U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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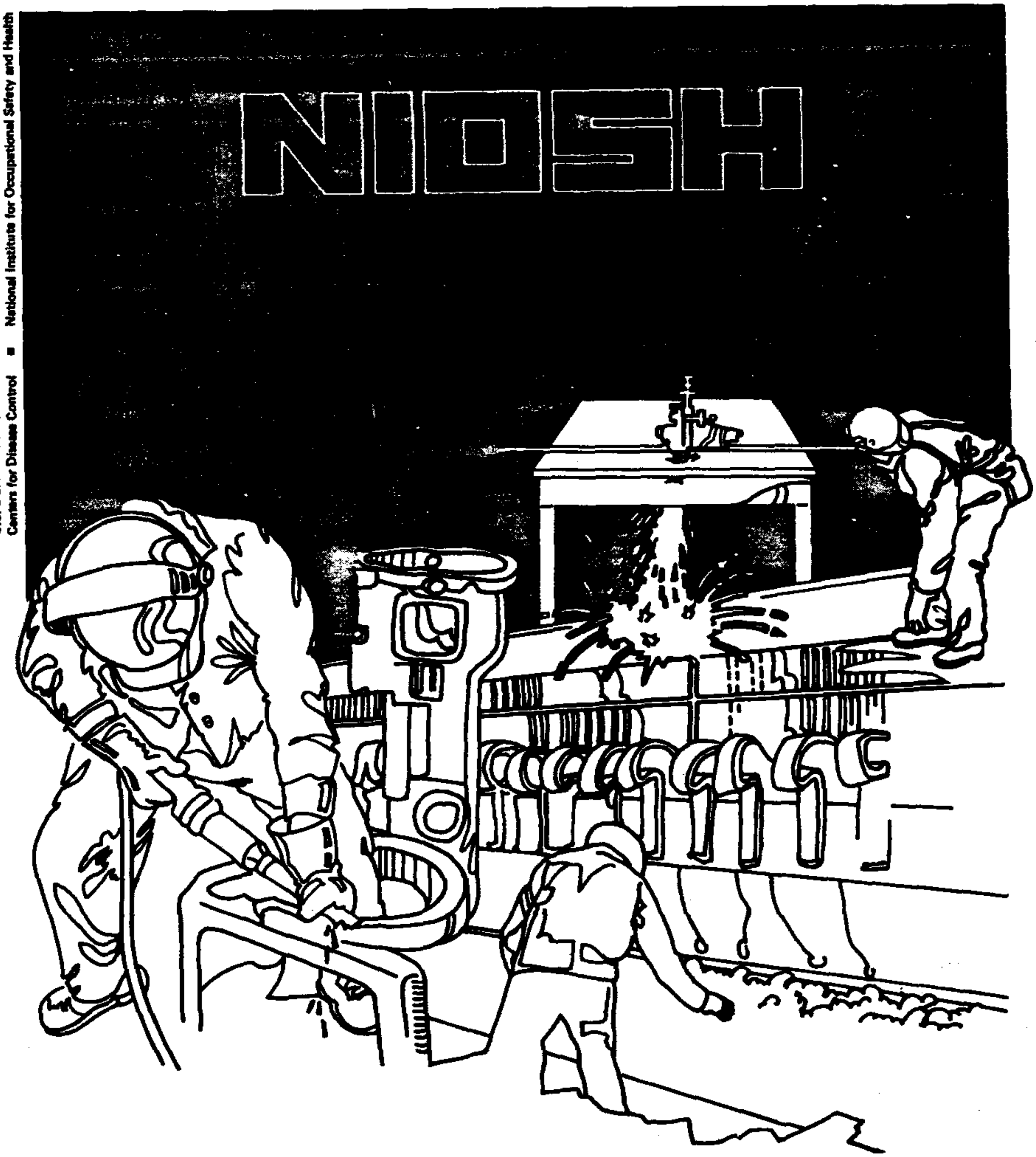

Health Hazard Evaluation Report

MHETA 88-214-1952
FLYING W PLASTICS COMPANY
GLENVILLE, WEST VIRGINIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

MHETA 88-214-1952
FLYING W PLASTICS COMPANY
GLENVILLE, WEST VIRGINIA
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I. Summary

On March 22, 1988, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation request from the Flying W. Plastics Company (FWP) to investigate potential occupational health hazards at their pipe fabricating plant in Glenville, West Virginia. The health concerns at this facility included exposures to noise and exposures to dusts and vapors generated from the fabrication of polyethylene (PE), polystyrene (PST), and polyvinyl chloride (PVC) pipe/pipe fittings. NIOSH investigators conducted industrial hygiene surveys at FWP on July 6-8 and July 28, 1988.

Industrial hygiene samples were collected for several chemical substances associated with the processing/fabrication processes like those at FWP; these included organic gases/vapors (including vinyl chloride), carbon monoxide, hydrogen chloride, phthalate compounds (di-n-butyl phthalate and di-cyclohexyl phthalate). Samples were also taken for airborne respirable dusts, asbestos insulation materials, and noise.

Airborne organic gases/vapors contained largely aliphatic hydrocarbons (butanes, pentanes, hexanes, and heptanes); toluene, xylene, methylene chloride, and 1,1,1-trichloroethane were also detected in air. These gases/vapors were below quantifiable levels and substantially below existing exposure standards/criteria of NIOSH, the Occupational Safety and Health Administration (OSHA), and the American Conference of Governmental Industrial Hygienists (ACGIH). The samples collected for di-n-butyl phthalate and di-cyclohexyl phthalate were also below detectable levels. Some workers at FWP were exposed to respirable PVC dusts at concentrations ranging from 0.06 milligrams per cubic meter of air (mg/m^3) to 1.3 mg/m^3. There are some research findings to suggest that PVC dusts are not nuisance particulates and can cause a benign form of pneumoconiosis with radiographic and histologic changes. At present there are no adequate exposure standards for PVC dusts. The tenure of the workers in the high dust exposure jobs was low, one year or less; consequently, it is unlikely that any of the workers at FWP had sufficient dust exposure/tenure to cause any measurable lung changes by pulmonary function testing or chest x-rays.

Asbestos insulation materials were detected on the Braybender machine in the quality control laboratory; sections of this insulation material were damaged and present an exposure hazard through the potential for asbestos fiber release.

Some employees at FWP received hazardous noise exposures in excess of the standards/recommendations of OSHA, NIOSH, and ACGIH. Job categories working in areas with hazardous noise levels included grinder, line take-off attendant, and hopper attendant. Workers in the grinding area used hearing protection; however, workers in the other job categories did not use hearing protection and some were exposed to hazardous noise levels.

During our evaluations, a large unguarded chain drive was observed on the blending machine in the warehouse grinding area. This unguarded chain drive presents a substantial safety hazard for workers in this area.

On the basis of data obtained during this evaluation, NIOSH investigators concluded that some workers at FWP receive hazardous noise exposures. Damaged asbestos insulation materials in the quality control laboratory also present a potential asbestos exposure hazard. Some workers are exposed to respirable PVC dusts and possibly at risk of developing a benign form of pneumoconiosis; although, at present, there are no adequate exposure standards/guidelines for PVC dusts to assess the health risks of these exposures. Exposures to other substances generated by pipe fabrication processes were below existing health standards/exposure guidelines. The unguarded chain drive on the blender machine was a safety hazard for workers in the grinding area. Recommendations to correct these occupational health/safety problems are presented in section VIII of this report.

Keywords: SIC 3079 (Pipe Fabrication), Extruding, Polyvinyl Chloride, Polyethylene, Polystyrene, Noise

II. Introduction

On March 22, 1988, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation request from the management of Flying W. Plastics Company (FWP) to investigate potential occupational health hazards at their pipe fabricating plant in Glenville, West Virginia. The potential health concerns at this plant included exposures to noise, and exposures to dusts and vapors generated from the fabrication of polyethylene, polystyrene, and polyvinyl chloride pipe/pipe fittings. There were no reports of occupational illness among this workforce of approximately 50 employees. On July 6-8, 1988, NIOSH investigators conducted an industrial hygiene survey at FWP to address the health concerns raised in this request. A second environmental survey was performed on July 28, 1988 to take additional noise measurements.

III. Background

The FWP, Glenville fabrication plant has been in operation approximately five years. Workers at this plant fabricate plastic pipe and pipe fittings using polyethylene (PE), polystyrene (PST), and polyvinyl chloride (PVC) materials on automated line operations. PVC and PE materials are used in pipe manufacturing; PST is used to manufacture the fittings. The product materials used in this fabrication process are polymerized powder, pellets, or reground pipe chips. These materials are fed into an extruder where the pipe is formed with heat/pressure. The polymer materials are loaded into the extruder both automatically and by hand held scoop. Hopper attendant is the job category responsible for loading the polymer materials. The pipe is then run through a vacuum sizing tank to control pipe diameter and thickness. Two water cooling tanks are used next in series to reduce the pipe temperature. At the end of the production line the pipe material is cut with a circular saw and stacked or rolled into a coil. The line attendant job category monitors/adjusts the pipe production process; the take-off attendant receives finished pipe product at the end of each production line.

A separate group of five automated lines are used to manufacture pipe fittings using extruding machines to melt the polymer materials prior to molding. Injection of polymer materials into the extruder is done automatically on these line operations. One employee, the molder, operates a mold fitting line.

PVC pipe materials with flaws or imperfections are taken to a grinding area, located in an adjacent warehouse, where they are ground into powder or small chips and recycled. Two grinders, a pulverizing machine, and a materials blending machine are operated in this area by two employees (grinders). These PVC grinding operations are located in the warehouse. A second grinding machine for PE pipe is located between the pipe/pipe fitting manufacturing lines in the main plant.

IV. Methods

Industrial hygiene evaluations were done at FWP to evaluate potential occupational health hazards from the manufacture of pipe/pipe fittings. This evaluation included sampling for organic gases/vapors including vinyl chloride, 2) carbon monoxide, 3) hydrogen chloride, 4) phthalate compounds, 5) airborne respirable dusts, 6) airborne particle size distributions, 7) bulk asbestos insulation, and 8) noise.

The organic gas and vapor samples were collected on a solid charcoal media in a sorbent tube using portable sampling pumps calibrated at 50 cubic centimeters per minute (cc/min).[1] Personal and area samples were taken over a full shift (7 hours or longer). Bulk airborne gas/vapor samples were also collected using similar charcoal tubes at a sampling rate of approximately 100 cc/min. These bulk samples were analyzed qualitatively for hydrocarbon compounds by gas chromatography (GC).[1]

Vinyl Chloride samples were also collected using activated charcoal media at a sampling rate of 25 cc/min; consecutive, partial period samples were taken over the full shift and analyzed by GC according to NIOSH Analytical Method 1007.[1,2] This analytical method has a detection limit of 0.01 milligrams per sample; this corresponds to an airborne detection concentration of about 0.6 ppm for a full shift sample.

The phthalate samples were collected on cellulose ester filter media using portable sampling pumps calibrated to 2.0 lpm. Full shift samples were taken. The media was desorbed in carbon disulfide and analyzed for di-n-butyl phthalate and di-cyclohexyl phthalate by GC according to NIOSH Analytical Method 5020.[1] This analytical method has a detection limit of about 0.01 mg/sample; this corresponds to an airborne detection concentration of about 0.01 mg/m^3 for an 8 hour sample.

Airborne respirable dust samples were collected on polyvinyl chloride (PVC) filter media using portable sampling pumps calibrated at 1.7 liters per minute (lpm). A 10 millimeter nylon cyclone was used to separate the respirable dusts from total airborne dusts; this cyclone has a 50 percent collection efficiency for dusts with an aerodynamic diameter of approximately 3.5 microns (µm).[3] Both personal and area samples were collected over a full shift sampling period. These dust samples were analyzed gravimetrically on an electrobalance with an instrumental precision of approximately 0.01 mg.

Samples were also collected to measure the size distributions of airborne particles. Particle size distribution samples were taken using the Sierra Model 296 personal cascade impactor. This is a six stage, multijet sampler which collects airborne particles on different stages according to their aerodynamic size. The dust is collected on mylar collection substrates coated with impaction grease. A sampling flow rate of 2.0 lpm was used; this flow rate provided the following aerodynamic cut points by stage: Stage 1

(20 µm); Stage 2 (15 µm); Stage 3 (10 µm); Stage 4 (6 µm); Stage 5 (3.5 µm); Stage 6 (2µm); and backup filter (< 2 µm). The amount of dust collected on each stage was measured gravimetrically using an electrobalance. The particle mass concentration in each size range can be determined and a size distribution established in comparison with the total mass of the sample.[3]

Short term, detector tube samples were collected for carbon monoxide and hydrogen chloride. These samples were collected over a period of about two-five minutes. A hand held sampling pump is used to pull 1000 cc of air through the detector tube. Detector tube samples use colormetric methods to measure airborne chemical concentrations; airborne chemicals interact with reagents in the detector tube media to produce a color change proportional in length to the airborne chemical concentration of the analyte.[4]

A bulk sample of insulation was collected from a materials testing machine (the Braybender Machine) located in the plant quality control office. This sample was analyzed by polarized light microscopy with dispersion staining.[5]

Noise measurements were taken using a sound level meter with an octave band analyzer. The sound level meter was used to measure the overall levels of broadband noise produced by the equipment operated during our evaluation. An A-weighted sound scale was used for this purpose. A-weighted sound level readings electronically filter broadband noise in ways that approximate the ear's response to sound energy at different frequencies - i.e. showing less sensitivity to low frequency and high frequency sounds relative to those in the mid-frequency range (500-6000 HZ).[6]

The octave band analyzer measured the sound energy within the different frequency ranges (octave bands) comprising the broadband noise produced by operation of plant equipment. Octave-band filters in the frequency ranges from 31.5 hertz (HZ) to 16,000 HZ are used in this meter to selectively measure the sound energy in the different frequency bands. This instrument, along with the sound level meter, was field calibrated daily prior to survey measurements.

Personal, time-weighted noise exposure measurements were also taken using a noise dosimeter. This noise dosimeter was attached to the worker's lapel and operated throughout the shift to take a full shift noise exposure measurement. An A-weighted sound scale was also used with this sampling instrument.

The decibel (dB) scale is used to report the sound levels measured during this evaluation; this is a logarithmic scale. The dB is a dimensionless unit used to express the logarithm of the ratio of the measured sound pressure (P_1) to a reference sound pressure (P_0=0.00002 newtons per square meter):[6]

$$\text{Sound pressure level in dB} = 20 \, \text{Log}_{10} \, P_1/P_0$$

V. Evaluation Criteria

Evaluation criteria are used as guidelines to assess the potential health effects of occupational exposures to substances and conditions found in the work environment. These criteria consist of exposure levels for substances and conditions to which most workers can be exposed day after day for a working lifetime without adverse health effects. Because of variation in individual susceptibility, a small percentage of workers may experience health problems or discomfort at exposure levels below these existing criteria. Consequently, it is important to understand that these evaluation criteria are guidelines, not absolute limits between safe and dangerous levels of exposure.

Several sources of evaluation criteria exist and are commonly used by NIOSH investigators to assess occupational exposures. These include:

1. The U.S. Department of Labor (OSHA) permissible exposure limits (PEL's);[7]

2. The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit (Exposure) Values (TLV's);[8]

3. NIOSH recommended exposure limits (REL's).[9,10]

These criteria have been derived from industrial experience, from human and animal studies, and, when possible, from a combination of the three. Consequently, due to differences in scientific interpretation of these data, there is some variability in exposure recommendations for certain substances. Additionally, OSHA considers economic feasibility in establishing occupational exposure standards; NIOSH and ACGIH place less emphasis on economic feasibility in development of their criteria.

The exposure criteria described below are reported as: Time-weighted average (TWA) exposure recommendations averaged over the full work shift; short term exposure limit (STEL) recommendations for a 10-15 minute exposure period; and ceiling levels (C) not to be exceeded for any amount of time. These exposure criteria and standards are commonly reported as parts contaminant per million parts air (ppm), or milligrams of contaminant per cubic meter of air (mg/m^3). Occupational criteria for the air contaminants evaluated during this study are as follows:[7-10]

SUBSTANCES	NIOSH (REL)	ACGIH (TLV)	OSHA (PEL)
Di-cyclohexyl Phthalate	NO REL	NO TLV	NO PEL
Di-n-butyl Phthalate	NO REL	5 mg/m^3 - TWA	5 mg/m^3 - TWA
Carbon Monoxide	35 ppm - TWA 200 ppm - C	50 ppm - TWA 400 ppm - STEL	50 ppm - TWA
Hydrogen Chloride	NO REL	5 ppm - C	5 ppm - TWA
Airborne Polyvinyl Chloride Dust	NO REL	NO TLV	NO PEL
Total Airborne Hydrocarbons	NO REL	NO TLV	NO PEL
Vinyl Chloride*	LFL	5 ppm - TWA	1 ppm - TWA

* Considered to be a human carcinogen by ACGIH and NIOSH.
LFL - Lowest feasible limit of exposure.

The occupational health criteria/standards for continuous noise exposure, based on a A-scale weighting, are as follows:(6-8,11)

Exposure Levels (dBA[1])

Hours of Exposure	ACGIH TLV	NIOSH REL	OSHA PEL
16	80	80	85
8	85	85	90
4	90	90	95
2	95	95	100
1	100	100	105
1/2	105	105	110
1/4	110	110	115
1/8	115	115	-

[1]dBA - Decibel Level, A-Scale Weighted.

As indicated above, continuous noise exposures should not exceed 115 dBA for any amount of time according to the OSHA PEL, ACGIH TLV, or NIOSH recommended standard.(7,8,11)

VI. Results/Discussion

PE/PVC pipe and PST fittings were manufactured at FWP during this evaluation. Three of the four automated pipe manufacturing lines were in operation; while, two of the five pipe fitting lines were in operation. These manufacturing operations were done in a large, rectangular building (the fabricating plant) with an open bay design. The pipe manufacturing operations are located at the south end of the plant; the pipe fitting operations were on the north end. Dilution ventilation is provided for these operations by large axial fans, located near the ceiling, at both ends of the plant (north and south). Ceiling fans were located over the pipe manufacturing operations to provide additional air mixing. The large plant entrance doors were kept open during this evaluation due to warm ambient conditions and this served as an additional source of outside dilution air.

The PVC grinding operations in the warehouse were operated during this evaluation; however, the PE grinder in the plant was not operated. The two warehouse grinding machines are enclosed in a room with sound insulation. The pulverizing machine had local exhaust ventilation (so did the PE grinder in the plant); however, the pulverizing and blending warehouse operations had no exhaust ventilation/dust control at the product load out point.

Organic vapor sampling was done to evaluate the potential for hazardous exposures to thermal decomposition products generated through the melting of PE, PVC, and PST materials. The three bulk air samples taken for qualitative identification of organic gases and vapors contained largely aliphatic hydrocarbons (butanes, pentanes, hexanes, and heptanes). Toluene, xylene, methylene chloride, and 1,1,1-trichloroethane were also detected. The concentrations of all compounds in these bulk samples were very low; consequently, only a total hydrocarbon concentration was measured for individual charcoal tube samples. Fourteen of the 15 organic vapor samples collected at FWP were below the analytical quantification limit for total hydrocarbon compounds, $< 2\ mg/m^3$. One sample, collected from the quality control office, had a total hydrocarbon concentration of $4\ mg/m^3$; this hydrocarbon concentration, and related chemical odor, is attributed to operation of the Braybender Materials Tester. Total hydrocarbon concentrations from all FWP operation were well below existing health standards/criteria of NIOSH, OSHA, or ACGIH for any of the individual chemical compounds detected in the bulk samples.[7-10]

The five personal, breathing zone, vinyl chloride samples were all below the analytical detection limit, less than 0.6 ppm. The material safety data sheets for the PVC materials indicated that there could be vinyl chloride residual present in the polyvinyl chloride materials first received from the manufacturer. However, the PVC materials processed during our evaluation were primarily reground product obtained from damaged/flawed pipes - not newly manufactured PVC. Vinyl chloride is a human carcinogen and NIOSH recommends that exposure to vinyl chloride exposures be maintained at the lowest feasible level.[10]

Phthalate compounds are commonly used as plasticizers in PVC and have been identified as a thermal decomposition product of polyvinyl chloride materials.[12] The six personal, breathing zone air samples collected for phthalates (di-n-butyl phthalate and di-cyclohexyl phthalate) were all below detectable levels, < 0.01 mg/m^3.

Short term detector tube samples taken for other thermal decomposition gases from PVC, PE, and PST materials indicated the presence of carbon monoxide and hydrogen chloride. The three carbon monoxide (CO) samples collected near the line take-off area of fabricating lines one and three ranged from non-detectable (< 0.5 ppm) to a high of 1 ppm. Hydrogen chloride was also detected in the line take-off area for the PVC pipe (lines one and three). Two hydrogen chloride (HCL) samples taken by placing the sampling orifice inside the newly manufactured PVC pipe prior to line take-off ranged from 2 ppm to 10 ppm; general ambient concentrations of HCL in the take-off area were lower, due to dilution effects, with HCL concentrations ranging from non-detectable (< 0.5 ppm) to a high of 1 ppm. None of the short term, ambient concentration exceeded the personal exposure standards/criteria of NIOSH, OSHA, or ACGIH.[7-10]

The operating temperature of the extruders can influence the nature and amount of thermal decomposition products from polymer materials such as PVC.[13] During our evaluation, extruding temperatures ranged from approximately 110° centigrade (C) to 215°C. PVC is reported to be relatively stable at temperatures below 225°C; between 225°C and 475°C, PVC materials are reported to degrade thermally releasing first HCL and then, above 300°C, CO and carbon dioxide (CO_2), benzene, and vinyl chloride.[13] The extruding temperatures during this evaluation were in a range associated with minimal thermal degradation for PVC and this is consistent with industrial hygiene sampling results.

Airborne dust concentrations at FWP were largely due to grinding/pulverizing operations and hopper loading operations. Dust from the grinding operations was largely PVC; while, dusts from the line operations in the fabricating plant contained both PVC and PE materials. Table I presents respirable dust exposures/concentrations by job and area. Personal exposures to respirable dusts at FWP ranged from 0.06 milligram per cubic meter of air (mg/m^3) to a high of 1.3 mg/m^3. The job categories with the highest average respirable dust exposures included grinder (0.4 mg/m^3) and PVC line hopper attendant (0.3 mg/m^3). Workers in both of these job categories were exposed primarily to PVC dusts. The grinders were observed using disposable respirators and a face (eye) shield throughout most of the shift; the hopper attendant wore no eye or respiratory protection.

Airborne dusts from the hopper areas of the pipe fabricating lines and from the grinding area showed a bimodal size distribution (two predominant dust sizes). Most of the dusts from the hopper areas was in a size mode with a mass median aerodynamic diameter (MMAD) of approximately 20 microns (μm). A second dust size mode was seen in this area with a MMAD of approximately 2-3 μm; although, this size mode represented only a small fraction of the total airborne dusts. Dusts from the grinding/pulverizing area had a predominant size mode approximately 15-20 microns in MMAD and a second size mode of approximately 3-5 µm in MMAD. It is possible that this bimodal size distribution in the grinding area reflects differences in dust sizes generated from grinding and pulverizing operations. These airborne dust size distributions indicate that most of the dusts generated at FWP have a large particle size and would not be respirable-capable of penetrating to the aveolar, gas exchange regions of the lung; about 20-25 percent of the total airborne dusts were below 5 µm in aerodynamic diameter and in the optimum size range for aveolar deposition.(3) Dusts in this size range presents the greatest pneumonocotic risk based on the biological activity of the dust.(3)

Some research suggests that PVC dusts can produce a benign form of pneumoconiosis with radiographic and histological changes and should not be considered nuisance dusts; although at present, these studies are inconclusive.(14-17) Polyethylene dusts are not considered to have pneumoconiotic effects and can be treated as nuisance dusts. Personal respirable dust exposures at FWP were below nuisance dust exposure recommendations; however, there are no acceptable dust exposure standards/criteria for PVC dusts to address any pneumoconiotic health risk.

The bulk insulation sample collected from the insulated cord on the Braybender machine was comprised of approximately 80-90% chrysolite asbestos. The insulation on this cord was damaged at several locations presenting a potential for asbestos fiber release and asbestos exposure. NIOSH, ACGIH, and OSHA consider asbestos to be a human carcinogen; NIOSH recommends that asbestos exposures be reduced to the lowest feasible limit.(7-10)

Workers at FWP are exposed to noise through operation of the pipe/pipe fitting fabricating lines in the plants and grinding/pulverizing equipment in the warehouse. Noise exposures on any day can be variable (both in terms of intensity and duration) depending on the different equipment in operation. Personal, time-weighted average (TWA) noise exposure measurements taken over a three day period ranged from a low of 80 dBA to a high of 104 dBA (Table II).

Exposure to high noise levels can cause permanent damage to hearing ability. When an individual is first exposed to hazardous noise levels, the initial change usually observed is a temporary loss of hearing ability (threshold shift) in the higher sound frequency ranges. After a rest period away from the noise, hearing ability usually returns to its former level. The long-term (cumulative) effects of repeated, prolonged exposure to high noise levels can result in permanent pathologic changes in the inner ear (the cochlea) and irreversible (permanent) threshold shifts in hearing ability. This hearing damage is generally classified as noise induced hearing loss. Exposure to a very brief but very loud noise can also cause a form of permanent (noise induced) hearing loss called acoustic trauma. When any hearing loss involves the sound frequency ranges commonly used for speech (500-2000 Hz), considerable difficulty in communication (hearing conversational speech) develops.

It is currently believed that exposure to noise levels in excess of 115 dBA is hazardous and should be avoided. Exposure to sound levels below 70 dBA are regarded as safe and will not cause any permanent hearing loss.[6] The hazard of A-weighted noise levels between 70-115 dBA is a function of the duration of exposure. The OSHA PEL for eight hours of noise exposure is 90 dBA as a TWA.[7] Both NIOSH and ACGIH recommend an eight hour TWA noise exposure level of 85 dBA to prevent noise induced hearing loss.[8,11] The OSHA PEL and NIOSH/ACGIH recommendation for the maximum allowable noise exposure limit is 115 dBA.[7,8,11] Workers should not be exposed to a continuous noise level above 115 dBA for any amount of time.

The three noise exposure measurements from the grinding area exceeded both the OSHA TWA exposure limit of 90 dBA and the OSHA 115 dBA ceiling limit. The workers in the grinding area wore hearing protection devices (ear plugs) throughout the entire shift according to company policy; when inserted properly, these ear plugs should provide sufficient attenuation to reduce these noise exposures within allowable limits.[6] Two of the seven noise samples from the fabrication plant exceeded the OSHA TWA noise exposure limit of 90 dBA (take-off attendant - area, PVC lines one and three); while five of the seven samples exceeded the NIOSH/ACGIH exposure recommendations, 85 dBA. The hopper attendant and take-off attendant job categories had overexposures to noise by NIOSH/ACGIH criteria; the noise sample collected from the line attendant job category did not exceed existing standards/criteria for noise exposures. Three of the noise dosimeter samples from the take-off attendants exceeded the OSHA 115 dBA ceiling limit at some point during the shift.

Table III lists the A-weighted sound level measurements from the equipment operated during our evaluation. The two grinding machines were the primary noise sources in the warehouse grinding area. These machines were enclosed in a sound reduction chamber lined with acoustical tile; however, operation of these grinders produced noise levels in excess of existing standards outside the chambers. Sound levels measured near the operator during grinding activities ranged from approximately 107 to 111 dBA. Sound levels near the ear plug dispenser on the south wall were approximately 95-103 dBA. The highest sound energy levels from the operation of the grinding equipment occurred in the 250 to 2000 Hz frequency range. The primary source of elevated noise exposures in the fabrication plant were the circular table saws used to cut the PVC/PE pipe at the end of each production line. These saws were of a portable design on rollers; however, they were attached to the concrete floor with metal support legs. (NOTE: The PE grinding machine in the fabrication plant was not used during our evaluation and we were unable to take any noise measurements from this machine). The saws for the PVC lines one and three were operated more frequently than the PE line saw (line six). The PVC pipe was being cut into 8 foot lengths requiring a saw cut every 40-70 seconds; the PE pipe was being rolled into large coil and required infrequent use of the line saw. Sound levels 2-3 feet from these saws (lines one and three) were in a range from approximately 100-105 dBA. Sound levels between the two lines, the area where the take-off attendants spent the most time, ranged from approximately 90-95 dBA. The highest sound energy levels from these saws were in a frequency range from approximately 1000-8000 Hz.

VII. Conclusions

1. Employee exposure to thermal decomposition products from the PVC, PE, and PST materials did not exceed any of the standards/recommendations of NIOSH, OSHA, or ACGIH. During this evaluation, the extruders were operated in a temperature range from 110°C to 215°C; higher extruder operating temperatures could result in higher employee exposures to thermal decomposition products.(13)

2. Respirable dust exposures at FWP were highest among the PVC grinders and the PVC line hopper attendant. There are some research findings suggest that PVC dusts are not nuisance particulates and can cause a benign form of pneumoconiosis with pulmonary radiographic and histologic changes. However, at present there are no exposure standards/criteria for PVC dusts.(14-17) The tenure of workers in these high exposure categories was low, one year or less; consequently, it is unlikely that any of the workers at FWP had sufficient dust exposure/tenure to cause any measurable lung changes by pulmonary function testing or chest x-rays.

3. The Braybender testing machine in the quality control laboratory contains exposed, friable asbestos insulation and presents the potential for the release of asbestos fibers into room air. Asbestos is a human carcinogen and NIOSH recommends that exposures to asbestos be reduced to the lowest feasible limit.(10)

4. Some employees at FWP received hazardous noise exposures in excess of the OSHA PEL's, ACGIH TLV's and the NIOSH REL's. Job categories working in areas with hazardous noise levels would include grinder, take-off line attendant, and hopper attendant. Workers in the grinders job category wore hearing protection per company regulation to reduce noise exposures; however, employees in the line take-off and hopper attendant job categories used no hearing protection and some of these workers were overexposed to noise.

5. The unguarded chain drive on the blender machine in the warehouse grinding area was a safety hazard for workers in this area.

VIII. Recommendations

1. New PVC materials received from the manufacturer should be used in well ventilated areas, as discussed in the PVC material safety data sheet, to prevent worker overexposure to any residual vinyl chloride monomer that may be present in newly manufactured PVC polymer materials.

2. Several control measures could be taken to reduce dust exposures at FWP:

   - Eliminate the manual loading of the hopper on PVC line #3; replace this hopper with an enclosed extruder feeding system like those used in the other pipe fabricating lines.

- Enclose all boxes, containers, or bins used to: 1) receive ground/pulverized PVC materials from the blender or pulverizer machine 2) load extruding machines.

- A respiratory protection program should be developed for certain workers/work activities at FWP. This program should meet the standards established by the American National Standards Institute, Inc. (ANSI) as defined in ANSI Standard 288.2-1980, Practices for Respiratory Protection. The PVC hopper attendant should use respiratory protection when performing manual loading of the line hopper. Respiratory protection should also be used by all workers performing periodic cleaning operations on plant equipment in dusty areas (e.g. grinding equipment). Each worker should be given a personal respirator. One-half face piece, air purifying respirators with high efficiency respirators are recommended.

3. The grinders and hopper attendants should use eye protection, safety goggles/glasses or face shields.

4. Grinders (working with PVC) and PVC hopper attendants could be offered baseline chest radiographs and spirometry on first employment at FWP. These studies could be repeated periodically (every 3-5 years) throughout the workers employment in this job category.

5. The asbestos insulation on the Braybender Testing Machine cord should be replaced with a non-asbestos insulation. This insulation should be removed and disposed of in accordance with state laws. Contact Mr. Paul Rader with the West Virginia State Air Pollution Control Commission for more specific details on state requirements and available contractor services (304-348-4022).

6. Workers in grinding, hopper attendant and line take-off attendant job categories should be required to use hearing protection. Any employee working around the take-off line saws or the grinders should use hearing protection while in these areas.

7. Establish a hearing conservation program for FWP workers in grinding and pipe fabrication jobs to prevent permanent, noise induced hearing loss. This program should be structured according to the OSHA final rule in hearing conservation as detailed in the Federal Register, Vol. 48, No. 46, Tuesday, March 8, 1983. All workers in grinder, hopper attendant, and line take-off attendant job categories should receive periodic audiometric testing and counseling regarding the need to wear hearing protection. Indications of progressive threshold shifts would warrant follow-up actions aimed at further protective measures. New workers should be given a base-line audiometric test prior to work in the shop.

8. The ear plug dispenser in the grinding area should be relocated to warehouse entrance so employees do not have to enter the grinding area prior to obtaining hearing protection.

9. Other control measures could be taken to reduce noise levels at FWP:

   - Enclose the line take-off saws in mobile boxes with acoustical tile insulation to absorb sound energy.

   - Check with the manufacture of the saws/saw blades to see if there is a substitute saw blade that could be used to reduce sound levels from saw operation.

   - Seal the hole/opening where the grinder pipe injection port passes through the sound enclosure chamber. This opening around the grinder injection part should be sealed with a sound absorbing material.

10. Place a guard around the chain drive on the blender machine in the warehouse grinding area.

IX. References

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

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

1. Flying W. Plastics Company
2. OSHA, Region III
3. NIOSH Regional Offices

For the purpose of informing affected employees, copies of this report should be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

RESPIRABLE DUST CONCENTRATIONS

Flying W. Plastics Company
MHETA 88-214

Date	Job	Area	Concentration mg/m^3
7/06/88	Hopper Attendant	PVC Pipe Lines 1&3	0.51
7/06/88	Foreman	All Over Pipe Manufacturing Area	0.19
7/06/88	Line Attendant	Pipe Line 6, PE Line	0.11
7/06/88	Grinder	PVC Grinding Area - Warehouse	0.15
7/06/88	Grinder	PVC Grinding Area - Warehouse (Cleaned Blender Today)	1.3
7/07/88	Area Sample	PVC Line 3, PVC Manual Hopper	0.09
7/07/88	Grinder	PVC Grinding Area - Warehouse and Outside Loading Truck	0.06
7/07/88	Area Sample	PVC Grinding Area - Warehouse	0.18
7/08/88	Hopper Attendant	PVC Pipe Lines 1&3	0.13
7/08/88	Foreman	All Over Pipe Manufacturing Area	0.2
7/08/88	Grinder	PVC Grinding Area - Warehouse	0.11
7/08/88	Area Sample	PVC Grinding Area - Warehouse	0.15

mg/m^3 - milligrams of dust per cubic meter of air

TABLE II

PERSONAL NOISE EXPOSURE MEASUREMENTS

Flying W. Plastics Company
MHETA 88-214

Date	Job/Area	Sound Level[1] (dBA)	Noise Levels[2] Exceeded 115 dBA	Hearing Protection
7/07/88	Hopper Attendant - Lines 1&3	86	NO	NO
7/07/88	Take-off Attendant - Lines 1&3	87	YES	NO
7/07/88	Take-off Attendant - Line 6	89	YES	NO
7/07/88	Area Sample - Lines 1&3 Take-off Area	91	NO	NO
7/07/88	Grinder - Warehouse	95	YES	YES
7/08/88	Line Attendant - Line 6	80	NO	NO
7/08/88	Take-off Attendant - Lines 1&3	91	YES	NO
7/08/88	Take-off Attendant - Line 6	83	NO	NO
7/08/88	Grinder - Warehouse	102	YES	YES
7/08/88	Grinder - Warehouse	104	YES	YES

1 Time-weighted average noise exposure measurements in decibels using an A-Scale weighting.

2 Indicates those workers with a noise dosimeter reading in excess of the OSHA ceiling limit of 115 dBA.

- Lines 1&3 were PVC lines; line 6 was a PE line.

TABLE III

SOUND LEVEL METER READINGS

Flying W. Plastics Company
MHETA 88-214

Operation/Activity	Sampling Location	Sound Level (dBA)[1]
Grinding/Pulverizing PVC Pipe	Warehouse - 6' from grinder on lower (floor) level	100-103
Grinding/Pulverizing PVC Pipe	Warehouse - upper level grinding platform by operator	107-111
Grinding/Pulverizing PVC Pipe	Warehouse - ground level near the hearing protection dispenser	95-103
Sawing PVC Pipe	Fabrication plant - line #1, 2' from saw	100-105
Sawing PVC Pipe	Fabrication plant - line #3, 3' from saw	100-104
Sawing PVC Pipe	Fabrication plant - between saws on lines 1&3 near worker	90-95

[1] Decibels using an A-scale weighting