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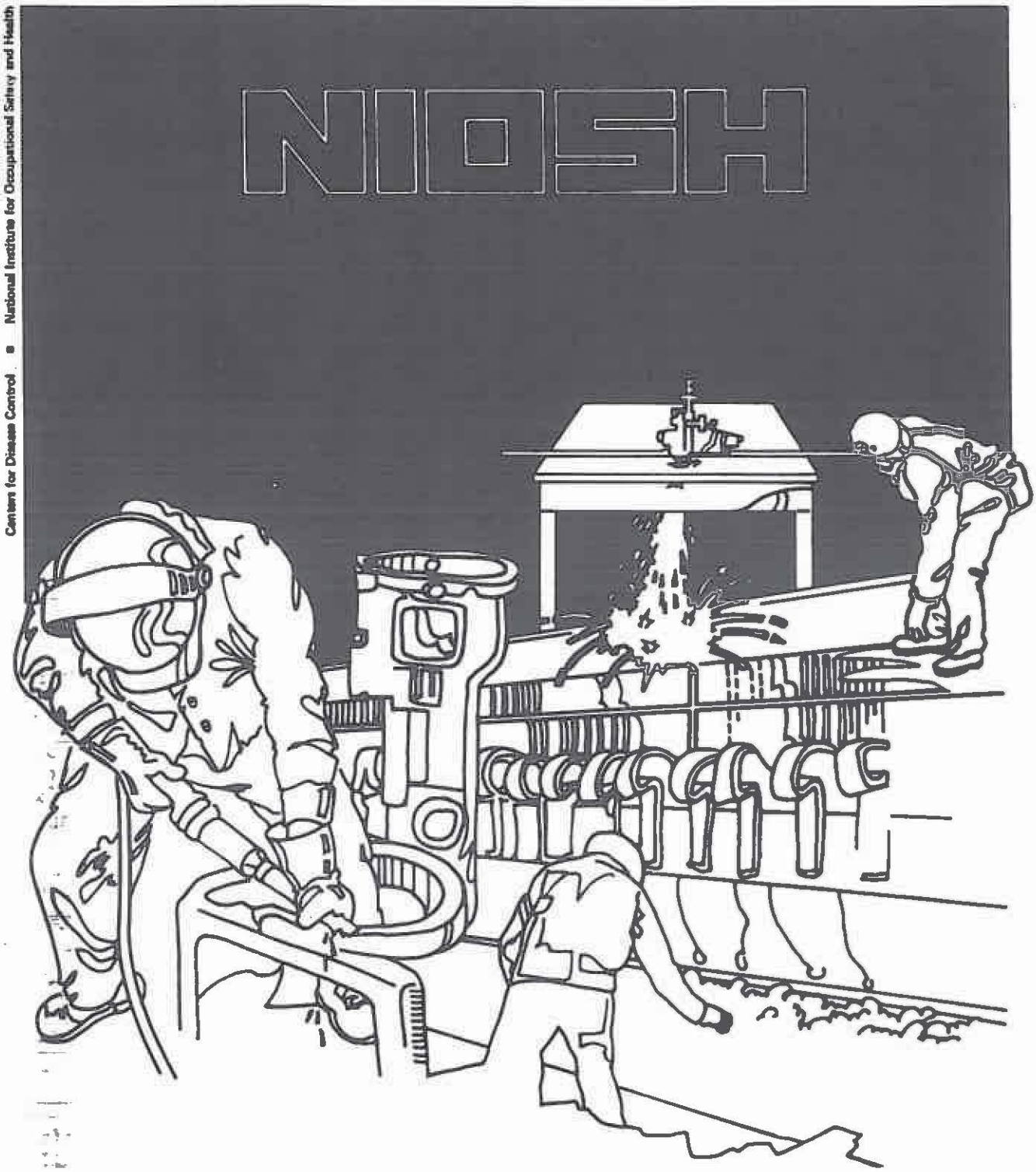

Health Hazard Evaluation Report

HETA 82-223-1340
RUBBERMAID INCORPORATED
WOOSTER, 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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 82-223-1340
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RUBBERMAID INCORPORATED
WOOSTER, OHIO

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I. SUMMARY

On May 19, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate present work conditions and practices in the Wire Line and Plastics II Departments of Rubbermaid Incorporated, manufacturer of plastic and synthetic rubber items for household use, in Wooster, Ohio. The request focused on three issues: contaminants in the Wire Line Department; exposure in Plastics II to heavy metals; and dust exposures associated with a granular polyethylene. Additionally, in September 1982, Local 302 of the United Rubber Workers requested further evaluation of exposures to contaminants in the Wire Line. Reported health effects included episodes of lightheadedness, nausea, upper respiratory symptoms, burning eyes, runny nose, and in two instances loss of consciousness.

The industrial hygiene evaluation involved sampling for airborne contaminants and evaluation of Wire Line exhaust ventilation. The medical evaluation involved interviewing Wire Line workers reporting health effects. Site visits were conducted in June of 1982 and January 1983.

Evaluation of airborne contaminants in the Wire Line Department indicated low levels of the following contaminants: acrolein <0.01-0.4 mg/m^3: OSHA standard 0.25 mg/m^3; benzene <0.05-0.1 mg/m^3: NIOSH criterion 3.2 mg/m^3; ethanol <0.05-0.07 mg/m^3: OSHA 1900 mg/m^3; formaldehyde 0.04-0.3 mg/m^3: NIOSH lowest level feasible; hexane 0.05-0.07 mg/m^3: ACGIH criterion 180 mg/m^3; isooctane 0.09-0.2 mg/m^3: ACGIH 1450 mg/m^3; methyl ethyl ketone 0.07-0.16 mg/m^3: NIOSH 590 mg/m^3; toluene 0.1-0.3 mg/m^3: NIOSH 375 mg/m^3; total alkanes 8-90 mg/m^3: NIOSH (stoddard solvent) 350 mg/m^3; undecane 2-24 mg/m^3: no standard; vinyl chloride none detected: NIOSH below detection limits. Carbon monoxide levels were negligible (4.6 mg/m^3 or less; NIOSH 40 mg/m^3). Carbon dioxide levels were about 0.07%: ACGIH 0.5%. Initial exposure monitoring of set-up workers to lead, chrome III, and chrome VI were below one-half of their respective evaluation criteria of 0.05 mg/m^3: OSHA; 0.5 mg/m^3: NIOSH; and 0.0002 mg/m^3: NIOSH. Two of the four workers had cadmium exposures at or exceeding the NIOSH recommended limit of 0.04 mg/m^3. Cadmium exposures of these workers during the follow-up survey were 0.005-0.025 mg/m^3 over the work shift, compared to 0.011-0.043 mg/m^3 during the initial survey.

Seven nondirected medical interviews were conducted with symptomatic Wire Line workers. Five had experienced episodes of lightheadedness and/or nausea during the work shift severe enough to require leaving work. Two of these lost consciousness. All continued to complain of upper respiratory symptoms. Six of seven experienced burning eyes or runny nose. Five of seven experienced dry throat.

Sampling for contaminants did not indicate the presence of an existing or very probable health hazard in the Wire Line under normal operating conditions. No chronic health hazard was apparent. The presence and combination of various process-related odors in the Wire Line Department may contribute to the workers' irritant symptoms. Cadmium exposure of color changers in the Plastics II Department, although lower during the follow-up survey than during the initial survey, still exceeds the NIOSH action level. Recommendations presented in Section VIII address solvent release, air influx, and possible steps to reduce irritant symptoms in the Wire Line Department. Additional recommendations on housekeeping, material handling, work practices, respiratory protection, and medical monitoring are given for Plastics II set-up workers exposed to cadmium.

KEYWORDS: SIC 3079 (Miscellaneous Plastic Products), thermal decomposition products, polyvinyl chloride, organosol, wire dipping, solvents, injection molding, pigments, cadmium, benzene, formaldehyde, vinyl chloride.

II. INTRODUCTION

In May of 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Rubbermaid Incorporated, Wooster, Ohio, to evaluate present conditions and work practices in the Wire Department and the Plastics II Department. The company's request addressed three issues: general conditions at the Bowman Operation Wire Line; union concerns expressed to the company about the Plastics II color changers' exposure to heavy metals present in the pigments; and dust exposures associated with switching to a granular polyethylene in the Plastics II Department. Employee representation was provided by Local 302 of the United Rubber Workers.

NIOSH conducted an initial industrial hygiene survey June 14-15, 1982, in the above areas, and the results of that survey were presented in Interim Report No. 1 issued in September 1982.

On September 1, 1982, NIOSH received an inquiry from Local 302 of the United Rubber Workers requesting further evaluation of the Wire Line and an additional evaluation of the Printing Area located adjacent to the Wire Line. The union was concerned about possible exposures to raw materials used in, and thermal decomposition products originating from, the process. A survey addressing this request was conducted January 18-20, 1983.

III. BACKGROUND

A. Past NIOSH Evaluations

NIOSH had conducted a health hazard evaluation (HHE 80-196-957)[1] at this same plant in late 1980 and early 1981. At that time, the company requested an evaluation of existing working conditions and practices in all phases of their manufacturing processes. The investigation focused on the Compression Molding Department. Zinc, chromium, lead, selected nitrosamines, free silica, and respirable nuisance dust levels were evaluated. Other areas which were addressed included the Wire Department, the resin reclamation area, warehousing areas, and Plastics I and II. Contaminant levels of cadmium, lead, and chromium were evaluated in the Plastics I injection molding area. No health hazards associated with the processes and materials in use during the evaluation were identified.

B. Facility and Workforce

Rubbermaid, Inc., manufactures a wide variety of plastic and synthetic rubber items primarily for household use. The facility has been producing goods in the Wire Department (Wire Line) for 40 years and in the Plastics II Department for 20 years.

The plant employs 1820 workers, 59% of whom are production workers. The Wire Line operates fully staffed (16 workers) during the first shift and a half-shift (with 9 workers) during the second shift. Plastics II operates on all three shifts, five days per week, with four color changers per shift. Plastics II had 160 workers, including the 12 color changers. Eighteen maintenance workers serve the two areas. About 58% of the work force is female.

C. Process Description

The three processes addressed in this Health Hazard Evaluation are the Wire Line and Shelf Paper Extrusion Operations at the Bowman Street Operation and the Plastics II Injection Molding Area at the Akron Road facility, both in Wooster, Ohio.

1. Wire Line

The Wire Line operation involves the coating, curing, finishing, and packaging of vinyl resin-coated wire products. The process involves attaching a hang wire to the item to be processed by induction welding, passing it through a preheat oven where it is raised to a temperature of about 350°F [177°Celsius (C)], dipping the item in an organosol (a dispersion of vinyl resin, plasticizer, and a solvent) filled vat maintained at between 90-100°F (33-38°C), and passed through a curing oven at temperatures of 230-250°F (110-121°C). The parts, carried by conveyor through the ovens and organosol dip, are delivered to the finisher-packers where the hang wires are removed, the plastic tube remaining after removal of the hang wire is fused with a silicone-dipped soldering iron, packaging sleeves or inserts are applied, and the items are packed in boxes. Materials used include organosol, adipate ester and phthalate ester plasticizers, a stoddard-type solvent, and a silicone fluid.

2. Extrusion Area

Polyethylene is formed into sheets at a die fed by twin extruders through a coextrusion block. The sheet is then passed over cooling rolls and through a thickness gauge to a vented corona discharge station, which prepares the sheet for printing. The printing is done on a two-color flexographic printer. Local exhaust units are located on the printer to remove solvent vapors from the sheet as it passes through. The sheet subsequently passes through a water-based glue applicator, a vented glue-drying oven, a slitter which cuts the sheets to narrower widths, and then to the winders. Large rolls of shelf paper are transferred to another area (Rewind), where the sheets are cut into 10-foot lengths, shrink wrapped in polyethylene, and boxed.

Substances used in this process are polyethylene, ethyl alcohol, ethyl acetate, flexographic printing ink, and a rewettable adhesive.

3. Plastics II

The Plastics II area produces polyethylene items (such as wash baskets and trash containers) by injection molding. The resin (polyethylene) in pelletized or granular form is delivered to each machine through a series of pipes from bulk storage silos. At the machine, the resin is mixed with a powdered colorant, fed from a separate container on the colortronic unit, in a hopper which gravity feeds into the injection mold machine.

Color changers are responsible for filling each machine's colorant container at the beginning of each shift and for color changeovers during the shift. They are also responsible for the adjustment of equipment, mold changes, and cleaning and maintaining the colortronic units. Process packers are responsible for inspecting and packing finished items as they come off of the conveyor from the machine. Materials used are largely limited to polyethylene resin (including reclaimed scrap) and the powdered colorants.

IV. METHODS AND MATERIALS

A. Industrial Hygiene

The industrial hygiene evaluation involved personal and area sampling for selected contaminants associated with substances present in the materials being used in the processes. In the Wire Line Department, sampling was also done to identify and characterize airborne contaminant release associated with the heating and/or thermal decomposition of raw material components. All personal exposure samples were obtained in the workers' breathing zones. Sample duration approximated a full work shift (except for grab samples).

1. Wire Line

This area was evaluated during both surveys. The initial survey involved breathing zone and area sampling for formaldehyde and grab sampling for formaldehyde and hydrogen chloride. The follow-up survey involved collecting four sets of area or process samples; three on the wire line (directly above the induction welding work station, inside the curing oven inlet, and directly above the wire line take-off position) and one general area sample by the coextrusion block on the shelf liner extrusion unit closest to the Wire Line. (This

extrusion unit was in operation during the survey.) The samples obtained during this second survey were intended to enable the NIOSH investigator to identify potential contaminants being released by the process and which 1) were considered to be potentially present due to the materials being used, 2) had been reported in the literature as being capable of producing symptoms consistent with those reported by Wire Line workers, or 3) were an expressed concern of the union representatives and employees. These area samples permitted determination and evaluation of the following contaminants: vinyl chloride, methyl ethyl ketone, acrolein, furfural, isopropyl and ethyl alcohol, benzene, ethyl acetate, 1,1,1-trichloroethane, formaldehyde, and any other compounds of interest which may have been identified by gas chromatography/mass spectroscopic analysis of the samples obtained using standard charcoal sorbent tubes. Direct-reading carbon monoxide levels were also obtained in the general area and around the oven inlets and outlets. General area carbon dioxide levels were obtained using direct-reading indicator tubes.

No personal samples were obtained during the second survey since the compounds of concern were considered to be generated internally or immediately outside of the process equipment and area sampling at or in close proximity of the equipment would permit a more optimal collection of any existing contaminants being released. Additionally, initial screening of the three charcoal tube area samples and one charcoal tube process sample for identification and semi-quantitation of contaminants present provided information which was used in determining what analyses if any, needed to be done on the remaining sorbent tubes to evaluate the Wire Line contaminant release profile. Methods and collection media used, as well as sampling rates and analytical limits of detection are presented in Table I and Appendix A. (Note that formaldehyde sampling during the initial survey used NIOSH Method No. P&CAM 354,[5] whereas during the follow-up survey formaldehyde was determined along with acrolein using an experimental method.)

2. Extrusion Area

Personal and area samples for ethyl acetate and ethyl alcohol in use on the shelf liner printer in the Extrusion Area were obtained by the Occupational Safety and Health Administration (OSHA) industrial hygienist during his survey on January 20, 1983. This was done since this process had not been using the printer during its operation on the previous day when NIOSH did area sampling. Precalibrated low flow pumps equipped with standard charcoal tube samoling media were used, the samples being analyzed by OSHA's laboratory.

3. Plastics II

The Plastics II industrial hygiene evaluation involved obtaining breathing zone samples for cadmium, lead, total chromium, and chromium VI exposures on workers handling the powdered pigments (Set-Up/Color Changers). Additionally, two sets of area samples for total and respirable plastic dust were obtained adjacent to injection mold machine resin hoppers to compare levels of dust associated with using pelletized and ground polyethylene resin fed to the units through a pneumatic material handling system.

During the follow-up survey, worker exposure sampling for cadmium was repeated, since exposure levels to cadmium during the first survey exceeded the NIOSH recommended action level of 0.020 milligrams per cubic meter (mg/m^3). The methods used in this area, sampling media, flow rates, and analytical limits of detection are also given in Table I.

4. Wire Line Exhaust Ventilation

Additionally, an evaluation of the effectiveness of exhaust ventilation equipment present on the curing oven of the Wire Line was conducted with the use of smoke tubes and smoke candles during the January survey.

B. Medical

Nondirected medical interviews were conducted on an individual basis with the seven Wire Line workers expressing health effects associated with work on that process.

V. EVALUATION CRITERIA

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 Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's 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 solely 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 only 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.

The applicable evaluation criteria for contaminants sampled during the survey are presented in Table II.

A brief discussion of the toxicology of cadmium follows to supplement Table II. Cadmium dust overexposures were documented in the Plastics II area (see Sections VI and VII).

Cadmium is a toxic heavy metal which may enter the body either by inhalation (breathing) or by ingestion (swallowing) of cadmium metal or oxide. Once absorbed, cadmium accumulates in organs throughout the body, but major depositions occur in the liver and kidneys. Acute inhalation exposure to high levels of cadmium can cause pneumonia or pulmonary edema, as well as liver and kidney damage.[13] Chronic exposure may lead to emphysema, and kidney disease, or cancer of the prostate.[14] The possibility that cadmium exposures may cause cancer has been expressed, but this issue remains questionable.

VI. RESULTS

A. Industrial Hygiene

1. Wire Line Department (Including Extrusion Area)

The results of personal and area samples for formaldehyde exposures on the wire line obtained during the initial survey were all below the calculated environmental limit of detection of 0.2 parts per million or 0.3 mg/m^3. Direct-reading indicator tubes for formaldehyde and hydrogen chloride did not indicate any detectable amounts of either compound when taken at the inlet to the curing oven and in the plume generated in the area of the soldering tips. Nor did personal or area samples contain detectable formaldehyde (Table III).

An extensive evaluation to determine the airborne concentration of potential contaminants originating from the Wire Line during the follow-up survey indicated that of the following list of substances present at detectable levels, none (with the exception of an acrolein sample obtained inside the curing oven inlet) was present in concentrations above one-fourth of the most stringent evaluation criterion for the specific compound (Table IV). These substances were: acrolein, benzene, ethanol, formaldehyde, hexane, isooctane, methyl ethyl ketone, toluene, and total alkanes. Concentrations of furfural, ethyl acetate, 1,1,1-trichloroethane, if present, were in such small quantities as to defy positive confirmation with the use of gas chromatography/mass spectroscopy. No vinyl chloride was detected in any sample. The major constituent of all the samples analyzed for the identification of various organics was a naphtha-type product consisting mainly of undecane, an eleven carbon alkane ($C_{11}H_{24}$) plus numerous other saturated and unsaturated aliphatics having ten to 12 carbon atoms in the chain.

Table V presents the OSHA data for ethyl acetate and ethanol obtained in the Extrusion Area on the day following the evaluation of the Wire Line. Concentrations of both substances were well below the evaluation criteria.

Direct-reading carbon monoxide levels obtained in the Extrusion Area and by the Wire Line were less than four parts per million. Carbon dioxide levels determined with direct-reading indicator tubes were about 0.07 percent (1260 mg/m^3 or 700 ppm) (Table VI).

Smoke tube measurements in the areas adjacent to the Wire Line indicated that air movement was into that department from the surrounding areas. Observation of smoke candle emissions

inside of the curing oven did not indicate any perceptible escape of the smoke. A smoke candle emitting smoke in the chiller hood located at the take-off end of the wire line demonstrated that this device does not function as an exhaust system for any materials generated out in the finishing and packing area.

2. Plastics II

Personal exposure data for set-up workers in Plastics II to metals are presented in Tables VII and VIII. Three of the four workers sampled for cadmium exposure during the initial survey were considered as having had cadmium exposures exceeding the action level (one-half of the recommended exposure limit) during the work shift sampled. Two set-up workers had exposures of 0.04 mg/m^3 and one had an exposure of 0.03 mg/m^3. Concentrations of lead, total chrome, chrome VI, and respirable and total dust were within the evaluation criteria.

A repeat of exposure monitoring for cadmium among Set-Up Workers during the follow-up survey demonstrated lower exposure concentrations, 0.005 to 0.025 mg/m^3 time-weighted average (Table VIII), than during the initial survey (0.011 to 0.043 mg/m^3). Nevertheless, two of the four concentrations during the follow-up survey still exceeded the NIOSH action level of 0.020 mg/m^3. (NIOSH recommended standard is 0.040 mg/m^3 averaged over a work shift up to 10 hours in a 40-hour workweek.)

B. Medical

Of the seven interviews conducted with symptomatic workers on the Wire Line, five (71%) reported one to three episodes of lightheadedness and/or nausea during work which was severe enough to require their leaving work. Two of these lost consciousness. Although none of the workers have had to leave work due to these symptoms during the six months preceding the follow-up survey, all the workers complain of continuing upper respiratory symptoms. Six of seven (86%) experienced burning eyes or runny nose. Five of seven (71%) experienced dry throat.

A variety of environmental odors and fumes were considered by the Wire Line workers to be responsible for their reported symptoms. The mentioned sources included "fumes" associated with fusing the residual plastic nib on coated wire products (2 of 7 workers interviewed mentioned this source); "fumes" from the end of the curing oven (4 of 7); and "fumes" from either the Kolene machine (a discontinued process using caustic solutions to remove the plastic coating from rejected wire products) or the extruder in the Extrusion Area (5 of 7). All workers reported that symptoms had

decreased since improvements in ventilation had been made and the Kolene process discontinued.

VII. DISCUSSION AND CONCLUSION

A. Wire Line

The formaldehyde sampling conducted on the Wire Line during the initial survey (June 1982) did not indicate the presence of formaldehyde vapors above the method's limit of detection, which corresponded to an air concentration of about 0.3 mg/m^3 or 0.2 ppm. During the follow-up survey conducted in January 1983, a sampling method for acrolein (a suspected thermal decomposition product) was used which was also capable of being analyzed for formaldehyde. Formaldehyde concentrations in these three samples (one at the welding end of the Wire Line, one at the product take-off, and one in the Extrusion Area) ranged from 0.04 to 0.05 mg/m^3 (0.05 to 0.07 ppm). A process sample located inside the cure oven inlet had 0.3 mg/m^3 (0.4 ppm). While the process sample indicates a level at which irritant effects could be expected, this is not a realistic exposure sample; the concentrations which workers in the area may encounter would be less than 0.08 mg/m^3 (0.1 ppm), as shown by the three area samples. Levels of formaldehyde below 0.08 mg/m^3 (0.1 ppm) are not usually associated with causing irritation in non-sensitized individuals and sensitization is not considered likely to occur at these levels.[12]

Worker complaints of burning eyes, tearing, and eye problems upon going outdoors into the bright light may be associated with the use of the silicone in which the soldering irons are dipped to prevent buildup from fusing plastic nibs on the organosol-dipped wire products. Investigation of silicone lubricants in a previous NIOSH study in which similar eye irritation was being experienced by workers indicated that the material can cause transient irritation when introduced into the eye but that the effects are temporary.[15] The silicones would not be expected to form a mist or aerosol in the present application, but rubbing the eyes after handling the soldering iron and silicone containers may introduce the material into the eyes.

The induction welding process located at the entrance to the preheat oven did not present any significant source of exposure to welding fumes or chemical agents. A NIOSH study addressing worker exposures to welding fumes associated with induction welding demonstrated negligible contaminant levels.[16]

The exhaust ventilation present on the curing oven through which organosol dip-coated objects passed was evaluated by the use of irritant smoke tubes and 3-minute smoke candles during the

follow-up survey. A newly installed auxiliary canopy exhaust hood located immediately at and slightly above the entrance to the cure oven was intended to remove any smoke or vapors rolling back out of the oven entrance. Smoke generated from smoke tubes at the top of the cure oven inlet were removed by the new hood. Additionally, when smoke candles were ignited, placed in a can attached to a hang wire, and sent through the cure oven while releasing smoke, no smoke was observed to escape from the oven even though the amount released was more than what would be generated during normal operating conditions. The oven and exhaust system were both in operation during the test as they would be during normal production.

A chiller hood located at the oven discharge allowed smoke to escape, but this unit was not designed to be an exhaust ventilation hood. The smoke candle in the chiller hood exceeded the clearance capabilities of the unit as they pertain to internal air movement. Considering the hood's location at the end of the cure oven (after the oven's own exhaust fan take-off) and its intended function of cooling parts, a situation resulting in the release of smoke as observed during the test is considered unlikely during normal operating conditions. For small amounts of vapors escaping from the oven, the hood is probably sufficient to prevent their escape into the take-off area.

Smoke tube plumes in the passageway and production area adjacent to the Wire Line indicated air movement into the area. This is probably the result of the exhaust ventilation present on the Wire Line equipment and in the ceiling. This may be responsible for an influx of odors from surrounding processes and activities in other parts of the building. The company had extended the cure oven exhaust stacks since the first survey to reduce the likelihood of recirculating exhaust air through the comfort ventilation heat exchanger unit.

No health hazard was considered to be present from the low or non-existent exposures to hexane, isooctane, methyl ethyl ketone, toluene, total alkanes, furfural, ethyl acetate, isopropanol, 1,1,1-trichloroethane, benzene, acrolein, vinyl chloride, carbon monoxide, and carbon dioxide. Carbon dioxide levels during the survey were a factor of 100 below concentrations associated with loss of consciousness, dizziness, and dyspnea (difficulty in breathing).[17]

The symptoms experienced by the Wire Line workers seemed to be related to one or more irritant or annoying odors in the plant. An important consideration in attempting to associate subjectively perceived odors with a health hazard is that the intensity or obnoxious qualities of odors do not present a consistent relationship for all substances between odor intensity and the existence of a potential health hazard. Although extensive

sampling for contaminants in the Wire Line Department has not produced any evidence of a specific causal substance, it is possible that the presence and combination of various process-related odors may contribute to the workers' irritant symptoms. Nonetheless, chronic health effects due to the presence of odors associated with materials present in the Wire Line process and from airborne contaminants at the concentrations documented during the survey is considered unlikely.

Odor sources in the Wire Line Department could include the preheat oven, the curing oven, the warm finished product as it comes out of the curing oven, the open vats of organosol, and trace quantities of material from the plastic nib-fusing procedure. Evaluation of solvent vapors coming directly off of the organosol tanks was not undertaken because (1) their temperature is maintained at a level lower than the cure oven through which organosol-coated items pass and which was evaluated; (2) the passive application process of the organosol to the wire items (i.e. mechanical dipping); (3) the fact that no worker is stationed in the immediate vicinity of these tanks for any length of time; and (4) the fact that neither the resin nor the plasticizer was considered to produce any appreciable amounts of vapors or mists as used in the process.

An additional concern raised by the union in the wire line addressed possible decomposition products, should the organosol come in contact with the electric heating elements located below the vats. Potential contaminants that could be released include carbon dioxide, carbon monoxide, hydrogen chloride, hydrocarbons, plasticizers, butyl-p-cresol, and chlorinated hydrocarbons.[18] Additional factors influencing the production of the contaminants would include time, temperature, and material composition. Generation of these contaminants from the organosol during normal operations is unlikely. The identification of two plasticizers, di(2-ethylhexyl)adipate and di(2-ethylhexyl)phthalate, as animal liver carcinogens from feeding studies conducted by the National Toxicology Program suggests that these compounds should be handled cautiously and that the amount of plasticizer containing mixtures openly exposed to workroom air be limited.[19,20]

B. Plastics II

The job of set-up workers in the Plastics II area involved adding additional powdered colorant to the colortronic units at the beginning of each shift (restocking). Additionally, when a color change was required they would be responsible for switching colorant containers on the units and cleaning out the hoppers. The cleaning had been done with a small hand brush at the time of the initial survey, but use of an industrial vacuum-cleaning system had been initiated by the time the follow-up survey was conducted.

Five (5) color changes per day is considered average. The color changes would not generally all be done by one individual.

Exposure of the set-up color changers to lead and chrome, including chrome VI, were well below the NIOSH action levels of one-half the recommended exposure limit. During the initial survey, two color changers were exposed to cadmium dust at the NIOSH recommended exposure limit of 0.04 mg/m^3 for a full shift and one exceeded the action limit with an exposure of 0.03 mg/m^3. During the follow-up survey, none of the four color changers monitored was overexposed to cadmium, although two still exceeded the NIOSH action level of 0.02 mg/m^3. The exposures do not seem to be related to the number of color changeovers, since two of the workers were only involved in the addition of powdered pigments to the colortronic units.

In addition to dust generated during color changeovers, exposures probably occur from the handling of the pigment prior to and during its addition to the colortronic units. Work practices generating visible quantities of pigment dust were the overfilling of pigment scoops when filling the colortronic units and tossing down empty boxes to the floor below. Problems associated with the pigment containers themselves included torn plastic liners resulting in spillage during emptying of boxes, the generation of dust from the displacement of air inside the container during pigment handling activities, and the absence of any cover on the container. Finally, although respirators were provided to workers if they requested them, some workers using respirators had beards (which makes a good fit impossible) and the issuance of a respirator by the employer to an employee, even if only because of the worker's request, necessitates including that individual in an established and acceptable respiratory protection program. The practice of carrying cosmetics, tobacco products, or food items by workers handling pigments provides an additional, avoidable route of exposure to the metals.

The yellow, chocolate, gold, dark almond, avocado, dark chocolate, and almond pigments all contain cadmium compounds, but the presence of these pigments in the Plastics II area does not represent a risk to other workers in the area not involved with the handling and loading of the colortronic units. The company indicated that they were working with their color supplier to eliminate the metals (e.g. cadmium and lead) from their pigments and also were undertaking efforts to devise a reusable pigment container which could also be used as a dispenser on the equipment.

Respirable and total dust samples for dust levels associated with the use of granular polyethylene were negligible. Material safety data sheets from the polyethylene manufacturer indicated that particle size for the pellets averaged 3175 micrometers (um) (0.125

inches), and the granular material had an average particle size of 6350 um (0.25 inches). Respirable dust is generally considered to have a particle size less than 10 um (0.0004 inches).

C. Summary

No specific substance was identified which could reasonably be considered responsible for symptoms being experienced by some of the Wire Line workers. Although odors associated with the process were noted in the area, extensive sampling for numerous contaminants associated with the Wire Line process did not indicate the presence of an existing or very probable overexposure to any single substance under the normal operating conditions of this area.

Color changers' exposures in the Plastics II Department, although lower during the follow-up survey than during the initial survey, are still at levels exceeding the NIOSH action level for cadmium in cadmium-containing dusts. Efforts undertaken by the company to reduce the workers' exposures are commendable and should be completed. During this transition stage, medical and industrial hygiene recommendations associated with exposure levels above the NIOSH action level should be instituted.

VIII. RECOMMENDATIONS

A. Wire Line

Organosol vats, except for the area where parts are being dipped, should be enclosed with removable covers in order to reduce the amount of surface area from which solvent vapors can escape. This would also reduce the potential for the evaporative release of other materials present in the organosol into the workroom environment.

Workers on the Wire Line should have access to drinking water to help decrease mild irritant symptoms and dry throat. The use of table top smoke removers should also be considered as one possibility in reducing the plastic soldering smoke generated in small quantities at the soldering stations.

The presence of odors in the area, although not themselves an actual health hazard, may be enhanced by the influx of air from surrounding plant areas, by changing weather conditions, production rates, maintenance of local exhaust equipment, and quantities of general make-up air to the area. If complaints by workers of odors persists, the company may wish to contract with a firm experienced in industrial exhaust ventilation to evaluate the existing balance of the total make-up and exhaust air systems present in the Wire Line Department. Considerations of comfort ventilation may also enter into this assessment.

B. Plastics II

The following corrective actions are recommended for the set-up workers (color changers):

Cadmium-containing pigments should be kept in closed containers, especially once a sack has been opened. Additionally, the transfer of the powder should be kept to a minimum and done in a manner to minimize dust generation.

All dry sweeping should be discontinued and preferably replaced with vacuuming, or at least wet mopping. The company should continue efforts to eliminate toxic metals from the pigments in favor of less toxic substitutes and to devise a more dust-free system of handling powdered materials.

Food storage, handling, and consumption should be prohibited in cadmium work areas. Smoking or carrying uncovered tobacco or tobacco products in cadmium work areas should also be prohibited.

Workers should wash their hands before eating or before using tobacco to prevent their absorbing additional amounts of cadmium compounds.

The respirators in use by set-up workers should be equipped with high-efficiency cartridges. Single-use respirators should not be used for cadmium dust, and cartridges provide better protection than the approved dust pre-filter clipped onto half-mask respirators without cartridges. Qualitative fit testing should be done when issuing respiratory protection, as well as at periodic intervals, and workers issued respirators should not be permitted to have beards that interfere with respirator fit.

Employees individually issued respiratory protection should be instructed in the proper inspection and maintenance of their equipment as well as being provided proper storage for the unit when not in use. Additionally, workers to whom respirators are issued should have received a medical evaluation for fitness to use a respirator.

Work clothing and street clothing should be exchanged at the beginning and end of each workday to prevent the wearing of contaminated clothing outside the workplace.

Periodic medical examinations are recommended for employees who may be exposed to hazardous levels of cadmium.[21] This would serve to establish a baseline for future health monitoring and to detect any pre-existing conditions which would place an exposed employee at increased risk. The examination should include evaluation of lung, kidney, and liver function.

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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, 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. Rubbermaid Incorporated, Wooster, Ohio
2. United Rubber Workers, Local 302
3. United Rubber Workers, International
4. NIOSH, Region V
5. OSHA, Region V

For the purpose of informing the approximately 40 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 I

Air Sampling and Analytical Methodology

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

Substance	Collection Media*	Flow Rate (Lpm)**	Analysis***	LOD****	References+
Acrolein and Formaldehyde	Coated Charcoal Tube	0.1	Gas Chromatography (NPD)	Acrolein 0.5 ug Formaldehyde 1 ug	See Appendix A
Carbon Monoxide	Ecolyzer 6000™	-	Electrochemical	0-100 ppm	Direct Reading
Cadmium (Cd), Lead (Pb), Chromium (Cr)	Mixed Cellulose Ester Filter	2	Atomic Absorption	Cd-2 ug Pb-3 ug Cr-3 ug	NIOSH Method No. P&CAM 127 (2)
Cadmium	Mixed Cellulose Ester Filter	2	Atomic Absorption	2 ug	NIOSH Method No. S312 (modified) (3) See Appendix A
Chromium VI	Polyvinyl Chloride Filter	2	Spectrophotometric	0.2 ug	NIOSH Method P&CAM 319 (4)
Ethanol	Charcoal Tube	0.1	Gas Liquid Chromatography	Not given	OSHA
Ethyl Acetate	Charcoal Tube	0.1	Gas Liquid Chromatography	Not given	OSHA
Formaldehyde	Coated XAD-2 Resin	0.05	Gas Chromatography (FID)	6 ug	NIOSH Method P&CAM 354 (modified) (5) See Appendix A

(continued)

TABLE I (continued)

Substance	Collection Media*	Flow Rate (Lpm)**	Analysis***	LOD****	References+
Formaldehyde	Detector Tube	-	Colorimetric	0.5-10 ppm	Direct Reading
Hydrogen Chloride	Detector Tube	-	Colorimetric	1-10 ppm	Direct Reading
Respirable Dust	Preweighed Filters and Stainless Steel Cyclone	8.9	Gravimetric	a	Sampling Data Sheet 29.02 (6)
Total Dust	Preweighed Filters	7.6	Gravimetric	a	Sampling Data Sheet 29.02 (6)
Vinyl Chloride	Charcoal Tubes (2 in Series)	0.1	Gas Chromatography (FID)	1 ug	NIOSH Method No. 178 (modified) (2) See Appendix A
Contaminant Characterization of Organics (Qualitative, Semi-Quantitative)	Charcoal Tubes	0.2	Gas Chromatography (FID); Gas Chromatography/ Mass Spectroscopy	10 ug	See Appendix A

* Sorbent tubes are standard size, filters are 37 millimeter in diameter held in cassettes, closed face.
** Lpm = liters per minute. 1000 liters = 1 m^3.
*** The type of detector used is given in parentheses. Appendix I presents analytical methods used which don't appear in the NIOSH Manuals of Analytical Methods, Vols. I-VII as well as modifications. NPD = nitrogen phosphorus detector; FID = flame ionization detector.
**** LOD = Analytical Limit of detection given in micrograms (ug) per sample.
+ Referenced NIOSH Methods which can be found in References 2 to 6 are given in parenthesis by the respective method number. Ethanol and ethyl acetate were OSHA samples analyzed by OSHA's laboratory.
a = Precision per weighing session was about 0.01 milligrams (10 ug).

TABLE II

Contaminant Exposure Evaluation Criteria and Health Effects Summary

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

Contaminant	Recommended Exposure Limit mg/m^3*	Source[1]	OSHA Standard mg/m^3	Symptoms and Health Effects[2]	Target Organs
Acrolein	0.25 (0.1)	ACGIH	0.25 (0.1)	Irritant to eyes, skin, mucous membranes; abnormal pulmonary function; delayed pulmonary edema; chronic respiratory disease	Heart, lungs, eyes, skin, respiratory system
Benzene	3.2 (1) C+	NIOSH	32 (10)	Irritant to eyes, nose, respiratory tract; giddiness; headache, nausea, staggered gait, leukemia	Blood, central nervous system, skin, bone marrow, eyes, respiratory system
Cadmium Dust	0.04	NIOSH	0.2	Pulmonary edema, dyspnea, cough, tight chest, substernal pain; headaches, chills, muscle ache; nausea, diarrhea; anosmia, emphysema; proteinuria, anemia; lung, prostate cancer	Respiratory system, lungs, kidneys, prostate, blood
Carbon Dioxide	9000 (5000)	ACGIH	9000 (5000)	Headache, dizziness, restlessness, paresthesias; dyspnea, sweating, malaise; increased heart rate, elevated blood pressure, coma, asphyxiation, convulsions	Lungs, skin, cardiovascular system
Chromium Metal	0.5	ACGIH	1	Histologic fibrosis of lungs	Respiratory system, lungs
Chromium VI	0.001	NIOSH	0.1	Nose and respiratory tract irritation; conjunctivitis, skin ulcers, sensitization dermatitis, lung cancer	Lung, respiratory system, eyes, skin
Ethanol	1900 (1000)	ACGIH	1900 (1000)	Mild eye and nose irritant; headache, drowsiness, tremors, fatigue; may enhance toxicity of other chemical agents	Eyes, respiratory system, central nervous system

(continued)

TABLE II (continued)

Contaminant	Recommended Exposure Limit mg/m³*	Source[1]	OSHA Standard mg/m³	Symptoms and Health Effects[2]	Target Organs
Ethyl Acetate	1400 (400)	ACGIH	1400 (400)	Irritant to eyes, nose, throat; narcosis; dermatitis	Eyes, skin, respiratory system
Formaldehyde	NEL[3]	NIOSH	3.7 (3 ppm)	Irritant to eyes, nose, throat; lacrimation; burning nose, cough; bronchial spasms, pulmonary irritation; dermatitis; nausea, vomiting, loss of consciousness	Respiratory system, lungs, eyes, skin, animal carcinogen (nasal)
Furfural	8 (2)	ACGIH	20 (5)	Irritant to eyes, upper respiratory tract; headache; dermatitis	Eyes, respiratory system, skin
Isopropanol	980 (400)	NIOSH	980 (400)	Mild irritant to eyes, nose, throat; drowsiness, dizziness, headache; dry, cracking skin; gastrointestinal cramps; nausea; diarrhea	Eyes, skin, respiratory system
Lead	0.05	NIOSH	0.05	Lassitude, insomnia, anorexia, weight loss, malnutrition, constipation, abdominal pains; anemia, tremors, wrist paralysis, kidney damage	Gastrointestinal system, central nervous systems, kidneys, blood
Methyl Ethyl Ketone	590 (200)	ACGIH	590 (200)	Irritant to eyes and nose, headache, dizziness, vomiting	Central nervous system, liver
Octane (Isooctane)	350 (75)	NIOSH	2350 (500)	Irritant to eyes and nose, drowsiness, dermatitis	Skin, eyes
Respirable Dust[4]	5	ACGIH	5	Reduction of visibility; unpleasant deposits in eyes, ears, nasal passages; direct chemical or mechanical injury to skin, mucous membranes	Respiratory system, skin, mucous membranes
Total Dust[4]	10	ACGIH	15		

(continued)

TABLE II (continued)

Contaminant	Recommended Exposure Limit mg/m^3*	Source[1]	OSHA Standard mg/m^3	Symptoms and Health Effects[2]	Target Organs
Stoddard Solvent (C_7-C_{12})	350	NIOSH	2900 (500)	Irritation of eyes, nose, throat; dizziness; dermatitis	Skin, eyes, respiratory system, central nervous system
Toluene	375 (100)	NIOSH	750 (200)	Fatigue, weakness; confusion, euphoria, dizziness, headache; dilation of pupils, lacrimation; nervousness, muscle fatigue, insomnia; paresthesias, dermatitis, photophobia	Central nervous system, liver, kidneys, skin
Vinyl Chloride	MDL++	NIOSH	2.55 (1)	Irritation of eyes and skin; dizziness, nausea; human carcinogen (liver); acroosteolysis	Skin, eyes, liver, lungs, central nervous system

1. Sources: NIOSH/OSHA Pocket Guide to Chemical Hazards, 1979 (Ref. 7).
ACGIH Threshold Limit Values for Chemical Substance and Physical Agents in the Workroom Environment with Intended Changes for 1982 (Ref. 8).
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3. MDL: No exposure limit recommended. NI[illegible] recommends an exposure [illegible] to the lowest feasible limit [illegible] work practices (Ref. 12).

4. These dust [illegible] which have [illegible] disease or [illegible] are kept under control.

* mg/m^3: milligrams per cubic meter. One milligram (mg) equals 1000 micrograms (ug). Parts per million (ppm) values where applicable are given in parentheses. All values are time-weighted average (TWA) for a full 8-hour (in the case of NIOSH up to a 10-hour) work shift, 40-hour workweek.

** The OSHA formaldehyde standard is also given in parts per million (ppm) in parentheses.

\+ C: indicates ceiling. Benzene ceiling is for 60-minute duration.

++ MDL: Minimum detectable level. No detectable exposure permitted to recognized human carcinogens.

TABLE III

Formaldehyde Exposure Sampling Results
Bowman Warehouse Wire Line

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

June 15, 1982

Sample Description			Formaldehyde Concentration in ppm (mg/m^3)*
BZ/A[1]	Job or Location	Duration-min[2]	
BZ	Wire finisher	427	N.D.[3]
BZ	Wire finisher	424	N.D.
BZ	Wire finisher	423	N.D.
BZ	Wire finisher	420	N.D.
BZ	Wire finisher	413	N.D.
BZ	Welder finisher	399	N.D.
A	Cure oven inlet	189	N.D.
A	Cure oven inlet	232	N.D.
A	Aisle by lunchroom	411	N.D.
Analytical Limit of Detection:			0.006 mg/sample
Calculated Environmental Limit of Detection:[4]			0.2 ppm (0.3 mg/m^3)
Evaluation Criteria:			See Table II

Notes: 1 - BZ = breathing zone; A = area sample
2 - Duration of Sampling given in minutes (min)
3 - N.D. = none detected, concentrations present were below analytical limits of detection.
4 - Calculated environmental limit of detection is based on an average air sample volume of 19 liters.
* - ppm = parts per million; mg/m^3 = milligrams per cubic meter.

TABLE IV

Quantitative and Qualitative Sampling Results for Selected Airborne Organic Vapors Present at the Bowman Street Wire Line and Extrusion Area

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

January 19, 1983

Sample Description*				Contaminant Concentration in Milligrams per Cubic Meter (mg/m^3)**										
Sample Set	Location	Duration (minutes)	Volume (liters)	Acrolein	Benzene	Ethanol	Formaldehyde	Hexane	Isooctane	MEK*	Toluene	Total Alkanes*	Undecane	Vinyl Chloride
2	Induction Welding, Wire Line, General Area Sample Approximating a > Workers Breathing Zone Height (3 Samples)	520	50.2	<0.01+	-	-	0.04	-	-	-	-	-	-	-
		520	105.2	-	<0.05	0.07	-	0.06	0.16	0.07	0.14	7.60	1.90	-
		520	53.6	-	-	-	-	-	-	-	-	-	-	<0.02
3	Curing Oven Inlet, Wire Line, Process Sample, Inside a > Hood Opening (3 Samples)	532	52.1	0.43	-	-	0.33	-	-	-	-	-	-	-
		532	105.7	-	0.10	<0.05	-	0.07	0.16	0.16	0.27	89.88	23.65	-
		532	54.0	-	-	-	-	-	-	-	-	-	-	<0.02
4	Wire Line Takeoff, Wire Line, General Area Sample, Suspended Directly Above Takeoff > Worker (3 Samples)	530	54.0	<0.01	-	-	0.05	-	-	-	-	-	-	-
		530	102.		0.05	0.07		0.06	0.16		0.14	7.60		
		530	54.1											0.
1	Extruder Area, General Area, Sample by Extruder Head, Running a > Colorless Polyethylene (3 Samples)	512	48.0	0.01	-	-	0.04	-	-					
		512	95.4	-	<0.05	0.07	-	0.06	0.16	0.07	0.14	7.60	1.90	-
		512	54.2	-	-	-	-	-	-	-	-	-	-	<0.02
Analytical Limit of Detection (in mg)***				0.0005	0.005	0.005	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.001

(continued)

TABLE IV (continued)

Sample Description*				Contaminant Concentration in Milligrams per Cubic Meter (mg/m^3)**										
Sample Set	Location	Duration (minutes)	Volume (liters)	Acrolein	Benzene	Ethanol	Formaldehyde	Hexane	Isooctane	MEK*	Toluene	Total Alkanes*	Undecane	Vinyl Chloride
Evaluation Criteria (in mg/m^3)++														
									(octane)			(Stoddard Solvent)		
	NIOSH			-	3.2b	-	NELc	-	-	590	375	350	-	MDLd
	OSHA			0.25	32	1900	2.5	1800	2350	590	750	2900	-	2.5
	ACGIH			0.25	32b	1900	NELc	180 (n-hexane)	1450	590	375	525	-	MDLd

* Sample Description Key: a- indicates values by row which are qualitative and semi-quantitative. b-[illegible] on the day sampled, yellow and almond organosol were used. MEK = methyl ethyl ketone. Total alkanes covers the 10 to 12 carbon chain compounds including undecane.

** Concentrations are given in milligrams per cubic meter (mg/m^3), weights in milligrams.

[illegible] denotes concentration was below the calculated environmental limit of detection for that specific [illegible] listed in the table.

*** See Table I.

++ See Table II. b Denotes compound is considered to be a carcinogen or suspect carcinogen necessitating that exposure levels be kept at the lowest feasible level. c NEL = Substance an animal carcinogen, No Exposure Limit (NEL) recommended. d MDL = Minimum Detectable Level, i.e., environmental exposures to vinyl chloride should be kept below the detection limits of valid industrial hygiene samples.

TABLE V

Ethyl Acetate and Ethyl Alcohol Exposure Levels Determined by OSHA
Bowman Street Facility

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

January 20, 1983

Sample Description*		Contaminant Concentration in mg/m^3 (ppm)**	
Type and Location	Duration (min)	Ethyl Acetate	Ethanol
BZ Utility Operator	445	72 (20)	65 (50)
BZ Extruder - Printer Operator	442	72 (20)	65 (50)
Area Sample Between Extrusion Area and Induction Welding on Wire Line	420	<72 (20)	<65 (50)
Area Sample on Work Table at Take-Off End of Wire Line	417	<72 (20)	<65 (50)
Evaluation Criteria (see Table II)		1400 (400)	1900(1000)

* BZ indicates breathing zone exposure value followed by job title. Area samples are given by location. Duration is given in minutes.

** Concentrations given in milligrams per cubic meter (mg/m^3) with parts per million equivalent (ppm) in parentheses. < indicates concentration if present is below specified value.

TABLE VI

Area Grab Sample Results for Carbon Monoxide and Carbon Dioxide
Bowman Warehouse Wire Line

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

January 19, 1983

Sample Location	Contaminant	Concentration in mg/m^3 (ppm)*
Extrusion Area	Carbon Monoxide	None Detected
Wire Line - Welding End	Carbon Monoxide	None Detected
Wire Line - Preheat Oven Exit	Carbon Monoxide	2.3-4.6 mg/m^3 (2-4 ppm)
Wire Line - Cure Oven Inlet	Carbon Monoxide	None Detected
Extrusion Area	Carbon Dioxide	0.07%=1260 mg/m^3 (700 ppm)
Wire Line Area	Carbon Dioxide	0.07%=1260 mg/m^3 (700 ppm)
Evaluation Criteria (see Table II)	Carbon Monoxide	40 mg/m^3 (35 ppm)
	Carbon Dioxide	9000 mg/m^3 (5000 ppm)

* mg/m^3 = milligrams per cubic meter. Parts per million (ppm) are given in parestheses. Carbon dioxide values are also presented in percent with the calculated mg/m^3 and ppm values.

TABLE VII

Airborne Exposure Levels to Cadmium, Lead, Total Chromium,
Chromium VI, and Nuisance Particulate in the Plastics II Department

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

June 15, 1982

Sample Description					Contaminant Concentration in mg/m³*				
BZ/A[1]	Job or Location	No. Color Changes	Color[2]	Duration-min	Cd	Pb[3]	Cr[3]	Cr VI	Resp/Total Dust
BZ	Setup/Color Changes	1	yel, alm, cho	440 (465)**	0.043	<0.004	<0.004	0.0003	-
BZ	Setup/Color Changes	1	gld, cho, lta, dka, wht	457	0.011	<0.003	<0.003	<0.0002	-
BZ	Setup/Color Changes	3	gld, yel, alm, cho, icb, wht	462	0.029	<0.004	<0.004	0.0004	-
BZ	Setup/Color Changes	0	cho, alm, avo	450	0.037	0.006	0.011	-	-
A	Machine C-5 hopper/ colortronic platform (Pelletized resin)	-	-	255	-	-	-	-	0.08/0.18
A	Machine [illegible] hopper/ colortronic platform (pelletized resin)			[illegible]					[illegible]
Analytical [illegible]									
Evaluation [illegible]					0.04	[illegible]	0.5	[illegible]	[illegible]

Notes: 1 - BZ = breathing zone; A = area sample
2 - Colors: alm = almond; avo = avocado; cho = chocolate; dka = dark almond; gld = gold; icb = ice blue; lta = light almond; wht = white
3 - Value given with less than (<) are calculated to be environmental limits of detection for that specific sample.
* - Concentrations are given in milligrams (mg) per cubic meter (m^3). Cd = cadmium; Pb = lead; Cr = total chromium; Cr VI = chromium VI; Resp/Total Dust is respirable and total dust obtained from area samples and is presented as respirable value/total value.
** - For this particular individual the sampling train for Cd, Pb, and total Cr failed necessitating pump replacement which reduced total sampling time for these three agents to 440 minutes. The Cr VI sample ran 465 minutes.

TABLE VIII

Breathing Zone Exposure Levels to Cadmium Dust
in the Plastics II Department

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

January 19, 1983

Sample Description*				Cadmium Concentration in mg/m^3**
Job	No. Color Changes	Colors	Duration (minutes)	
Setup/Color Changes	1	alm, cho	459	0.005
Setup/Color Changes	0	alm, cho	466	0.025
Setup/Color Changes	1	alm, gld, yel	463	0.008
Setup/Color Changes	1	cho, gld, icb, ltb, wht	465	0.023
Analytical Limit of Detection (see Table I)				0.002 mg
Evaluation Criteria (see Table II)				0.04 mg/m^3

* Colors: alm = almond; cho = chocolate; gld = gold; icb = ice blue; ltb = light blue; yel = yellow; wht = white.

** mg/m^3 = milligrams per cubic meter.

APPENDIX A

Special Analytical Methods

Rubbermaid Incorporated
Wooster, Ohio
HETA 82-223

Acrolein and Formaldehyde

The method used for analysis of acrolein and formaldehyde employs sorbent coated with 2-hydroxymethylpiperidine and is being evaluated concurrently for aldehyde analysis. The method has not been evaluated for formaldehyde, therefore, at this time the collection efficiency and sample stability of formaldehyde is unknown.

Sample treatment: The front and back sections of each tube were desorbed separately in 2 ml each of toluene and then agitated for 30 minutes in an ultrasonic bath. The solutions were separated from the sorbent and transferred to autosampler vials for analysis. The range of standards used for calibration was 1 to 10 ng/ul.

Samples were analyzed using a Varian 3700™ gas chromatograph equipped with a nitrogen-phosphorus detector. The column was a 6' by 1/4" glass column packed with 5% SP-2401-DB on 100/120 mesh supelcoport. The temperature programming was 90°C for 8 minutes, increasing 20°/min to 200°C, holding here for 16 minutes. The injector and detector temperatures were 230°C and 250°C respectively.

Characterization of Total Organics

All charcoal samples were desorbed with 1 ml carbon disulfide spiked with hexadecane as an internal standard. They were analyzed by gas chromatography (FID) using a 30 meter DB-1 bonded phase fused silica capillary column (spitless mode). Two of the samples were further analyzed by GC/MS to identify compounds present. Since only "semi-quantitative" indications of the amounts present were requested, concentrations of the various analytes identified were estimated based on only one standard containing the compounds of interest.

Modifications

Cadmium: NIOSH Method No. S312
In addition to the nitric acid specified in the method, perchloric acid was used to get more complete ashing of the filters.

Formaldehyde: NIOSH Method No. P&CAM 354
Modification of the analytical method involved desorbing front and back sections of the tubes with two milliliters (ml) of methyl alcohol instead of isooctane, containing 0.5 microliters (ul) per milliliter of 2-phenyl ethyl alcohol as an internal standard.

Vinyl Chloride: NIOSH Method 178
The A and B sections of the samples were separated and analyzed by gas chromatography using NIOSH Method 178 with the following modifications.

Desorption Process:	1 hour minimum in 1 ml of carbon disulfide containing 1 microliter per milliliter of hexane as an internal standard
Gas Chromatograph:	Hewlett-Packard Model 5730A equipped with a flame ionization detector
Column:	6' by 1/8" glass 1% SP-1000 on Carbopack B
Oven Conditions:	Thermal programming, 70°C to 190°C

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