HETA 86-071-1817
JULY 1987
DUBOIS CHEMICAL COMPANY
SHARONVILLE, OHIO

NIOSH INVESTIGATOR:
Steven H. Ahrenholz, C.I.H.

## I. SUMMARY

On December 9, 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation (HHE) from Local 774 of the International Union of Electronic, Electrical, Technical, Salaried and Machine Workers (IUE). The request concerned exposures to numerous substances (in excess of 700) used in batch formulation of specialty chemicals for institutional and industrial applications. Workers were concerned that existing exposures may be responsible for a variety of health effects such as birth defects, lung problems, nosebleeds, headaches, and respiratory irritation. The products manufactured include washing compounds, water and waste treatment chemicals, sanitation products, specialty cleaning and maintenance compounds, cutting fluids and metalworking specialty products, and specialty lubricants. About 80 workers are involved in production.

The HHE involved an industrial hygiene survey for specific contaminants and groups of contaminants. Noise exposure evaluation and a limited ventilation assessment were also performed. Contaminant and noise sampling was generally limited to personal exposures. Contaminants evaluated included: sodium hydroxide dust (NaOH), hydrochloric acid (HCl) and phosphoric acid ($H_3PO_4$), methylene chloride, and toluene. Due to the vast number of raw materials potentially present and the nature of batch production, our evaluation of worker exposures was limited. The evaluation focused on the overall effectiveness of company's industrial hygiene program for controlling exposures to all potential contaminants. NIOSH investigators conducted a walk through survey December 18, 1985, and a follow-up industrial hygiene survey April 9-11, 1986.

Full-shift noise exposures ranged from 78 to 88 dB(A) TWA with a mean of 82 dB(A) TWA. The percent of the daily allowable noise exposure based on the OSHA noise PEL of 90 dB(A) for eight hours ranged from 19 to 74%. Five workers had full-shift noise exposures at or above 85 dB(A) TWA, the NIOSH recommended exposure limit. Maximum one minute average noise levels encountered by workers during the shift ranged from 88 to 113 dB(A). Overall area noise measurements ranged from 84 to 96 dB(A).

Personal chemical exposure sampling results are: NaOH-below detectable levels (ND) up to 0.63 milligrams per meter cubed of air (mg/m$^3$) with an arithmetic mean of 0.12 mg/m$^3$, OSHA Permissible Exposure Limit (PEL)-2mg/m$^3$, NIOSH Recommended Exposure Limit (REL)-2 mg/m$^3$ ceiling; HCl-range ND up to 0.05 mg/m$^3$ with a mean falling between detectable and quantifiable levels, OSHA PEL-7 mg/m$^3$ ceiling; and $H_3PO_4$-all values were ND, OSHA PEL 1 mg/m$^3$. Solvent exposures during the survey were limited to three workers formulating or packaging solvent containing products. Time weighted average exposures for two Liquid Compounders to methylene chloride were 10 mg/m$^3$ and 6.6 mg/m$^3$, and 380 mg/m$^3$ for the Liquid Packager. The OSHA PEL is 1735 mg/m$^3$, however NIOSH recommends that methylene chloride levels be maintained as low as feasible and that it be treated as a potential occupational carcinogen. Full-shift toluene exposure for the Liquid Compounder was 0.6 mg/m$^3$, and 45 mg/m$^3$ for the Liquid Packager. The OSHA PEL for toluene is 751 mg/m$^3$, the NIOSH REL 375 mg/m$^3$.

Noise levels in the facility represent a risk for potential hearing impairment. Some areas and equipment generate sufficiently high noise levels (85 dB(A) or greater) to present an auditory hazard for unprotected workers in the immediate area. Contaminant exposures measured were below levels associated with adverse health effects, except for methylene chloride. Significant exposures to this latter compound represent not only an acute hazard from the formation of elevated blood carboxyhemoglobin levels and central nervous system effects but may also represent a long-term health effect considering methylene chloride's status as a potential occupational carcinogen.

NIOSH investigators have concluded from data gathered during the conduct of this HHE that a health hazard exists from exposures to methylene chloride. Full-shift noise exposures in excess of 85 dB(A) represent an auditory hazard. The presence of levels throughout the production and maintenance areas in excess of 90 dB(A) indicates that individual workers' noise exposures at or in excess of the OSHA PEL are possible. Exposures to sodium hydroxide, hydrochloric and phosphoric acids, and toluene were well below both mandatory and recommended exposure criteria. Recommendations addressing chemical substitution, local exhaust ventilation, personal protective equipment, work practices, a hearing conservation program and housekeeping are presented in Section IX of this report.

KEYWORDS: SIC (2842 Specialty Cleaning, Polishing, and Sanitation Preparations) batch process, methylene chloride (CAS #75-09-2), noise, acids, alkaline dust, ventilation, personal protective equipment.

## II. INTRODUCTION

On December 9, 1985, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from Local 774 of the International Union of Electronic, Electrical, Technical, Salaried and Machine Workers (IUE). The request concerned worker exposures to numerous substances used at the DuBois Chemical Company, Sharonville, Ohio, in the production of specialty chemicals for institutional and industrial applications. Exposures to dusts and vapors generated during production were the requestors primary concern. NIOSH investigators conducted an initial industrial hygiene survey December 18, 1985, to further define the concerns of the request and to obtain information in preparation for the follow-up survey. The follow-up industrial hygiene survey was conducted April 9-11, 1986. Letter reports with data concerning high level or overexposures were sent to management and labor representatives May 13, 1986, and June 11, 1986.

## III. BACKGROUND

### A. Product Lines and Raw Materials:

DuBois Chemical, a division of Chemed Corporation, produces specialty chemicals for institutional and industrial applications. Product lines formulated at the Sharonville, Ohio production facility include dishwashing compounds, kitchen sanitation products, laundry products, housekeeping products, specialty cleaning and maintenance compounds, cutting fluids and other metalworking specialties, water and waste treatment chemicals, and specialty lubricants. Final product form may be liquid or powder, with approximately 85 to 90% of current production involving liquid formulations. About seven million pounds of product are produced monthly. The company formulates about 400 different products from over 700 raw materials. Examples of the classes of raw materials used include acids, bases, solvents, fragrances, surfactants, emulsifiers, oils, waxes, starches, alcohols, metal salts, glycols, fatty acids, water, silicones, resins, and biocides. All production is done in batches. Raw material exposures evaluated included alkaline dust (sodium hydroxide), acids (hydrogen chloride and phosphoric acid), and solvents (toluene and methylene chloride).

### B. Process Description:

Product formulation takes place on the mezzanine where the various raw materials are added to one of two types of mixing units depending upon whether the final product is a powder or a liquid. Powder products are blended in ribbon blenders (also called powder mixers). The powder raw materials are either conveyed to the mixers from bulk storage tanks outside by a pneumatic material handling system or are added manually from paper bags or drums delivered to the area on pallets. Liquid constituents are added manually from drums or with pails.

Liquid product formulation takes place in kettles which range in capacity from 500 to 8000 gallons. Liquid raw materials are pumped directly into the kettles from bulk storage tanks located outside. Alternate and supplemental methods of delivering liquid raw materials to the kettles include hoses run from pipeline manifolds to the tanks and emptying of 55 gallon drums through the kettle charging door. Powder materials are added to kettle mixtures in the same way. The production floor is divided into two primary areas-powder mixing and liquid compounding.

Batch sheets are generated for each product made during a shift. The batch sheet also contains safety measures to be followed during production of the batch and necessary personal protective equipment. A two-man crew in the powder mixing area of the mezzanine makes 12 to 18 powder batches per shift. Each liquid compounder is generally assigned to make three batches per shift.

Once the blending process is completed, the product is drawn from the bottom of the respective ribbon blender through a holding hopper or from the kettle to a packaging station located on the ground floor immediately beneath the mezzanine. In this area powdered materials may be packaged into boxes, pouches, pails, or drums. Liquid products are packaged in gallon bottles, five gallon containers, 55 gallon drums and bulk packs. This area is divided into two areas-powdered packaging and liquid filling.

The determination of what products will be made during each shift is usually made during the latter part of the preceding workshift or in the morning immediately prior to the start of the day shift.

C. Engineering Controls and Personal Protective Equipment:

Local exhaust ventilation connections are present on the liquid blending kettles and the powder mixers as well as the pneumatic bulk powder handling system. Elephant trunk and lip exhaust ducts are present at the powder take-out stations.

Bulk raw material handling systems are present for large quantity and frequently used raw materials. Drummed and bagged raw materials are also used extensively.

Personal protective equipment in use by workers and required for some activities or in some areas includes respirators, hearing protection, gloves, aprons, and face shields. Safety goggles are required only in the liquid areas but hard hats and safety shoes are required plant-wide.

Housekeeping activities include a propane powered sweeper that makes rounds to remove dust accumulations on the floors. Floor trenches in the powder packaging and liquid filling areas collect spills on the floors and discharges of residual material in the lines coming from the mixing kettles.

## IV. METHODS AND MATERIALS

The evaluation techniques applied during this evaluation included personal and area sampling for chemical contaminants, personal dosimetry and area measurement for noise levels, and a limited assessment of ventilation controls and design. Chemical exposures evaluated during the HHE included alkaline dusts (as sodium hydroxide), methylene chloride, hydrochloric acid, phosphoric acid, and toluene.

Due to the large number of raw materials used by the company in the production process, in excess of 700, and the equally large number of products formulated, about 400, exposure monitoring during the NIOSH HHE was conducted in a manner to address primarily the frequent or continuing contaminant exposures encountered by the workers. An effort was made to have the workers identify substances of particular concern and include these in the evaluation if possible. The fact that the majority of production is of the batch process type, that the various products produced during any one day or workshift are determined by customer orders received during the preceding 12 to 24 hours, and that minimal amounts of finished products are stockpiled makes evaluation of selected products using starting materials of greater concern difficult. Another consideration included in formulating the approach to this evaluation is the brevity of exposure due to the infrequent nature of-or small volume production of-some products. The number of samples collected during this evaluation was thus more limited for some compounds, than others because of production demands. Concerns of this type potential for exposure to more toxic substances, are addressed through evaluation of exposures of a more frequent nature which provides information about the general level of exposure. Additional considerations must then be included regarding the adequacy of current control measures if more toxic materials are to be handled.

A. Chemical Contaminants:

All exposure monitoring for chemical contaminants used calibrated, portable battery operated sampling pumps connected to a sampling train that contained the appropriate sample collection media for the analytes of interest. The methods used for sampling and analysis, as well as any modifications to the respective methods, follow.

1. Alkaline Dusts:

These samples were collected on 37 millimeter teflon filters having a pore size of 1 micrometer and mounted in a two piece plastic cassette. A flow rate of 2 liters per minute was used for both full-shift and short-term samples. The samples were analyzed according to NIOSH Method 7401.[1] A Fisher Accumet Mini-pH Meter*, Model 640, was used to detect the end points of the titrations. Results were reported as sodium hydroxide and the limit of detection (LOD) was 30 micrograms (ug) per sample.

2. Methylene Chloride:

Methylene chloride was collected on standard coconut shell charcoal tubes with two connected in series. Each tube was regarded as part of the sample, the first tube was analyzed in total as the front section of the sample. The second charcoal tube in line served as the backup section. A sampling rate of 20 cubic centimeters (cc) per minute was used over the sampling period. Samples were analyzed by gas chromatography according the NIOSH Method 1005[1] with the following modifications.

| | |
|---|---|
| Desorption Process: | 30 minutes in 1.0 milliliter (mL) of carbon disulfide containing 1 microliter (uL) per mL of toluene as an internal standard. |
| Gas Chromatograph (GC): | Hewlett-Packard Model 5711A* equipped with a flame ionization detector. |
| Column: | 30 meter (m) X 0.32 millimeter (mm) silica capillary column coated internally with 0.50 micrometers (um) of DBWAX. |
| Oven Conditions: | 70° Celsius (C), isothermal. |

Both the LOD and the limit of quantitation (LOQ) were 10 ug per sample for methylene chloride.

3. Hydrochloric and Phosphoric Acids:

Acid samples were collected on washed silica gel sorbent tubes at a flow rate of 200 cc per minute. Analyses were performed by ion chromatography according to NIOSH Method 7903.[1] A Dionex * ion chromatograph coupled to a WISP 710B autosampler was used. The limit of detection for hydrochloric acid is one ug per sample and for phosphoric acid is 9 ug per sample.

4. Toluene:

Toluene samples were collected on standard coconut shell charcoal tubes at sampling rate of 200 cc per minute. Samples were analyzed by gas chromatography according to NIOSH Method 1501[1] with modifications.

| | |
|---|---|
| Desorption Process: | 30 minutes in 1.0 mL of carbon disulfide containing 1 uL/mL of hexane as an internal standard. |
| Gas Chromatograph: | Hewlett-Packard Model 5711A* equipped with a flame ionization detector. |
| Column: | 6 foot x 1/4 inch glass column packed with 0.2% carbowax 1500 on 60/80 Carbopack C*. |
| Oven Temperatures: | 150°C (302°F), isothermal. |

The limits of detection and quantitation were 0.01 mg per sample for toluene.

B. Noise Measurements:

1. Noise Dosimetry:

Personal noise exposure monitoring was conducted using Metrosonics Metrologger* noise dosimeters (Model dB-301/26). The dosimeters were calibrated pre - and post-shift according to the manufacturer's instructions to assure that the units had not changed during the sampling period. Data obtained on the noise dosimeters were stored on a magnetic tape with a Metrosonics Metroreader* (Model dB-653) for later analysis.

2. Area Noise Measurement:

Selected areas of the facility were evaluated by conducting an octave-band analysis of the noise levels present. These analyses were conducted with a Gen Rad Precision Sound Level Meter* (Model 1982). The sound level meter was calibrated both before and after measurements were obtained as specified by the manufacturer's instructions. A National Bureau of Standards traceable calibrator was used for calibration.

C. Ventilation Measurements:

A Kurz Direct Reading Thermoanemometer* was used to measure air flow at kettles and ribbon blenders connected to local exhaust systems. Smoke tubes were used to observe exhaust hood air flow patterns. Additionally the integrity (intactness), effectiveness, and design of the various exhaust systems were evaluated visually.

## V. EVALUATION CRITERIA AND TOXICOLOGY SUMMARIES

A. 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 (TLVs*), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLVs* are lower than the corresponding OSHA standards. Both NIOSH recommendations 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 required by the Occupational Safety and Health Act of 1970 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.

1. Chemical Contaminants

Table 1 present the evaluation criteria (NIOSH/OSHA/ACGIH) for chemical contaminants evaluated during this hazard evaluation.

2. Noise Evaluation Criteria:

Exposure to high levels of noise may cause temporary or permanent hearing loss. The extent of damage depends primarily upon the intensity of the noise and the duration of the exposure. There is abundant epidemiological and laboratory evidence that protracted noise exposure above 90 decibels (dB(A)) causes hearing loss in a portion of the exposed population.

OSHA's existing standard for occupational exposure to noise (29 CFR 1910.95)[7] specifies a maximum permissible noise exposure level of 90 dBA for a duration of 8 hours, with higher levels allowed for shorter durations. NIOSH, in its Criteria for a Recommended Standard[8], proposed a limit of 85 dBA, 5 dB less than the OSHA standard.

Time-weighted average noise limits as a function of exposure duration are shown below:

| Duration of Exposure (hrs/day) | Sound Level, dBA NIOSH | OSHA |
|---|---|---|
| 16 | 80 | 85 |
| 8 | 85 | 90 |
| 4 | 90 | 95 |
| 2 | 95 | 100 |
| 1 | 100 | 105 |
| 1/2 | 105 | 110 |
| 1/4 | 110 | 115* |
| 1/8 | 115* | - |
| - | 140 | dB** |

* No exposure to continuous noise above 115 dBA

** No exposure to impact or impulse noise above 140 dB peak sound pressure level (SPL)

When workers are exposed to sound levels exceeding the OSHA standard, feasible engineering or administrative controls must be implemented to reduce levels to permissible limits. The OSHA noise standard has been expanded with the addition of a hearing conservation amendment.[9] For workers exposed at or above a TWA of 85 dBA, this amendment requires noise exposure monitoring, audiometric testing, the use of hearing protective devices where necessary, record keeping provisions, and employee education.

B. Toxicology Summaries:

1. Methylene Chloride:

In 1976, NIOSH proposed a recommended exposure limit (REL) to methylene chloride of 260 milligrams per meter cubed of air ($mg/m^3$) averaged over an 8- to 10-hour workshift.[10] This level was considered adequate to prevent interference by methylene chloride with delivery of oxygen to the tissues (i.e. prevent significant carboxyhemoglobin levels in the blood), and impairment of the central nervous system. Since 1976, the carcinogenicity of methylene chloride has been documented in several studies of chronic effects in animals. On the basis of carcinogenic and tumorigenic responses in rats and mice, and in accordance with the Cancer Policy of the Occupational Safety and Health Administration[11], NIOSH now recommends that methylene chloride be regarded as a "potential occupational carcinogen." Although the potential for methylene chloride-induced cancer in humans has not been determined, the probability of a population of exposed workers developing cancer could be decreased by decreasing exposure. Therefore, NIOSH recommends that occupational exposure to methylene chloride be controlled to the lowest feasible limit.[3] OSHA issued revised guidelines on controlling occupational exposure to methylene chloride August 11, 1986 to note that both NIOSH and the ACGIH have recommended exposure limits substantially lower than the current permissible limit. OSHA has also issued an advance notice of proposed rulemaking for methylene chloride.

2. Alkaline Dusts (Sodium and Potassium Hydroxide):

The occupational hazards from exposure to alkaline materials, including sodium and potassium hydroxide, are primarily those of irritation and corrosion of tissues coming in direct contact with the chemical. The tissues most susceptible to rapid, severe, and often irreversible damage are the eyes. Accidental entry into the eyes by way of splashes of solid or liquid materials, or strong solutions of them, should be prevented by the use of eye protection covering all angles of entry.[12]

Contact of alkaline materials with the skin or respiratory tract may result in irritation, corrosion, or erosion. These materials react with tissue proteins resulting in deep injuries. Acclimatization or "hardening" of the upper respiratory tract due to prolonged or repeated inhalation of these materials does occur. This may be the result of an increased protective mechanism or a decrease in the sensory protective system, in which case the exposure may lead to chronic injury.[12]

Prolonged contact of the skin with dilute solutions of the strong alkalies can cause irritation. Irritation, burns, or contact dermatitis can occur through direct handling of potassium hydroxide (caustic potash) and sodium hydroxide (caustic soda, caustic flake, lye, or liquid caustic).

In this evaluation all exposures to alkaline dusts were evaluated as sodium hydroxide. The recommended exposure limit of 2 milligrams per meter cubed of air ($mg/m^3$) for sodium hydroxide over a 15 minute period is aimed at preventing noticeable irritation from exposure to sodium hydroxide dusts and mists.[13] The ACGIH TLV* for potassium hydroxide is based upon its extreme corrosivity to tissue.[14]

3. Acids (Hydrogen Chloride and Phosphoric):

Solutions of hydrogen chloride (hydrochloric acid) may cause eye irritation, severe burns, and permanent damage with loss of sight. Hydrochloric acid may cause severe burns of the skin unless the acid is washed off immediately. Repeated or prolonged exposure of the skin to dilute acid solutions may cause dermatitis. Erosion of the teeth may occur from repeated or prolonged exposure.[15]

Phosphoric acid mist is an irritant to the eyes, upper respiratory tract, and skin. The solid is especially irritating to the skin in the presence of moisture. There is no evidence that phosphorous poisoning can result from contact with phosphoric acid. The risk of pulmonary edema resulting from the inhalation of mist or spray is remote. A dilute solution, buffered to a pH of 2.5 causes a moderate, brief stinging sensation but no injury if a droplet enters the human eye. A 75% solution will cause severe skin burns.[15]

The ACGIH TLV* for hydrogen chloride of a ceiling concentration of 7 mg/m$^3$, is considered to be sufficiently low to prevent toxic injury from exposure to hydrogen chloride, but is on the borderline of severe irritation. The TLV* of 1 mg/m$^3$ over an 8-hour workshift for phosphoric acid is reportedly below the concentration causing throat irritation among unacclimated workers and well below that tolerated by acclimated workers.[14]

4. Toluene:

Toluene vapor causes narcosis (stupor). Controlled 8-hour exposures of human subjects at varying levels produced effects ranging from mild fatigue, weakness, confusion, lachrymation, and paresthesia (abnormal sensation without objective cause, such as numbness, prickling, and tingling) at a level of 750 mg/m$^3$. Exposures of the same duration at a level of 3000 mg/m$^3$ included euphoria, headache, dizziness, dilated pupils, and nausea. Aftereffects of these high level exposures included nervousness, muscular fatigue, and insommia persisting for several days. Workers exposed for many years to concentrations in the range of 300 to 1130 mg/m$^3$ exhibited no clinical or laboratory evidence of altered liver function[15].

Toluene exposure does not appear to result in the hematopoietic (blood forming) effects caused by benzene. The myelotoxic effects previously attributed to toluene are judged by more recent investigations to be the result of concurrent exposure to benzene present as a contaminant in the commercial toluene used.[15]

Toluene splashed in workers' eyes has caused transient corneal damage and conjunctival irritation. Complete recovery occurred within 48 hours. Repeated or prolonged skin contact with liquid toluene has a defatting action, causing drying, fissuring, and dermatitis.[15]

The NIOSH recommended exposure limit (REL) of 375 mg/m$^3$ for toluene is based on the observations that changes in muscular coordination, reaction time, and production of mental confusion and mucous membrane irritation have been observed for toluene exposures up to 750 mg/m$^3$; but these same effects have not been reported for exposures at or below the REL in industrial workers and experimental subjects.[16]

## VI. RESULTS

### A. Chemical Contaminant Exposures:

Exposures of workers to chemical contaminants and noise during the HHE follow-up survey are presented in Tables II through IV and in the following paragraphs. Area octave band noise analyses are presented in Table V and paragraph B(2).

1. Alkaline Dust (Evaluated as Sodium Hydroxide):

A total of 24 breathing zone exposure samples to alkaline dusts were collected. Twenty of the samples ran full-shift and four represent short-duration samples collected during powder compounding. Job titles of workers monitored included: Liquid Compounder, Head Compound Mixer (powder compounding), Assistant Compound Mixer (powder compounding), Scrubber Operator, Head-drum Filler, Material Handler, Case Packer Operator, and Pouch Machine Operator. The range of full-shift alkaline dust exposures over the two days of sampling was from below detectable levels (less than (<) about 0.03 mg/m$^3$) or non-detectable (N.D.) up to 0.63 mg/m$^3$. The mean (arithmetic) exposure concentration over the two day was 0.12 mg/m$^3$. The OSHA permissible exposure limit (PEL) for full-shift airborne sodium hydroxide exposure is 2 mg/m$^3$. Short-term exposures to alkaline dusts (27 to 68 minutes) were all below detectable levels (< 0.56 mg/m$^3$). Note that the environmental limit of detection for the short-term samples is elevated, when compared to the full-shift samples, because of the small sample volume. The NIOSH REL for sodium hydroxide over a 15 minute sampling period is a ceiling concentration of 2 mg/m$^3$. Table II presents worker exposures by location, job title, sample type, sample duration and individual exposure concentration.

2. Methylene Chloride:

The number of workers working with or around methylene chloride or products containing this compound was very limited during the survey. Two workers were involved with the production of PEEL-Filmite* which contains methylene chloride. The Liquid Compounder had an 8-hour TWA exposure to methylene chloride of 10 mg/m$^3$. This incorporated two shorter duration samples while working around the mixing kettle of 33 mg/m$^3$ and N.D. The full-shift TWA was calculated using the observed short term exposures and their time periods along with an assumption of no methylene chloride exposure during the remaining 307 minutes of the workshift. The area sample obtained over the kettle where methylene chloride was used by this worker documented an airborne TWA of 20 mg/m$^3$.

April 11, 1986, methylene chloride exposures for a second Liquid Compounder and a Liquid Packager were obtained. The short-term and calculated full-shift TWAs for the compounder mixing a product using methylene chloride were 54 mg/m$^3$ (over 59 minutes) and 6.6 mg/m$^3$ (8-hour TWA) respectively. A Liquid Packager manually filling 55 gallon drums of methylene chloride containing product had a full-shift TWA of 380 mg/m$^3$. This value exceeds both the original NIOSH REL of 261 mg/m$^3$, proposed in 1976[(10)], and the current NIOSH recommendation of maintaining exposures at the lowest feasible level[(3)].The area sample mounted on the filling scale at his work station demonstrated a TWA area concentration of 380 mg/m$^3$.

3. Hydrochloric and Phosphoric Acids:

Hydrochloric and phosphoric acid breathing zone exposures obtained over the workshift were negligible. All hydrochloric acid exposures, with the exception of one, ranged from below to slightly above the calculated environmental limit of detection (ELOD) of 0.01 mg/m$^3$. One Take-out Operator in packaging had an 8-hour TWA of 0.05 mg/m$^3$, although because of analyte break-through onto the back-up section of the sorbent tube this concentration should be considered a minimum exposure value with the actual exposure a somewhat higher concentration.

All phosphoric acid exposures were below a calculated ELOD of 0.10 mg/m$^3$. As indicated in the opening paragraph to this section, all chemical exposure data presented here are found in Table II.

4. Toluene:

Airborne toluene concentrations, both short-term and full-shift breathing-zone exposures as well as full-shift area concentrations, were low. Two short-term exposures for a Liquid Compounder using toluene in a product formulation were 1.8 mg/m$^3$ and non-detectable (ELOD of 1.4 mg/m$^3$). An area sample obtained at his work location over the full workshift was 1.0 mg/m$^3$. The Liquid Packager in Special Product Packaging had a full shift breathing zone exposure of 45 mg/m$^3$ with an area concentration at his work station obtained over the same sampling period of 33 mg/m$^3$.

B. Noise Survey and Noise Exposure Results:

1. Personal Noise Exposures:

Individual worker's noise exposures averaged over the workshift sampling periods of the survey ranged from 78 to 88 decibels-A weighted (dB(A)). The mean (arithmetic) sample period TWA was 82 dB(A) with a standard deviation of 3dB. The percent of the daily allowable noise exposures ranged from 19 to 74%, based on the OSHA PEL of 90dB(A) for eight hours.

The highest full-shift noise exposures occurred in liquid compounding, on the propane powered floor scrubber, and out in the bulk unloading area. Maximum noise levels of one minute duration encountered by workers during the work shift ranged from 88 up to 113 dB(A). Four maximum levels in excess of 100 dB(A) occurred in the areas of liquid compounding, powder packaging, and outdoors in the bulk unloading area. Table III presents both the TWA dB(A) level for the workers monitored as well as the projected 8-hr TWA . Maximum levels are included for each sample.

The noise exposures of the six workers having the highest cumulative TWA are presented by hour and day in Table IV. This serves as an expansion of data for the highest noise exposures presented in Table III. Cumulative noise exposures for both days are similar for the jobs presented in the table, liquid compounding, scrubber operation, and bulk unloading. Noise exposure levels appear quite uniform throughout the work shift.

Examination of the hourly noise exposures throughout the shift indicates fairly constant noise levels.

2. Area Noise Survey Measurements:

An octave band noise analysis of several locations; production, maintenance, and outdoors; documented high noise areas. The compounding areas and bulk unloading area have the highest noise components in the 63 (79-84 dB(A)), 250 (78-90 dB(A)), 500 (80-90 dB(A)) and 1000 Hertz (78-86 dB(A) octave bands. The boiler room and maintenance area had the highest overall measured noise levels, 95 and 96 dB(A) respectively. The lower frequency octave bands were again responsible for the largest contribution to the overall measured noise level. Table V presents both the octave band analyses and overall weighted and unweighted noise levels for the areas surveyed.

C. Ventilation:

1. Visual Inspection and Observation:

Visual inspection of the local exhaust systems present in the production and packaging areas, as well as observations made during the use of equipment serviced by the systems provided the following observations:

a. The liquid compounding kettles are directly connected to either individual or common local exhaust fans which place the kettles under negative pressure.

b. Powder blending units are connected to a central local exhaust system and several units are also served by moveable elephant trunk ducts. Escape of airborne powder from the equipment during charging and mixing was observed. This appeared to be influenced by distance of the take off from the central duct and inability to properly place loose elephant trunk ducts at the point of dust generation.

c. Drum filling discharges in the powder packaging area have annular local exhaust hoods with interchangeable hood configurations applicable to different size drums. These units appeared most effective when using drums that fit right under the hood.

d. A local exhaust canopy hood on the box packing line is located well above the spill area of the turntable where damage to powder bulk packs or release of material from incompletely sealed packs occurs. Dust generated from damaged packs would escape the effective capture zone of the hood.

e. An exhaust duct opening in the special products packaging area is located in a corner near the floor, remote from drum filling stations and blocked by surrounding containers. A single wall exhaust fan is located in the outside wall, remote from the actual fill stations. No local exhaust system is present for drum filling of flammable or solvent containing products.

f. No active provisions for outside make-up air to replace that exhausted on the mezzanine level exists other than for wall louvers and a comfort ventilation system.

g. All local exhaust units for the liquid compounding kettles discharge at roof level, ranging from six to 46 inches above the roof deck.

h. Damaged sections of ductwork on the exhaust system removing airborne dust were observed. Dented ductwork, misshapen elbows, and temporary makeshift patches were observed on the system in the powder packaging area.

Face velocity air flow measurements at dry compounders 1 and 2 averaged 85 and 208 linear feet per minute (lfpm) at the floor grate level. A removable elephant trunk duct available for use as supplementary local exhaust at the dry compounding stations was in use at dry compounder 1. The centerline face velocity was in excess of 6000 lfpm.

Face velocity measurements obtained from mixing kettles in the liquid compounding area (kettles 125, 126, 115, and 121) averaged 112 lfpm. Flow rates varied from 67.5 lfpm (kettle 115) to 225 lfpm (kettle 125).

Smoke tube air flow evaluations indicated that all the kettles for which air flow was measured, as well as the two dry compounders, were under negative pressure. The effect of cross drafts along with the low face velocities on some of the equipment appears to negate the ability of the local exhaust system to capture contaminants generated or released outside of the hood (or mixer) opening.

## VII. <u>Discussion</u>

### A. Chemical Contaminant Exposures:

Exposures to chemicals used in production during the survey period were generally negligible with the exception of methylene chloride. The workers of concern did not use any respiratory protection during their exposures. The individual drumming the Peel-Filmite* did not wear gloves during the filling operation and the gloves available to him were not suitable for protection against methylene chloride. A wall exhaust fan was operating in the special products filling area and the fire door on the east side of the room was open. An overhead garage door to the outdoors located immediately outside of this area and north of the open fire door was opened periodically throughout the workshift. These latter two items indicate that the existing exhaust ventilation and general make-up air is inadequate in effectively controlling the worker's exposures to airborne contaminants.

Lower level exposures to methylene chloride observed for Liquid Makers on the mezzanine indicate that the engineering controls present on the mixing kettle still permit the escape of contaminant vapors.

While elimination of methylene chloride from the workplace will also eliminate methylene chloride exposures, this action does not negate the need for corrective measures to assure that exposures to other materials used in or generated during production are kept within acceptable limits. The vast array of compounds used in the numerous products formulated at this facility requires that engineering controls, work practices, and personal protective equipment programs be adequate to control contaminants ranging in toxicity from hydrofluoric acid (corrosives), methylene chloride and formaldehyde (potential occupational carcinogens [3,17]), to relatively innocuous material like coconut oil. The limitations of this survey should be recognized, that very few of the various raw materials were used during the industrial hygiene survey. Thus other product formulations will present different contaminants and potential exposures. Changes in OSHA standards and accepted occupational exposure limits with the advent of more or new toxicity data should encourage optimium control of all contaminants.

Optimium operation of engineering controls for the process requires regular maintenance and repair schedules. Damaged, blocked, and modified ductwork or hoods reduces significantly the effectiveness of the system. The hygroscopicity of powdered material was mentioned as an ongoing problem with removing dusts. This suggests a need for clean-out ports and possible system modifications to increase particulate transport velocities. The inability to properly position moveable exhaust ducts and the absence of more efficient hoods reduces the efficiency of the system. Properly operating contaminant collection systems can also aid in reducing housekeeping requirements and equipment deterioration in addition to reducing worker exposures or controlling potential exposures.

The most efficient contaminant collection occurs at the point of generation. This is exemplified by the presence of local exhaust systems on the liquid kettles, however flow rates at the kettle openings varied and both liquid and powdered materials were normally added at these openings in addition to directly piping in the liquid raw materials.

Another problem identified with the liquid compounding local exhaust systems is the location of the systems' discharges. Collected contaminants such as acid and solvent vapors are essentially discharged directly onto the building roof. This does not provide adequate removal of contaminants from the air envelope surrounding the building. Louvers on the side of the building on the mezzanine level are used for air intakes. The level of contaminant discharge on the roof is insufficient to prevent good dispersion of contaminated air from the exhaust systems. Poor discharge conditions result in low-level contamination which can re-enter the building due to wind effect (building turbulence), negative pressure within the building, or the action of mechanical air supply systems.[18]

Work practices are important in maintaining low exposure levels and include careful addition of bulk materials from bags and drums, proper use of personal protective equipment, prompt clean-up of spills, proper disposal of empty containers and utilization of engineering controls.

The personal protective equipment required for different products is specified on each formulation sheet. The chemist preparing the sheet specifies the necessary personal protective equipment, however at the time of initiation of this evaluation no review concerning the appropriateness of specified equipment was being conducted prior to issuance of the formulation sheet. A review process has reportedly been implemented since that time.

Neither quantitative nor qualitative respirator fit testing was performed by the company since they did not have designated respiratory protection areas. The necessity for fit testing remains an essential element of a respiratory protection program. The fact that some batch sheets specify respiratory protection demonstrates the need for fit testing in the absence of designated respiratory protection areas. Formal training of workers in the use and maintenance of their respirators was deficient as determined through questioning workers using respirators. Survivair respirators are the only brand currently available for issuance to workers. The NIOSH investigator discussed the need for fit testing and that almost without exception more than one manufacturers' respirators need to be stocked. This would help assure adequate respirator fit by providing a better respirator selection to chose from in accommodatiing each worker's unique facial characteristics.

Rubber gloves available for the workers were sent out for cleaning and returned for re-use. The gloves are returned and dumped into a pile from which workers select their gloves, avoiding those with holes, cuts, or tears. One size of gloves is provided for all workers. Deficiencies with this glove program are apparent. All chemical resistant gloves have limited useful lifetimes and permeation resistance depending upon the glove material, chemicals encountered, and mechanical wear that occurs during their use. Gloves need to be selected based upon the chemical exposure. Reconditioning or cleaning of gloves used to provide chemical protection is unacceptable. The cleaning process itself may compromise the gloves integrity severely, providing it has not already surpassed the effective glove life during use. The company reportedly providing DuBois' glove reconditioning service did so by a dry cleaning process. Secondly, the co-mingling of gloves of different ages exposed to different chemicals prohibits any method of separating out those that chemically and physically are no longer providing protection. Finally, gloves should be available in more than one size to fit different worker's hands. Proper glove selection and fit will not only provide better protection but will facilitate a better grasp by the worker when handling hazardous materials.

A housekeeping issue in the liquid packaging area concerned the accumulation of residual product from kettles and hose lines in the floor trenches. No flushing mechanism is present in the trenches themselves, resulting in accumulations of various products. Reactions of incompatible materials in the floor trench may result in additional contaminant exposures. Accumulation of product on the walking surfaces in the area creates hazardous walking conditions.

The noise dosimetry and area noise measurements obtained during the survey demonstrates the need for implementation of a hearing conservation program. Several workers had noise exposures at or above 85 dB(A) over their work shift. The OSHA noise standard 1910.95 requires implementation and administration of a hearing conservation program whenever employee noise exposures equal or exceed an 8-hr TWA of 85 dB(A) or a workshift noise dose of 50 percent is reached.[9] This program would include audiograms of exposed workers, worker training, providing hearing protectors for exposed workers, recordkeeping, and posting high noise areas.

## VIII. CONCLUSION

Exposures to chemical contaminants evaluated during the HHE were low with the exception of methylene chloride in the Special Products Formulating and Packaging area. Methylene chloride exposures for the special products drum filler were in excess of both the current OSHA PEL and the NIOSH REL. Due to the large number of raw materials used and product formulations, an assumption that overexposures from other product formulations or raw materials will not occur cannot be casually assumed. Changes in operating conditions, work practices, engineering controls, and materials used contribute to a dynamic potential exposure situation. The fact that the substances used and produced are so variable necessitates control measures for the most hazardous materials and situations, thus assuring that less toxic materials would also be adequately controlled. This supports the need for worker education, good work practices, effective engineering controls with a preventive maintenance program, housekeeping, and effective implementation and operation of personal protective equipment programs.

This facility has high noise areas and full-shift noise exposures that necessitate a hearing conservation program. Control measures to reduce noise levels in the various areas may also prove useful in reducing exposures and the actual number of high noise areas. The nature of production operations and equipment layout prevent serious consideration of administrative controls alone as an effective method for solving the noise exposure problems.

## IX. RECOMMENDATIONS

### A. Chemical Contaminants:

1. The ideal approach to prevent exposures to toxic substances like methylene chloride is by substitution with a less toxic material. This is something the company is reportedly pursuing.

2. Periodic review of the various substances used in production, along with subsequent efforts to substitute more toxic substances with compounds of lesser toxicity should prevent continued regular or infrequent use of less desirable materials (from a health hazard perspective) in the workplace. This may be done by maintaining current material safety data sheets and using recommended evaluation criteria that incorporate more current toxicity information than the OSHA PELs.

### B. Ventilation:

1. Local exhaust ventilation present on Kettle 121 used to make Peel Filmite* should be evaluated to assure optimum performance of the system. The average face velocity measured during the survey was 95 feet per minute. The face velocity of 150 to 200 feet per minute is recommended considering the toxicity of methylene chloride. Covering the kettle opening during blending and holding periods is also suggested since the system as it currently exists still allows the escape of methylene chloride vapors.

2. Local exhaust ventilation should be provided at the drum filling point where higher toxicity compounds, such as methylene chloride present in Peel Filmite*, are discharged from enclosed production equipment.

3. A hood involving flanges and a mechanism for positioning (e.g. magnets, clips, or hooks) should be added to mobile local exhaust take-offs such as those present at the powder mixers. This would permit more effective utilization of the system.

4. The canopy hood present in the "bulk pack" packaging area should be redesigned to more effectively capture dust released from incompletely sealed or damaged pouches of product that spill as they are discharged from a conveyor onto the revolving packing table.

5. Inspection and cleaning of dust handling local exhaust equipment in the powder mixing area may need to be performed more frequently than every three months due to the corrosivity of materials, varying powdered raw materials usage and the hygroscopicity of the dust.

6. Damaged ductwork should be replaced to provide a smooth internal duct surface. This will reduce air turbulence and surface irregularities which favor product accumulation in systems serving the powder production and packaging area.

7. Extension of local exhaust discharges above the mezzanine roof is recommended in preference to sealing the wall vents currently used to provide make-up air. This latter approach would necessitate drawing makeup air from an elevator shaft connecting the lower floor and the general comfort ventilation system. Additionally, exhaust emissions would continue to leak through cracks, non-functional ceiling fans, and around windows, doors, and pipe runs. Contacting a firm specializing in industrial exhaust ventilation is advised.

8. Implementation of any changes concerning the ventilation system necessitates a subsequent assessment of the effectiveness specific modifications have in achieving the desired objective.

9. Ductwork passing through the fire walls into the special products packaging area should be equipped with automatic closing fire doors on each side of the wall through which the duct passes.[19]

C. Personal Protective Equipment:

1. The personal protective equipment program should be re-evaluated, especially as it pertains to protective clothing and respiratory protection. The re-use of gloves issued to protect against chemical contaminants should be discontinued. The types of gloves available should be enlarged, since polyvinyl chloride gloves previously in use do not offer effective protection against all compounds present at this facility. This last item, discontinuing re-use of chemical gloves, was initiated by the company in August 1986 (direct communication).

2. Stocking more than one size glove is generally required to accommodate different hand sizes and provide a proper grip. Gauntlets and impervious aprons are provided but impervious shoe covers and leggings should also be available to workers manually handling and dumping 55 gallon drums of materials such as hydrofluoric acid.

3. The company has a written respiratory protection program however, all workers issued or having occasion to use respiratory protection need to be fit tested and instructed in the care, use, and limitations of the respirator. The cartridges on infrequently used air purifying respirators should be changed prior to each use rather than relying on the individual to detect break through or to change them at some unspecified interval. Due to differences between workers, more than one size and possibly more than one manufacturer's respirator will need to be stocked.

4. Safety equipment specified on formulation sheets should be chosen with input from the safety engineer to insure that the best protection is provided out in the formulation and packaging areas. The company has transferred this function to the safety engineer with consultation from the formulating chemist. This selection process should include consideration of workplace conditions in addition to the potential hazards presented exclusively by the product or its raw materials.

5. Education of the workers concerning the hazards of chemicals used at DuBois as well as the proper selection and use of personal protective equipment should have greater emphasis. Several employees reported learning about various work hazards exclusively on an informal basis from co-workers. The number and nature of chemicals present in the workplace necessitates a formal training and orientation program for the worker regarding the hazards present. This training is reported by the company (personal communication) to be an integral part of the hazard communication program to comply with the OSHA hazard communication standard.

D. Housekeeping:

Improved housekeeping efforts such as immediate spill clean-up, regular removal of dust accumulations from floors and raw material storage areas, and flushing out floor trenches after the discharge of product from kettle bottoms and hose lines should be implemented. This last item would reduce both slipperiness of walking surfaces due to product accumulation and the potential for mixing of incompatible materials in the floor trenches.

E. Noise:

1. Implementation of a hearing conservation program for all production employees is recommended. This program should include annual audiometric testing, noise monitoring, hearing protective devices, recordkeeping, and worker education.

   A hearing conservation program is suggested in preference to an administrative program because the variability of batch production utilizing different equipment presents an enormous number of situations to characterize for noise exposure. The subsequent scheduling of production employees on line operations would be extremely complex due to the previous consideration if one controlled exposures exclusively by duration and intensity of exposure. Secondly, some employees are currently involved in tasks having continuous exposure above 85 dB(A).

2. High noise areas (e.g. the compressor and boiler rooms) should be posted as mandatory hearing protection areas. Hearing protection should be available for individuals required to work in these areas and they should be instructed in the proper use of the protective equipment.

E. Miscellaneous:

1. Routine personal exposure sampling of workers for workplace contaminants should be performed. This information will assist in evaluating the effectiveness of the various control measures being used. Individual exposure data should be provided to the affected workers.
2. All connections for the methylene chloride supply lines should be leak tight. The lines should have a positive drain, i.e. avoid retention of residual quantities of this compound in the lines, or be purged thoroughly of material prior to being disconnected.

## X. REFERENCES


1. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. 3rd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1984. (DHHS (NIOSH) publication no. 84-100).

2. National Institute for Occupational Safety and Health. NIOSH/OSHA pocket guide to chemical hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. (DHHS (NIOSH) publication no. 78-210).

3. National Institute for Occupational Safety and Health. Current intelligence bulletin 46– methylene chloride. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1986. (DHHS(NIOSH) publication no 86-114).

4. American Conference of Governmental Industrial Hygienists. Threshold limit values for chemical substances and physical agents in the workroom environment and biological exposure indices with intended changes for 1986-87. Cincinnati, Ohio: ACGIH, 1986.

5. Occupational Safety and Health Administration. OSHA safety and health standards. 29 CFR 1910.1000. Occupational Safety and Health Administration, revised 1983.

6. The Bureau of National Affairs, Ind. Occupational safety and health reported. 1986; 16:278-279.

7. Occupational Safety and Health Administration. OSHA safety and health standards. 29 CFR 1910.95. Occupational Safety and Health Administration, revised 1983.

8. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to noise. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1973. (DHEW publication no. (NIOSH) 73-11001).

9. Occupational Safety and Health Administration. Occupational noise exposure; hearing conservation amendment. 29 CFR 1910. Occupational Safety and Health Administration. Federal Register 1983; 48: 9738-85.

10. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to methylene chloride. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1976. (DHEW publication no. (NIOSH) 76-138).

11. Occupational Safety and Health Administration. Identification, classification, and regulation of potential occupational carcinogens. 29 CFR1990. Occupational Safety and Health Administration, 1985.

12. Patty FA. Patty's industrial hygiene and toxicology. Vol II--toxicology, 3rd revised ed. New York: John Wiley & Sons, 1981.

13. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to sodium hydroxide. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1976. (DHEW publication no. (NIOSH) 76-105).

14. American Conference of Governmental Industrial Hygienists. Documentation of the threshold limit values and biological exposure indices. 5th ed. Cincinnati, Ohio: ACGIH, 1986.

15. National Institute for Occupational Safety and Health. NIOSH/OSHA occupational health guidelines for chemical hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. (DHHS (NIOSH) publication no. 81-123).

16. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to toluene. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1973. (DHEW publication no. (NIOSH) 73-11023).

17. National Institute for Occupational Safety and Health. Current intelligence bulletin 34--Formaldehyde: Evidence of carcinogenicity. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. (DHHS (NIOSH) publication no. 81-111).

18. American Conference of Governmental Industrial Hygienists. ACGIH industrial ventilation: a manual of recommended practice. ACGIH Committee on Industrial Ventilation: Lansing, Michigan, 1984.

19. National Fire Protection Association. National fire codes. Vol. 9. National Fire Protection Association: Quincy, Massachusetts, 1983.

## XI. AUTHORSHIP AND ACKNOWLEDGEMENTS

| | |
|---|---|
| Study Conducted and<br>Report Prepared by: | Steven Ahrenholz, M.S., C.I.H.<br>Industrial Hygienist |
| Environmental Evaluation: | Larry De Armond, C.I.H.T.<br>Industrial Hygiene Technician |
| Noise Survey: | Randy L. Tubbs, Ph.D.<br>Acoustic Psychologist |
| Laboratory Analyses: | Datachem, Inc.<br>Salt Lake City, Utah |
| Originating Office: | Hazard Evaluations and Technical<br>Assistance Branch<br>Division of Surveillance, Hazard<br>Evaluations, and Field Studies |
| Report Typed By: | Sharon Jenkins<br>Clerk (Typing)<br>Industrial Hygiene Section |


## XII. 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. International Union of Electronic, Electrical, Technical, Salaried and Machine Workers, A.F.L.-C.I.O. Local 774.
2. DuBois Chemical Company
3. OSHA, Region V

For the purpose of informing approximately 80 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
Chemical Contaminant Exposure Evaluation Criteria and Health Effects Summary
DuBois Chemicals
Sharonville, Ohio
HETA 86-071

| Contaminant | Recommended Exposure Limit* (mg/m$^3$) | Source** | OSHA PEL$^+$ (mg/m$^3$) | Symptoms$^{+++}$ | Target Organs$^{+++}$ |
|---|---|---|---|---|---|
| Sodium hydroxide | 2 (15 min ceil.) | NIOSH | 2 | Irritation of nose; pneumonitis; burns eyes, skin; temporary loss of hair | Eyes, respiratory system, skin |
| Hydrogen chloride | 7 (ceiling) | ACGIH | 7 (ceiling) | Inflammation of the larynx; cough, burns throat; choking; burns eyes, skin; dermatitis | Respiratory system, skin, eyes |
| Methylene chloride | Lowest Feasible Limit | NIOSH | 1735$^{++}$ | Fatigue, sleepiness, light-headed; limbs numb, tingle; nausea; irritation of eyes, skin; vertigo; worsen angina | Skin, cardiovascular system, eyes, central nervous system; meets criteria of OSHA potential occupational carcinogen |
| Phosphoric acid | 1 | ACGIH | | Irritation upper respiratory tract, eyes, skin, burns eyes; dermatitis | Respiratory system, eyes, skin |
| Toluene | 375 | NIOSH | 750 | Fatigue, weakness; confusion, euphoria, dizziness; headache; dilated pupils, lacrimation; nervousness; muscle fatigue; insommia; paresthesia; dermatitis; photophobia | Central nervous system, liver, kidneys, skin |

* Recommended Exposure Limit is given in milligrams per meter cubed (mg/m$^3$); 15-min ceil denotes a ceiling value determined over any 15 minute interval; ceiling denotes that concentration is not to be exceeded.

** Sources: National Institute for Occupational Safety and Health (NIOSH) Recommended Criteria. Reference 2; 3 for methylene chloride. American Conference of Government Industrial Hygienists (ACGIH) Threshold Limit Values, reference 4.

\+ OSHA-PEL: Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) in mg/m$^3$. Reference 5.

++ OSHA revised guidelines on controlling occupational exposure to methylene chloride have been issued to reflect NIOSH AND ACGIH recommendations for lower exposure limits. Proposed rulemaking on methylene chloride by OSHA is also anticipated. Reference 6.

+++ Source: NIOSH Pocket Guide to Chemical Hazards. Reference 2.

## Table II
## Worker Exposures to Alkaline Dusts, Methylene Chloride, Hydrochloric and Phosphoric Acids, and Toluene
## DuBois Chemicals, Sharonville, Ohio
## HETA 86-071
## April 10-11, 1985

| Sample Description* | | Type | Duration | Contaminant Concentration in mg/M³** | | | | | Product or Comments |
|---|---|---|---|---|---|---|---|---|---|
| Date | Location/Job Title | | | NaOH | $CH_2Cl_2$ | HCl | $H_3PO_4$ | $C_6H_5CH_3$ | |
| 4/10 | Special Products Mfg/ Liquid Compounder | ST<br>ST | 07:28-09:45<br>13:29-14:05 | -<br>- | 33<br>ND | -<br>- | -<br>- | 1.8<br>ND | Peel-Filmiteé |
| | Special Product Mfg/ Kettle 121 | A | 07:30-15:27 | - | 20 | - | - | 1.0 | Peel-Filmiteé |
| | Liquid Compounding/ Liquid Compounder | BZ | 07:01-15:20 | 0.03 | - | ND | ND | - | Fabri-Sureé, Peel-Filmiteé |
| | Liquid Compounding/ Liquid Compounder | BZ | 07:07-15:16 | 0.04 | - | Trace | ND | - | Slurryé, Orbit NFé |
| | Liquid Compounding/ Liquid Compounder | BZ | 07:08-15:20 | - | - | ND | ND | - | Tempra-Tecké, Magnatrexé |
| | Liquid Compounding/ Liquid Compounder | BZ | 07:09-15:20 | - | - | ND | ND | - | Hicycle 143é, Clear Filmiteé, Depress-14é |
| | Powder Compounding/ Head Compound Mixer | BZ<br>ST | 07:04-14:42<br>14:10-14:37 | 0.13<br>ND | -<br>- | -<br>- | -<br>- | -<br>- | <br>Scaldé additive |
| | Powder Compounding/ Asst. Compound Mixer | BZ<br>ST | 07:05-15:15<br>14:10-14:37 | 0.10<br>ND | -<br>- | -<br>- | -<br>- | -<br>- | Scaldé additive |
| | Both Areas/ Scrubber Operator | BZ | 06:26-14:00 | ND | - | - | - | - | - |
| | Compounding/Porter | BZ | 07:41-15:20 | - | - | ND | ND | - | Cleans out kettles |
| | Packaging/ Bottle Machine Operator | BZ | 07:19-15:20 | - | - | ND | ND | - | - |
| | Packaging/ Take-out Operator (Liquid) | BZ | 07:17-15:20 | - | - | Trace | ND | - | - |
| | Packaging/ Take-out Operator | BZ | 07:20-15:20 | - | - | 0.05[a] | ND | - | - |
| | Packaging/ Take-out Operator | BZ | 07:26-15:20 | - | - | ND | ND | - | - |

Table II (continued)
Worker Exposures to Alkaline Dusts, Methylene Chloride, Hydrochloric and Phosphoric Acids, and Toluene
DuBois Chemicals
Sharonville, Ohio
HETA 86-071
April 10-11, 1985

| Sample Description* | | Type | Duration | Contaminant Concentration in mg/M³** | | | | | Product or Comments |
|---|---|---|---|---|---|---|---|---|---|
| Date | Location/Job Title | | | NaOH | $CH_2Cl_2$ | HCl | $H_3PO_4$ | $C_6H_5CH_3$ | |
| | Packaging/ Head-drum Filler | BZ | 07:15-15:15 | 0.05 | - | - | - | - | - |
| | Packaging/ Material Handler | BZ | 07:16-15:15 | ND | - | - | - | - | - |
| | Packaging/ Case Packer Operator | BZ | 07:10-15:08 | 0.40 | - | - | - | - | - |
| | Packaging/ Case Packer Operator | BZ | 07:11-15:08 | 0.63 | - | - | - | - | - |
| | Packaging/ Pouch Machine Operator | BZ | 07:13-15:09 | 0.05 | - | - | - | - | Cleaned pouch machine |
| 4/11 | Liquid Compounding/ Liquid Compounder | BZ | 07:03-15:08[b] | ND | - | ND | ND | - | Slurry, ISO-5é, Dujeté |
| | | ST | 09:26-10:25 | - | 54 | - | - | - | ISO-5é |
| | Liquid Compounding/ Liquid Compounder | BZ | 07:03:15:11 | ND | - | c | c | - | D-Secté, IFM-201é, LSRé |
| | Liquid Compounding/ Liquid Compounder | BZ | 07:25-15:09 | ND | - | - | - | - | Secureé, Secure Sealé, Hallmarké |
| | Powder Compounding/ Head Compound Mixer | BZ | 07:06-15:10 | 0.06 | - | Trace | ND | - | Blasté, BR-5512-Sé, BR-5512é, |
| | | ST | 09:14-10:20 | ND | - | - | - | - | BR-5512é |
| | Powder Compounding/ Asst. Compound Mixer | BZ | 07:07-13:35 | 0.10 | - | - | - | - | Super Kloré |
| | | ST | 09:14-10:22 | ND | - | - | - | - | BR-5512é |
| | Both Areas/ Scrubber Operator | BZ | 06:15-14:10 | ND | - | - | - | - | Operated scrubber |
| | Special Prod. Pkg/ Liquid Packager | BZ | 07:13-15:04 | - | 380 | - | - | 45 | Peel Filmiteé |
| | Special Product Packaging | A | 07:13-15:04 | - | 380 | - | - | 33 | On weighing scale @ workstation |
| | Packaging/Bottler Operator | BZ | 07:05-15:08 | - | - | ND | ND | - | |

continued

Table II (continued)
Worker Exposures to Alkaline Dusts, Methylene Chloride, Hydrochloric and Phosphoric Acids, and Toluene
DuBois Chemicals, Sharonville, Ohio
HETA 86-071
April 10-11, 1985

| Sample Description* | | | | Contaminant Concentration in mg/M³** | | | | | Product or Comments |
|---|---|---|---|---|---|---|---|---|---|
| Date | Location/Job Title | Type | Duration | NaOH | $CH_2Cl_2$ | HCl | $H_3PO_4$ | $C_6H_5CH_3$ | |
| | Packaging/ Take-out Operator | BZ | 07:09-15:03 | - | - | ND | ND | - | |
| | Packaging/ Take-out Operator | BZ | 07:09-15:04 | - | - | Trace | ND | - | |
| | Packaging/ Take-out Operator | BZ | 07:14-15:06 | - | - | ND | ND | - | |
| | Packaging/ Head drum Filler | BZ | 07:11-15:06 | ND | - | - | - | - | |
| | Packaging/ Material Handler | BZ | 07:10-15:03 | ND | - | - | - | - | |
| | Packaging/ Pouch Machine Operator | BZ | 07:10-15:01 | 0.62 | - | - | - | - | |
| | Packaging/ Pouch Machine Operator | BZ | 07:08-15:02 | 0.03 | - | - | - | - | Unit started at 11:45 |
| | Sample Statistics: (BZ, full-shift) | Sample Number | | 20 | 1 | 15 | 15 | 1 | |
| | | Range | | ND-0.63 | - | ND-0.05 | - | - | |
| | | Median Value | | ND | - | ND | ND | - | |
| | | Mean Concentration | | 0.12 | - | Trace | ND | - | |
| | Analytical Limits: (micrograms/sample) | Limit of Detection | | 30 | 10 | 1 | 9 | 10 | |
| | | Limit of Quantitation | | - | 10 | - | - | 10 | |
| | Evaluation Criteria in mg/m³***: | | OSHA | 2 | 1735 | C7[d] | 1 | 751 | |
| | | | NIOSH | C2[e] | Note 1 | - | - | 375 | |

* Sample types are breathing zone (BZ), area (A), and short-term (ST) breathing zone.
** Contaminant Concentrations and Evaluation Criteria are presented in milligrams per meter cubed (mg/m³) of air. The contaminants are sodium hydroxide (NaOH), methylene chloride ($CH_2Cl_2$), hydrogen chloride (HCl), phosphoric acid ($H_3PO_4$), and toluene ($C_6H_5CH_3$).
*** Evaluation Criteria used are the Occupational Safety and Health Administration°s Permissible Exposure Level and the National Institute for Occupational Safety and Health°s Recommended Exposure Limit for an 8-to 10-hour work shift, except where noted.
a: More than 30% of the HCl analyte was found on the backup section, indicating break-through. Concentration given should be considered a minimum.
b: Sample for NaOH ran from 07:03 to 13:20.
c: Pump failure, sample discarded, sample volume O.
d: The value given to evaluate HCl is a ceiling value (C), not to be exceeded.
e: The NIOSH Recommended Exposure Limit for NaOH is a ceiling value (C) for any 15 minute sample period.

Table III
Worker Noise Exposures
DuBois Chemicals
Sharonville, Ohio
HETA 86-071
April 10-11, 1986

| Sample Description | | | | Exposure Values[a] | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Area | Job Title | Sample Duration (minutes) | 8-hr TWA dB(A)) | Projected Exposure (%) | Sample period TWA (dB(A)) | Dose (%) of allowed from sample | Maximum period level (dB(A)) |
| 4/10 | Liquid Compounding | Liquid Compounder | 480 | 83 | 36 | 83 | 36 | 113 |
| | Liquid Compounding | Liquid Compounder | 451 | 88* | 73 | 87 | 68 | 99 |
| | Powder Compounding | Asst. Compound Mixer | 480 | 80 | 24 | 80 | 24 | 92 |
| | Plant-wide | Scrubber Operator | 418 | 89 | 84 | 88 | 73 | 98 |
| | Packaging | Bottle Machine Operator | 461 | 79 | 21 | 78 | 20 | 90 |
| | Packaging | Head-Drum Filler | 445 | 82 | 33 | 82 | 31 | 101 |
| | Packaging | Case Packer Operator | 455 | 80 | 26 | 80 | 25 | 95 |
| | Packaging | Case Packer Operator | 480 | 82 | 33 | 82 | 33 | 94 |
| | Packaging | Pouch Machine Operator | 480 | 81 | 28 | 81 | 28 | 96 |
| | Outdoors | Bulk Unloader | 464 | 83 | 36 | 82 | 35 | 108 |
| 4/11 | Liquid Compounding | Liquid Compounder | 432 | 85 | 52 | 84 | 47 | 96 |
| | Powder Compounding | Asst. Compound Mixer | 445 | 80 | 26 | 80 | 24 | 88 |
| | Plant-wide | Scrubber Operator | 431 | 89 | 83 | 88 | 74 | 97 |
| | Packaging | Bottle Machine Operator | 451 | 82 | 32 | 81 | 30 | 95 |
| | Packaging | Head-Drum Filler | 228 | 84 | 40 | 78 | 19 | 94 |

Table III (continued)
Worker Noise Exposures
DuBois Chemicals
Sharonville, Ohio
HETA 86-071
April 10-11, 1986

| Sample Description | | | | Exposure Values[a] | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Area | Job Title | Sample Duration (minutes) | 8-hr TWA dB(A)) | Projected Exposure (%) | Sample period TWA (dB(A)) | Dose (%) of allowed from sample | Maximum period level |
| | Packaging | Case Packer Operator | 437 | 78 | 20 | 78 | 18 | 90 |
| | Packaging | Pouch Machine Operator | 445 | 83 | 38 | 82 | 36 | 99 |
| | Packaging | Pouch Machine Operator Take-off | 480 | 80 | 24 | 80 | 24 | 98 |
| | Outdoors | Bulk Unloader | 438 | <u>87</u> | 69 | <u>87</u> | 63 | 104 |
| | Plant-wide | NIOSH Investigator | 413 | 82 | 33 | 81 | 29 | 90 |

OSHA Standard: PEL:[b] 90 100
Action Level:[c] 85 50

a: This footnote clarifies the column headings presenting noise exposure data collected during the survey. Eight hour time weighted average (TWA) in dB(A) using the OSHA 5dB doubling rule, assuming exposures continue for the rest of the shift-consistent with the previously measured noise levels. Projected exposure provides the calculated percent of the OSHA permissible exposure limit, 90dB(A) over 8 hours equalling 100%.
Sample period TWA and Dose (%) of allowed from sample provide the worker°s exposure averaged over the actual sampling period. The percent value indicates the actual amount of the PEL from noise levels during the sampling period. The Maximum Period Level indicates the highest noise exposure encountered by the worker averaged over a one minute sampling period. The dosimeters measure sound pressure levels 4 times per second incorporating the results into 15 minute intervals. The units report the Maximum Period Level or maximum noise level measured in any 1 minute interval during the entire sampling period. All values are A weighted, representing noise levels as perceived by the human ear.

b: The OSHA Permissible Exposure Level to noise over an 8-hour work shift is 90dB(A). NIOSH and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend an exposure limit of 85dB(A) TWA.

c: Action Level is the level of noise exposure which necessitates implementation of a hearing conservation program as specified in 29 CFR 1910.95, the OSHA noise standard.

*: Values which can be considered at or in excess of 85dB(A) are underlined.

Table IV
Hourly Breakdown of Selected Personal Exposures
as Hourly TWAs, in dB(A)
DuBois Chemicals
Sharonville, Ohio
HETA 86-071
April 10-11, 1986

| Job Title | Hour | 4/10/86 | 4/11/86 |
|---|---|---|---|
| Liquid Compounder | 1 | 86 | 84 |
| | 2 | 88 | 86 |
| | 3 | 88 | 86 |
| | 4 | 87 | 85 |
| | 5 | 87 | 86 |
| | 6 | 88 | 83 |
| | 7 | 88 | 87 |
| | 8 | 88 | 85 |
| | Cumulative TWA | 88* | 85 |
| Scrubber Operator | 1 | 91 | 91 |
| | 2 | 90 | 90 |
| | 3 | 85 | 86 |
| | 4 | 90 | 90 |
| | 5 | 85 | 88 |
| | 6 | 89 | 88 |
| | 7 | 89 | 88 |
| | 8 | - | 78 |
| | Cumulative TWA | 89 | 89 |
| Head-drum Filler | 1 | 81 | 82 |
| | 2 | 81 | 81 |
| | 3 | 82 | 86 |
| | 4 | 81 | 84 |
| | 5 | 81 | - |
| | 6 | 85 | - |
| | 7 | 83 | - |
| | 8 | 81 | - |
| | Cumulative TWA 82 | 84 | |
| Pouch Machine Operator | 1 | 83 | 81 |
| | 2 | 80 | 82 |
| | 3 | 81 | 79 |
| | 4 | 78 | 79 |
| | 5 | 80 | 88** |
| | 6 | 81 | 86** |
| | 7 | 82 | 84** |
| | 8 | 81 | 78** |
| | Cumulative TWA | 81 | 83 |

Table IV (continued)

Hourly Breakdown of Selected Personal Exposures
as Hourly TWAs, in dB(A)

DuBois Chemicals
Sharonville, Ohio
HETA 86-071

April 10-11, 1986

| Job Title | Hour | 4/10/86 | 4/11/86 |
|---|---|---|---|
| Bulk Unloader | 1 | 92 | 81 |
| | 2 | 82 | 90 |
| | 3 | 81 | 92 |
| | 4 | 78 | 85 |
| | 5 | 75 | 87 |
| | 6 | 76 | 88 |
| | 7 | 75 | 79 |
| | 8 | 85 | 81 |
| | Cumulative TWA | 83 | 87 |

* : Cumulative values were calculated by the dosimeter from the total sampling period. For sampling periods less than 8 hours, the unit calculated an 8-hour time weighted average (TWA) assuming continuation of the noise exposure pattern observed during the actual sampling time. For example, in the case of the Head-drum filler, on 4/11/86 his actual sampled exposure resulted in about 20% of his permissible dose according to the OSHA stand. Thus since this was a 4 hour sample, the same trends were assumed for the remaining unsampled period resulting in an exposure TWA of 40% of the OSHA standard or 84 dB(A).

**: Values obtained during pouch machine operation.

Table V

Area Short-term Octave Band Noise Analysis

DuBois Chemicals
Sharonville, Ohio
HETA 86-071

April 10, 1986

| Location | Descriptive Notes Unweighted Level | Octave Band Analysis Results in dB* Level 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | dB(C)** | dB (A)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mezzanine | Hot water tank, pump operating | 80 | 80 | 81 | 81 | 81 | 79 | 74 | 67 | 88 | 85 |
| Kettle 103 | Roof exhaust fan operating overhead | 84 | 78 | 78 | 80 | 78 | 76 | 72 | 68 | 87 | 84 |
| Maintenance Area | Air compressor on, generator off | 88 | 97 | 96 | 88 | 84 | 80 | 76 | 73 | 99 | 89(96)[+] |
| Boiler Room | Boiler #1 operating | 82 | 87 | 88 | 89 | 88 | 88 | 86 | 83 | 97 | 95 |
| Outdoors, Bulk Unloading Area | Dust collector discharge | 79 | 86 | 94 | 90 | 86 | 80 | 74 | 67 | 98 | 92 |
| Special Products Mixing Area | Kettle 115 operating | 79 | 86 | 90 | 90 | 86 | 82 | 73 | 63 | 94 | 91(85)[++] |

*: Results are presented in decibels (dB). No weighting is applied to the octave band analysis values. Individual columns are designated by the center frequency of each octave band.

**: The sum of the overall noise level is presented in these two columns. The first is essentially unweighted or dB(C), the second is A weighted, providing a value for the overall noise level as perceived by the human ear.

+: Value in parentheses is the noise level during an air release from the compressor.
++: Value in parentheses is for the kettle operating empty.