U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-65-348

SHELLER-GLOBE CORPORATION
HARDY DIVISION
UNION CITY, INDIANA

DECEMBER 1976

I. TOXICITY DETERMINATION

It has been determined that under present conditions, employees working with or near the polyvinyl chloride (PVC) injection molding process in Department 1700 are not exposed to detectable levels of vinyl chloride (VC) vapors. This determination is based on direct measurements and collected air samples taken during both normal and purging operations of injecting molding machine No. 4 on July 12 and 13, 1976. Hydrogen chloride (HCL), a thermal decomposition product of PVC, was also not detected during PVC injection molding.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from NIOSH, Division of Technical Services, Information and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies have been sent to:

A. Sheller-Globe Corporation, Hardy Division, Union City, Indiana
B. Authorized Representative of Employees
C. U.S. Department of Labor - Region V
D. NIOSH Regional Consultant for OSH - Region V
E. NIOSH - DTS, Information Resources and Dissemination Section

For the purposes of informing the approximately 44 "affected employees," the employer will promptly "post" the Determination Report in a prominent place where the affected employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees of the Sheller-Globe Corporation regarding possible exposure to vinyl chloride (VC) during injection molding of polyvinyl chloride (PVC) pellets in Department 1700 at the Sheller-Globe, Hardy Division Plant at Union City, Indiana.

IV. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

The Sheller-Globe Corporation, Hardy Division, is engaged in the manufacture of a wide variety of small metal castings and in the fabrication of plastics products for use on automobiles or home appliances.

Ten plastic molding machines are located in Department 1700. Machine No. 4 is the only machine used for molding PVC plastic. Approximately 44 people are employed in Department 1700. This includes eight or nine plastic molders, three set-up men, one materials handler, one inspector and one foreman (working each of three eight-hour shifts), plus the department supervisor. Plastic molders (machine operators) are assigned to operate a different machine each working day. This rotation allows each plastic molder to operate all machines within a two-week period. One of the ten machines had been newly installed at the time of this evaluation and was not in operation.

Molding machine No. 4 is set up for molding with PVC plastic pellets in order to fabricate flexible horn rim covers used on steering wheels of the American Motors Corporation Jeep vehicles. At the time of this evaluation, only four to six days were needed to process a one-month demand for the horn covers. Machine No. 4 was used to fabricate other plastic products from acrylonitrile butadiene styrene (ABS) molding material during the remainder of the monthly production schedule.

Thermoplastic molding pellets manufactured by Reichhold Chemical Inc., Jeffersontown, Kentucky, containing approximately 50 percent PVC resin, combined with plasticizers, stabilizers and pigment, are withdrawn from the pellet shipping boxes which are placed next to the molding machine. Flexible suction hoses are placed in the boxes which feed the pellets into a cylindrical shaped holding bin mounted on top of the molding machine. Pellets are funneled from the bottom of the bin into the molding machine where they are heated to provide the proper degree of fluidity (approximately 400° - 450° F). The melted PVC plastic is then injected and compressed into a two cavity water-cooled mold which rapidly cures the molded horn cover to approximately 100°F. After curing, the mold is automatically opened and the operator removes, by hand, two horn covers which are manually trimmed of excess plastic and packed in shipping boxes. The complete molding cycle requires about 20 seconds.

A small grinder was located near the molding machine operators' work station and was used to repelletize PVC plastic scrap and trimmings.

PVC plastic horn covers were molded in five different colors (black, tan, green, berry and blue). During color change, "purging" of the injection machine is performed by the set-up man. The injection nozzle is withdrawn from the mold and the hot liquid PVC plastic is forced from the melting chamber until the unneeded color is fully purged from the machine by the new replacement color. The hot liquid plastic is allowed to pile up below the nozzle and is then discarded by the set-up man who lifts the soft mass with a screwdriver and places it into a trash container. Some smoke and odor is generated during purging from the molten plastic which accumulates below the nozzle. Only general room ventilation was provided, and smoke was exhausted through roof mounted exhaust fans.

B. Evaluation Design

Prior to the initial survey, it was determined that employees were concerned about potential health hazards associated with molding PVC. PVC plastic pellet container boxes were labeled in accordance with 29 CFR, Part 1910, 1017 (Occupational Safety and Health Standard for Vinyl Chloride)[4] indicating PVC contains vinyl chloride, a cancer-suspect agent. Initial monitoring for VC had never been performed in Dept. 1700 and employees were anxious to know if VC vapors were driven off from PVC plastic when heated. Monitoring data from other industries has indicated that VC concentration levels above 1 ppm (current OSHA standard) can exist in PVC fabrication operations. Furthermore, PVC, when heated to temperatures in excess of 160° C (320°F) can release hydrogen chloride gas (HCL) due to thermal decomposition.[2] It was decided that direct measurements for HCL and VC should be taken during the initial survey using colorimetric gas detector tubes. Air samples were also to be collected and analyzed to obtain accurate quantitative data to determine actual VC concentration levels near the PVC injection molding machine.

C. Evaluation Methods

1. Initial Survey Sampling (July 12 and 13, 1976)

Detector tube measurements were made approximately one foot above the south side of the molding cavity and other measurements were taken directly above the injection nozzle during purging (period of greatest smoke and vapor odor). The time required for each measurement was 5-10 minutes and represented approximately 15-30 cycles or "shots" of the molding machine.

During single cavity molding on July 12, four measurements, two VC (one during purging) and two HCL, were made. One additional VC and HCL measurement was taken on July 13 when both mold cavities were in use. No detectable levels of vinyl chloride or hydrogen chloride gas were found. The detector tubes used were designed to measure levels of VC between 1 - 10 ppm and HCL between 1 - 10 ppm.

Vinyl chloride vapors were also sampled using charcoal tubes. Two charcoal tubes were connected in series to a small battery powered sampling pump which had been calibrated in order to determine the exact quantity of the air sample drawn through the charcoal tubes. Because vinyl chloride tends to migrate throughout the charcoal tube after sampling, the down stream tube of the sampling train served as backup for the upstream tube. A 50 cc/min. flow rate for the sampling pumps was required to provide adequate adsorption of VC by the activated charcoal.

Personal air samples were obtained by attaching air sampling equipment to the "plastic molder" operating injection machine No. 4 and to the operator on No. 5 as well. The "set-up man" assigned to "purge" machine No. 4 also wore a sampling pump. Air samples were taken from two fixed locations--one above the drinking fountain installed adjacent to machine No. 4 and the other positioned directly on the molding machine approximately one foot above the injector nozzle. Sampling times ranged from four to five hours for the personal and area samples, respectively.

2. Private Employee Interviews

During the survey on July 12 and 13, 1976, first and second shift employees working in Dept. 1700 were interviewed privately by NIOSH industrial hygienists to determine if employees felt they had experienced health problems which they believed were work related. The 11 plastic molders and three set-up men interviewed had all worked directly with the PVC injection molding machine No. 4 due to the daily rotation of work station assignment. These employees had worked in Dept. 1700 from one to five years (average 3.8 years).

D. Evaluation Criteria

In order that workers may better understand the potential health hazards associated with PVC plastic fabrication, the following discussion is provided.

PVC is a white thermoplastic substance which has good mechanical and electrical properties and is highly resistant to chemicals. PVC is produced by the polymerization of VC gas in the presence of catalysts such as organic peroxide, persulphates and ozone.[3] The properties of the PVC resin can be modified by the addition of plasticizers, stabilizers, filling agents and pigments. The PVC resin itself is not thought to be toxic; rather it is the unreacted vinyl chloride gas which is of concern. Vinyl chloride has been identified as a causative agent in the development of angiosarcoma, a rare and fatal form of liver cancer. The current OSHA standard for vinyl chloride has established the maximum permissible exposure to VC at 1 ppm time weighted average for any eight hour period.[4] NIOSH recommends that no employee be exposed to measurable amounts of VC gas, since no safe level has been determined.[7]

Hydrogen chloride gas can be generated as a thermal decomposition product of PVC at temperatures above 160° C.[2] HCL gas is colorless and is highly irritating to the mucous membranes of the eyes and upper respiratory tract. Prolonged exposure to low concentrations may cause erosion of the teeth.[5] The present threshold limit value established by the American Conference of Governmental Industrial Hygienists is 5 ppm.[6]

E. Evaluation Results and Discussion

Sampling results from the survey on 12 and 13, July, 1976, revealed no detectable levels (less than one microgram per sample) of vinyl chloride gas. No vinyl chloride was detected on any of the charcoal tube samples. Using carbon disulfide to desorb any vinyl chloride collected on the activated charcoal, each sample was analyzed using a gas chromatograph with a flame ionization detector. Maximum sensitivity of this equipment was reported to be one microgram per sample, one microgram per sample is equivalent to 0.07 ppm based on the smallest air sample volume taken during this survey. Using the largest air sample volume, analytical sensitivity is increased to 0.026 ppm.

Information provided by the supplier (Reichhold Chemical Inc.) of the PVC plastic pellets used by Sheller-Globe indicate that any residual VC gas which might have been entrapped in the PVC resin after polymerization is almost completely dissipated during mixing of the PVC resin with plasticizers, stabilizers and pigments. Vinyl chloride measurements taken by the supplier were reported to be less than 0.1 ppm at the location where the PVC pellets are placed in containers prior to shipment.

One of the 14 employees interviewed during the survey apparently had occasionally experienced a skin rash on the hands when handling freshly cured PVC plastic products (horn covers). Otherwise, employees had experienced no difficulty or symptoms of irritation from the PVC plastic molding process.

F. Conclusions

Considering the negative readings found on the VC and HCL colorimetric gas detector tubes and the fact that VC gas was not detected on any of the charcoal tube air samples, it can be stated that PVC plastic injection molding as performed under existing conditions does not present a health hazard to the employees of Dept. 1700. The fact that none of the 14 employees interviewed had experienced symptoms of eye irritation or upper respiratory difficulties while working near the PVC injection machine tends to support this determination.

G. Recommendations

Implementation of the applicable portion of the OSHA standard on vinyl chloride should be accomplished. Management and union representatives were not familiar with the requirements to determine actual employee exposure and to maintain records of VC measurements taken. An effective employee training program is also needed to explain the VC standard and the potential hazards of vinyl chloride gas and its use in the manufacture of polyvinyl chloride resin.

Injection molding department employees should be encouraged to report any symptom or irritation experienced which they feel might be associated with their work place exposures to any plastic molding process or their handling of any freshly fabricated plastic product. White cotton gloves should be provided to any worker who may have an increased sensitivity to certain plastic resins, plasticizers, pigments, etc. thereby preventing direct contact of the worker's skin with such substances.

V. REFERENCES

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3. Lefaux, Rene, Practical Toxicology of Plastics, 18 (1968).

4. Title 29, Code of Federal Regulations, Part 1910. 1017.

5. Patty, Frank A., Industrial Hygiene and Toxicology, Volume II, Revised Edition, 851 (1967).

6. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes of 1975, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio (1975).

7. NIOSH Recommended Standard for Occupational Exposure to Vinyl Chloride, NIOSH, Cincinnati, Ohio (1974).

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