a TWA.[4-6].

VI. **RESULTS**

June 1985 Survey

Results of the five personal breathing zone air samples, which were analyzed for those substances qualitatively identified in the area air samples are presented in Table 2. Chemicals detected in one or more personal samples included toluene, xylene, 2-methyl pentane, 3-methyl pentane, n-hexane, methyl cyclopentane, 1,1,1-trichloroethane, and cyclohexane. All chemical exposures were less than 1% of the corresponding occupational exposure criteria except for n-hexane. It was detected in two samples at 0.3 and 28.7 mg/m^3. The higher value is approximately 16% of the lowest occupational exposure criteria of 180 mg/m^3 (ACGIH).

The major substances identified in the air samples collected above the heated (200°C) bulk sample of amorphous polypropylene wax included acetone, acetic acid, methyl propyl ketone, methyl isobutyl ketone and a series of alphatic hydrocarbons (C_7-C_{19}). Except for possibly some of the aliphatic hydrocarbons, none of these were identified in the personal breathing zone or area air sample. The auto wax line, which was still being adjusted, ran for only 30 minutes during the initial visit.

Visual observations included noting that an eye wash located near a water fountain had insufficient water pressure. This problem was corrected during the initial visit.

January 1986 Survey

A. Air Sampling

Qualitative screening of thermal decomposition products from both cut and uncut bulk wax samples did not detect any furfural. However, formaldehyde and acetaldehyde were found. The analytical technique (gas chromatography with a flame ionization detector (GC-FID)) for furfural (the suspected causative agent) was not suitable for these two aldehydes due to problems in separating them and the presence of aliphatic hydrocarbons, which are interferences for the GC-FID techniques. Therefore gas chromatography-mass spectrometry was used for the analysis of field samples.

Formaldehyde was found on all the field samples in the 1-5 microgram (ug) range which correlates to an air concentration of 0.08 to 0.5 milligrams per cubic meter of air (mg/m^3). Acetaldehyde was present on the field samples at 5-10 ug/sample which equals an air concentration of 0.4 to 1 mg/m^3. For each field sample, acetaldehyde was present in greater concentrations than formaldehyde. Due to the imprecision associated with the mass spectroscopy quantitation, the laboratory could only report estimated concentration ranges. Because acetaldehyde has a low breakthrough and migration problems on the sorbent media used, the actual air concentrations may have been higher.

Methyl ethyl ketone was not detected in the four area air samples. Two other ketones, mesityl oxide and diacetone alcohol were found in the area samples but were below the limit of detection in six personal samples. Area screening samples for hydrocarbons contained branched alkanes in the C_9-C_{12} range as the major component and minor components including 1,1,1-trichloroethane, n-propyl acetate, toluene, xylenes, mesityl oxide and diacetone alcohol.

Detector tube air samples for hexane, CO, and CO_2 measured concentrations of a trace of hexane in one of two samples, 900 ppm for CO_2 in one sample and 10-20 ppm for CO in three samples. These values are below the lowest current occupational exposure criteria: 35 ppm for CO (NIOSH), 5000 ppm for CO_2 (OSHA) and 50 ppm for hexane (ACGIH).

Detector tube samples for formaldehyde continuously exhibited a yellow discoloration rather than the pink discoloration associated with the presence of formaldehyde. This included one sample collected on the opposite side of the plant, from the auto wax line. This indicated that air from the auto wax area was mixing with the general plant air. One sample taken in the office, as a comparison, exhibited no discoloration. According to technical information from the manufacturer, the yellow discoloration indicates the presence of other chemicals including other aldehydes (e.g. acrolein and acetaldehyde) and styrene.[1]

B. Other Environmental

Each time the operator filled the melt tanks, visible emissions were observed from the preheat tank, open buckets, and both melt tanks. The temperature of the melt tanks was 165°C (330°F) and the operator stated that both spray nozzles were operating at a slightly higher temperature (375°F)

One employee reported that she had been unclogging a jam in the auto wax machine and someone had started the machine before she was clear of it. A second employee reported that he was sprayed with hot wax, when he had the plexiglass shield open, while conducting maintenance on the auto wax line.

C. Health Effects

Nine employees were quizzed informally as to any health effects they experienced at work. All nine had experienced some of the aforementioned symptoms (Table 3). Irritation of the eyes, nose or throat was reported eight times, headaches were reported six times, and altered taste was reported two times. Most of the employees associated their symptoms with the auto wax and/or hand wax operation.

The NIOSH industrial hygienist experienced slight throat and eye irritation during the follow-up visit.

D. Engineering Controls

The ventilation system consists of local ventilation hoods located adjacent to the two duplex spray head operations. Another local ventilation hood is located near the top of a conveyor which carries the tubes to the inspection table. The total exhaust flow for the system is about 1270 CFM. The two spray hoods exhaust about 520 CFM; the hood located atop the conveyor exhausts about 220 CFM.

The ventilation fan for this operation is a 24 inch 6 bladed propeller fan driven with a 3/4 HP motor operating at 1725 RPM. The performance data for the fan was not available. There is no filter in the fan system so that any wax that invades the system can collect on the propeller blades to foul the fan. Inspection of the outlet of the fan from the outside of the building showed that some wax had penetrated that far. This indicates that in time, wax will coat the duct and foul the fan, gradually decreasing fan performance. A filter should be installed prior to the fan to control wax build-up. This would require sectioning the duct and installing a filter. A fan should be installed that would be better for this application, one that would not be as sensitive to fouling and would work better against static pressure than a propeller fan. The straight bladed fan or the backward curved blade fan would accomplish this.

Another deficiency in the ventilation system is the number of sharp bends and expansion and contractions in the ductwork. Each of these contributes to losses of energy and an increase in the fan static pressure. Speeding up the fan may overcome the resistance but will result in higher energy losses. Also, the propeller fan has a limited capability to overcome a rising static pressure.

The ventilation system controls wax emissions at three points. Two local ventilation hoods collect wax mist at the spray heads where two caulking tube interiors are waxed simultaneously. Observation of the wax spraying operation indicated that some wax mist was by-passing the hood. This happens because the wax is sprayed at an elevated temperature which causes a strong convective rise of the mist. Extending the top of the hoods a few inches (not to interfere with spray apparatus) would increase the capture zone of the hood. The other local ventilation hood is located atop a conveyor that carries the waxed caulking tubes to the inspection table. This ventilation hood pulls about 220 CFM, but is located where it contributes little to reducing exposure of personnel and where caulking tubes pass the hood in less than one second during normal operation. Relocating this hood to remove wax mist at the inspection table by installing a slot hocd (1 inch by 36 inches) just above the 36 inch fluorescent light mounted on the front of the table will reduce exposure of the inspector. If the airflow is inadequate, the fan efficiency or capacity should be increased to improve the collection at that point.

VII. DISCUSSION AND CONCLUSION

Based on these results the NIOSH investigators believe a health hazard existed from employee exposure to decomposition products of the amorphous polyproylene wax. Based on the reported employee symptoms and the environmental sampling results, aldehydes were the principal causative agent. It is possible that other materials not sampled for were also present but, if so, the identity of the chemicals is unknown.

It is noteworthy that the supplier knew of the potential for aldehydes, ketones, and carboxcylic acid to evolve as decomposition products as the wax was heated. When asked, the supplier readily provided the information to NIOSH. However, much time could have been saved if the information had been included on the material safety data sheet (MSDS). The engineering control system installed by Kardon industries appeared to have reduced air concentrations of decomposition products from the amorphous polypropylene wax. As noted in the results section further improvements, are possible. The NIOSH investigators believe that Kardon industries acted prudently by proceeding with installation of the local exhaust ventilation system on the auto wax line after the initial site visit, even though the causative agent or agents had not been identified.

VIII. RECOMMENDATIONS

1. Airborne concentrations of wax decomposition products including aldehydes should be further reduced. Appropriate techniques include substitution of a less hazardous material and/or additional modifications to the local exhaust ventilation system. If substitution is chosen, care must be exercised to ensure that the new material or, in this case, its decomposition products are actually less toxic.

2. The method of manually adding wax to the melt tanks should be modified to reduce emissions. Emission points noted visually include opening the preheat container, carrying heated wax in open buckets, and opening the melt tanks. Automating the operation should reduce the emissions.

3. Periodic evaluations of the local exhaust ventilation system's performance characteristics should be made. The readings obtained by NIOSH during this evaluation will provide base line data for future comparison.

4. Safety interlocks should be installed on the plexiglass shields located on each side of the auto wax machine. These will help prevent individuals from turning the machine on while someone is cleaning or unclogging the machine.

5. The chemical supplier should list potential decomposition products on the material safety data sheet for the amorphous polypropylene wax.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGMENTS

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XI. 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. Copies of this report have been sent to:

1. Kardon Industries
2. United Paper Workers Union, Local 1467
3. United Paperworkers International Union
4. OSHA, Region V

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

Sampling and Analytical Techniques

Kardon Industries
St. Paris, Ohio

HETA 85-308

Chemical	Flow and Collection Media	Analytical Techniques
Aldehydes in decomposition products of bulk wax samples (with & without mineral oil)	NA	Both bulk samples of the amorphous polypropylene were heated in a tube furnace at above 200°C. The effluent was sampled with a charcoal tube backed up with an ORBO-23 tube. The ORBO-23 tubes were analyzed the same as the field samples, as described above.
Aldehydes from sorbent tube	ORBO-23 (acrolein) sorbent tubes at 0.25 LPM	Initially field samples were to be analyzed for furfural, but furfural was not detected in decomposition products from bulk wax. The technique for furfural was not suitable for formaldehyde and aldehydes (found in decomposition products). Tubes were desorbed with 1 milliliter toluene, sonified for 30 minutes, then 1 microliter was injected into GC/MS. A 30 meter DB-1 fused silica capillary column was used (splitless mode). The major ions in the mass spectra of the formaldehyde and acetaldehyde derivatives were monitored and used to calculate peaks areas. Spikes of solution onto ORBO-23 tubes were used for standards.
Ketones	Charcoal tubes at 0.8 LPM for bulk air samples and at 0.025 LPM for field samples	High volume (bulk) air samples were desorbed in carbon disulfide and analyzed according to NIOSH method no. 1300 using a Varian 3700 gas chromatograph equipped with a carbowax 1500 column and a flame ionization detector. Identities of the peaks found was confirmed using mass spectrometry. Subsequently, the remaining samples were desorbed in carbon disulfide and analyzed by gas chromatography in the same manner as the bulk air samples.[9]
Methyl ethyl ketone	Ambersorb tube at 0.025 LPM	A and B sections of the tube samples were separated and desorbed using 1 milliliter carbon disulfide and analyzed using chromatography accuracy to NIOSH method no. 2500 with modifications.[9]
Organics in high volume (bulk) and field samples	Charcoal tubes A. Bulk air samples at 0.5 LPM B. Field samples at 0.025 LPM	Bulk air samples were desorbed with 1 milliliters of carbon disulfide and screened using an HP gas chromatography equipped with a flame ionization detector using a 30 meter fused silica capillary column (splitless mode). The field samples were then desorbed and analyzed as above for the principal chemical identified in the bulk air samples.
Organics in decomposition products from bulk polypropylene	NA	The bulk wax was heated in a tube furnace for 1 1/2 hours at 200°C. Air was blown over the bulk at 0.2 LPM and the effluent collected on a charcoal tube. The tube sample was desorbed and analyzed as above.
Total hydrocarbons on field samples	Charcoal tubes at 0.025 LPM	Charcoal tube air samples were desorbed in 1 milliliter carbon disulfide and analyzed using a gas chromatograph equipped with a flame ionization detector. Samples were quantified for total hydrocarbons using decane as a standard.

Table 2

Results of Personal Air Samples for Organic Vapors

Kardon Industries
St. Paris, Ohio
HETA 85-308

June 27, 1985

Sample Number	Operation	Volume	Sample Time	Air Concentration (mg/m^3) Toluene	Xylene	2-Methyl Pentane	3-Methyl Pentane	n-Hexane	Methyl Cyclopentane	1,1,1-Tri-Chloroethane	Cyclohexane
C-1	Compounder	46	705-1445	1.7	0.3	2.1	3.7	28.7	5.3	3.7	0.5
C-2	Operator-Line 2	44	711-1447	ND	ND	ND	*	0.29	ND	ND	ND
C-4	Operator-Line 2	15	1221-1450	ND	ND	ND	ND	ND	ND	ND	ND
C-3	Hand Wax	45	715-1435	ND	ND	ND	ND	ND	ND	ND	ND
C-6	Auto Wax	18	810-833	ND	ND	ND	ND	ND	ND	7.33	ND
	NIOSH Recommended Standard			375	435	N	N	350	N	1900	N
	ACGIH TLV			375	435	N	N	180	N	1900	1050
	OSHA PEL			750	435	N	N	1800	N	1900	N

Note: a series of aliphatic hydrocarbons were found on each sample.

ND = Non-Detected
N = No Current Criterion

Table 3

Health Effects Reported by Employee
During Follow-up Survey

Kardon Industries
St. Paris, Ohio
HETA 85-308

January 1986

Employee	Smoking Status	Years at Plant	Health Effects	Comments
1	Smoker	7 yrs	headache, eye irritation, nausea; nose & throat irritation; altered taste	only has problem when near auto wax
2	Ex-smoker	8 yrs	Chest pain, burning eyes	only has symptoms when working at auto wax or hand wax
3	Ex-smoker	9 yrs	nasal irritation; eye irritation; upper respiratory infection, chest tightness; high blood pressure	
4	non-smoker	7 yrs	headache; sore & dry throat; eye irritation	
5	smoker	9 yrs	asthma; headache; chest tightness; dry throat & mouth; funny taste, feels faint	
6	smoker	8 yrs	itching and burning eyes; sore throat; sinus problems; problems with contact lenses	
7	smoker	7.5 yrs	headache; dry throat; nausea	only gets symptoms when working near auto wax
8	smoker	9.5 yrs	headache; dizziness; shortness of breath	only gets symptoms when at auto wax
9	non-smoker	8 yrs	headache; nasal irritation; chest tightness; feels drunk; cold-like symptoms	symptoms only when on auto wax or hand wax

Age Range = 30-48