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NIOSH HEALTH HAZARD EVALUATION REPORT:

HETA #2003-0080-2905
Norwin Middle School East
North Huntington, Pennsylvania

June 2003

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

NIOSH

PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Erin Snyder of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Ron Hall, MS, CIH and Chad Dowell, MS of HETAB. Analytical support was provided by DataChem Laboratories (Salt Lake City, Utah). Desktop publishing was performed by Ellen Blythe. Review and preparation for printing were performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Evaluation of wood dust exposures from a wood shop at Norwin Middle School East

On February 24-25, 2003, NIOSH industrial hygienists conducted a health hazard evaluation at Norwin Middle School East. Employees were concerned that the dust collector used in the wood shop was not working properly, thus potentially exposing teachers in adjacent classrooms to wood dust. Health concerns included sinus infections, coughing, sneezing, sore throat, and eye irritation.

What NIOSH Did

- We collected area air samples in the wood shop and in two classrooms.
- We collected personal breathing zone samples from the wood shop teacher.
- We evaluated the local exhaust ventilation system and the dust collector in the wood shop.
- We talked to employees about their health concerns and working environment.

What NIOSH Found

- Results from both the area and personal breathing zone samples did not indicate exposures to wood dust in excess of occupational criteria.
- The local exhaust ventilation system and the dust collector are operating within recommended standards for dust removal.
- Stained ceiling tiles were found in the basement indicating past water incursion.
- The primary concern amongst teachers was lack of general housekeeping and poor communication with management.

What Norwin Middle School East Managers Can Do

- Improve communication between management and employees by forming a health and safety committee.
- Improve general housekeeping throughout the school building.
- Implement a filter change-out schedule for the heating, ventilation, and air conditioning (HVAC) system.
- Enclose the canopy hood in the wood shop to improve ventilation.
- Replace all stained ceiling tiles and create a program to manage indoor air quality issues.

What the Norwin Middle School East Employees Can Do

- Communicate health and safety concerns to appropriate management representatives.
- Improve housekeeping methods in the wood shop by using wet methods or HEPA filtered vacuums for clean-up of wood dust.

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513/841-4252 and ask for HETA Report # 2003-0080-2905

Health Hazard Evaluation Report 2003-0080-2905

Norwin Middle School East
North Huntington, Pennsylvania
June 2003

Erin M. Snyder, MS

SUMMARY

On November 27, 2002, the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a health hazard evaluation (HHE) at Norwin Middle School East in North Huntington, Pennsylvania. The request stated employees were concerned that the dust collector used in the wood shop was not working properly, thus potentially exposing teachers in adjacent classrooms to wood dust. Health concerns included sinus infections, coughing, sneezing, sore throat, and eye irritation.

On February 24-25, 2003, NIOSH industrial hygienists conducted an HHE at Norwin Middle School East. Following an opening conference and walkthrough tour of the wood shop, NIOSH investigators evaluated the wood shop ventilation system and the dust collector using a smoke machine. The next day, air monitoring was conducted for total dust in the wood shop and in two classrooms. The local exhaust ventilation (LEV) system in the wood shop was also evaluated. In addition, confidential interviews were conducted with teachers concerning their health and work environment.

Seven area air samples for total dust were collected. The locations of the samples included the sanding table and the band saw in the wood shop, and in classrooms 204 and 208 on the third floor of the school building. Classroom 208 is located above the wood shop, while classroom 204 is located in a hallway adjacent to 208. Personal breathing zone samples were collected from the wood shop teacher for total and inhalable dust. Sampling was conducted for the entire work day, which included six wood shop classes.

Air sampling results indicated that exposures to wood dust were below established occupational exposure limits on the day of the NIOSH survey. With the exception of the canopy hood, ventilation measurements indicated that the LEV and the dust collector were within recommended operating standards for dust removal. To be effective, the canopy hood should be enclosed on three sides, allowing for visibility from the front. The LEV system should be on whenever equipment is used in the wood shop. An emphasis should be placed on working as close to the inlet as safely possible without compromising any guards in order to capture the maximum amount of wood dust.

Concerns expressed by teachers related to poor general housekeeping and poor communication between employees and management. Recommendations in the report address these issues.

Keywords: 8211 Elementary and Secondary Schools, wood dust, wood working, IEQ, local exhaust ventilation

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INTRODUCTION

On November 27, 2002, the National Institute for Occupational Safety and Health (NIOSH) received an employee request to conduct a health hazard evaluation (HHE) at Norwin Middle School East in North Huntington, Pennsylvania. The request stated employees were concerned that the dust collector used in the wood shop was not working properly, thus potentially exposing teachers in adjacent classrooms to wood dust. Health concerns included sinus infections, coughing, sneezing, sore throat, and eye irritation.

On February 24–25, 2003, NIOSH industrial hygienists conducted an HHE at Norwin Middle School East. Following an opening conference and walkthrough survey of the wood shop, NIOSH investigators evaluated the wood shop ventilation system and the dust collector using a smoke machine. The next day, air monitoring was conducted in the wood shop and in two classrooms. The local exhaust ventilation (LEV) system in the wood shop was also evaluated during the survey. In addition, confidential interviews were conducted with teachers concerning their health and work environment.

BACKGROUND

Norwin Middle School East accommodates approximately 50 teachers and nearly 675 students in 6th through 8th grade. The middle school building has four floors of classrooms with the wood shop located on the lower level of the building across from the cafeteria. Each wood shop class is 43 minutes in length and has 10–15 students. The wood shop teacher's schedule consists of five consecutive classes held before his lunch period. Following lunch, he has a planning period and one additional class. All classes are assigned the same wood working project. Although the pace of each class may vary slightly, essentially the same equipment is used throughout the day by each class. The wood shop is equipped with a band saw, table saw, jointer, planer, four jigsaws, two drill presses, and multiple hand tools. Four large work tables are positioned down the center of the room for students' work. One table is frequently used for sanding and is equipped with LEV. Wood dust throughout the shop is collected by an LEV system connected to select equipment. Each class concludes by cleaning wood dust from the work tables and floor with a floor sweep connected to the LEV system. Blast gates throughout the system are used to adjust the air flow to the hoods or floor sweep as they are used.

The LEV system is an outdoor dry centrifugal dust collector. Wood dust is deposited into a 55-gallon drum located in a secured wooden enclosure. The dry centrifugal dust collector operates by a centrifugal force that directs wood dust particles into the drum. Teachers in classrooms adjacent to the wood shop voiced concerns that the dust collector did not efficiently capture the wood dust, allowing it to deposit in the classrooms.

In addition to the LEV system connected to select pieces of equipment in the wood shop, a canopy hood is located over a table used for painting and varnishing in a back corner of the room. The intent of the canopy hood is to draw vapors away from an individual as he/she stands at the table. The canopy hood exhausts to the outside of the building.

METHODS

After hours, on February 24, 2003, NIOSH investigators used a smoke machine (Rosco, Model 1500) to evaluate the capture efficiency of the LEV in the wood shop and the exhaust from the outdoor dust collector after school hours. The smoke machine was placed on the floor and smoke was pumped near the capture hood on the sanding table. NIOSH investigators observed the flow of smoke in the wood shop, in several classrooms on each floor of the building, and outdoors.

Area air samples for total and inhalable dust were collected in the wood shop and in classrooms 204 and 208. Classroom 208 was chosen because it is located above the wood shop; classroom 204 was chosen because it is located in a hallway adjacent to classroom 208, thus not above the wood shop.

Personal breathing zone (PBZ) samples were collected on the wood shop teacher for total and inhalable dust. Air samples were collected on a tared 37-millimeter (mm) diameter, (5 micrometer [µm] pore-size) polyvinyl chloride (PVC) filter at a calibrated flow rate of 2 liters per minute (Lpm). The filter was gravimetrically analyzed (filter weight) according to NIOSH method 0500.[1] Air samples for inhalable dust were collected with a tared 25-mm diameter 5 µm PVC filter in conjunction with an Institute of Occupational Medicine (IOM) inhalable sampler at a calibrated flow rate of 2 Lpm. The filter was gravimetrically analyzed according to NIOSH Method 0500.[1]

LEV systems were evaluated by measuring air velocity at the duct or hood opening using a TSI Velocicalc® model 8360 anemometer. This instrument measures air velocity in feet-per-minute (fpm). For each system evaluated, multiple measurements in a grid-like pattern were obtained and the results averaged to obtain the mean velocity. The following LEV systems were evaluated: the sanding table, band saw, table saw, three jigsaws, floor sweep, canopy hood, and the dust collector outside the building. Work practices during the use of these systems by the students were observed.

In addition, confidential unstructured interviews were held with teachers regarding health concerns and their work environment. Participation was voluntary for any faculty member at Norwin Middle School East.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the 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 even though 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 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 increases the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[2] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[3] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[4] Employers are encouraged to follow the NIOSH RELs, the ACGIH TLVs, or the OSHA PELs, whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

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 STEL or ceiling values which are intended to supplement the TWA

where there are recognized toxic effects from higher exposures over the short-term.

Wood Dust

Wood dust exposure may cause eye and skin irritation and respiratory effects. In industrial settings, certain hard woods, such as oak, maple, and walnut, have been linked to nasal cancer.[5] Loggers and persons involved in initial wood processing are exposed to irritant chemicals typically found in the bark or sap in the outer part of the tree. They are most affected by primary irritant dermatitis which consists of erythema and blistering.[5] Workers involved in the secondary wood processing (i.e., carpenters and furniture makers) are more often affected by the chemicals causing sensitization. Allergic dermatitis arising from exposure to wood substances is characterized by redness, scaling, and itching, which may progress to vesicular dermatitis after repeated exposures.[5] The adverse health effects that have been associated with exposure to wood dust upon which evaluation criteria are based include dermatitis, allergic respiratory effects, and mucosal and nonallergenic respiratory effects.

NIOSH recommends that wood dust be considered a potential occupational carcinogen and that exposures be reduced to the lowest feasible level, not to exceed the REL of 1 milligram of wood dust per cubic meter of air (mg/m^3) for both soft and hard woods.[2] ACGIH currently has a TLV of 1 mg/m^3 for hard woods such as beech and oak, and a TLV of 5 mg/m^3 for soft woods such as pine.[3] The ACGIH TLV of 5 mg/m^3 for soft woods was principally based on the low risk of occupational respiratory tract disease among wood workers in the building industry.[6] ACGIH recommends a STEL of 10 mg/m^3 for soft wood averaged over a 15-minute period which should not be exceeded at any time during the work day even if the 8-hour TWA exposure value is within the TLV.[3] There is currently no specific OSHA PEL for wood dust. The OSHA PEL for total particulate not otherwise regulated (PNOR) is 15.0 mg/m^3 and 5.0 mg/m^3 for the respirable fraction, determined as 8-hour averages.[4]

RESULTS

Seven area air samples for total dust were collected on the day of the survey. The locations of the samples included the sanding table and the band saw in the wood shop, and in classrooms 204 and 208 on the third floor of the school building. Total dust concentration results from these samples ranged from 0.027 to 0.142 mg/m^3 and the inhalable fraction results ranged from 0.047 to 0.226 mg/m^3 (see Table 1).

PBZ samples were collected on the wood shop teacher for total and inhalable dust. Sampling was conducted for the entire work day, which included six wood shop classes. The total dust result was 0.653 mg/m^3, while the inhalable fraction was 6.34 mg/m^3 (see Table 1). The personal inhalable air sample indicated concentrations exceeding the ACGIH inhalable wood dust criteria in the "notice of intended changes" for wood dust.[3] Upon inspection of the sampler, it appeared that the sample may have been inadvertently hit with wood dust (chunks of wood dust were visible on the filter). If the filter was inadvertently placed in the direct path of dust generation and hit with wood dust from one of the machines in the shop, it may not be a representative sample of exposure. Regardless, in comparison to current occupational evaluation criteria, which are based on total dust sampling methods, the results do not exceed relevant exposure limits.

Engineering controls, such as LEV, should continue to be used to reduce exposures to wood dust. An LEV system should be designed to have a capture velocity (minimum hood-induced air velocity necessary to capture and convey the contaminant into the hood) of approximately 200 fpm.[7] Table 2 shows the LEV measurements taken at the various pieces of equipment in the wood shop. At the face of the LEV, each piece of equipment is greater than 200 feet per minute (fpm). However, the results show that capture velocity decreases as distance from the face increases, so care should be taken to work as close to the LEV as safely possible. For the dust collector, a duct velocity of approximately 3500–4000 fpm (recommended duct velocities for average

industrial dust) is suggested to avoid plugging the duct work with material.[7] The system must also be designed to meet fire, safety, or environmental codes that apply to the school. Measurements taken for duct velocity of the dust collector currently in use at Norwin Middle School East indicated velocities within the recommended range of 3500–4000 fpm.

Informal interviews with 15 teachers were held on the day of the survey. Many cited poor housekeeping and visible dust as problems within the classrooms. During the warm weather months when windows are left open, the dust problem increases. Several stated health effects, such as sinus infections and congestion, improved over the summer months when school is no longer in session. Those teachers whose classrooms are located on the side of the building facing the dust collector appeared to have more health concerns than those whose classrooms are located in an adjacent wing of the building.

Stained ceiling tiles with visible mold growth were identified in the basement hallway. The administration noted that a plumbing leak had occurred in a bathroom on the floor above, thus resulting in water damaged ceiling tiles. A walk through of the entire school was not performed during the survey; therefore, additional ceiling tiles may have water damage.

DISCUSSION

While evaluating the capture efficiency of the LEV in the wood shop and the exhaust from the outdoor dust collector, NIOSH investigators observed that the generated smoke was not entrained back into the classrooms. While the observations from the smoke machine do not indicate a problem, it is understood that the smoke is not a surrogate for wood dust particulate. Due to differences in particle density, wood dust may not travel in the same pattern as the smoke. During the survey, winter conditions prohibited the classroom windows from being open, which is a common practice during warm weather. Opening classroom windows for additional ventilation in the spring and early summer (the school does not have air conditioning), may increase the likelihood of wood dust particulate reaching the classrooms. The recent addition of the downward-pointing exhaust duct to the dry centrifugal dust collector should limit the potential for wood dust particulate to deposit in adjacent classrooms. Prior to the NIOSH survey, the heating, ventilation, and air conditioning (HVAC) system was cleaned and the filters were changed. Also, each classroom received a thorough cleaning by the custodial staff. This should improve working conditions in the building.

During the NIOSH evaluation, air sampling results (both PBZ and area) indicated that concentrations of wood dust were below applicable occupational exposure criteria and did not indicate an airborne hazard. Pine is primarily used in the work-working class; therefore, wood dust exposures are compared to occupational criteria for soft wood. ACGIH has listed wood dust criteria in the "notice of intended changes" section of the TLV booklet.[3] The changes listed include evaluating wood dust exposure with the inhalable fraction rather than as total dust. The proposed TLV is 1 mg/m^3 for the inhalable fraction of nonallergenic and noncarcinogenic wood dust and 0.5 mg/m^3 for the inhalable fraction of allergenic wood dust.[3] It should be noted that these are industrial criteria and may not be applicable to a school environment.

CONCLUSIONS

Air sampling results from the NIOSH survey indicated that exposures to wood dust were below established occupational exposure limits on the day of the survey. With the exception of the canopy hood, the LEV and the dust collector were within recommended operating standards for dust removal. To be effective, the canopy hood should be enclosed, allowing for visibility in the front. The LEV system should continue to be used whenever equipment is being used in the wood shop. An emphasis should be placed on working as close to the inlet as safely possible in order to capture the maximum amount of wood dust. Concerns expressed by teachers related to poor general housekeeping and poor communication between employees and management.

RECOMMENDATIONS

The following recommendations are based on observations and results from the NIOSH survey and are intended to help ensure the health and safety of staff at Norwin Middle School East.

Wood Shop

1. Housekeeping practices should be improved to reduce exposures to wood dust or other possible contaminants. Dry–sweeping materials toward the dust collector's floor sweep slot should be discouraged to prevent dust from becoming airborne. Damp clean–up methods (i.e., mopping) or vacuuming with a high efficiency particulate air (HEPA) filter vacuum should be allowed during clean-up activities. Damp clean-up methods should not be used in any area where they may cause a potential electrical or safety hazard. Extreme care must be taken to prevent any electrical or slipping hazards if damp methods are used.

2. Safety glasses should be worn by teachers and students in the wood shop at all times; they are currently worn on a voluntary basis. Although measurements were not taken during the NIOSH survey, previous research has shown that the types of equipment used in the wood shop can jeopardize hearing.[8] The administration at Norwin Middle School East should consider implementing a hearing conservation program in accordance with NIOSH's *Preventing Occupational Hearing Loss - A Practical Guide*, which can be accessed at http://www.cdc.gov/niosh/96-110.html.[9]

3. To prevent an electrical accident, extension cords in the wood shop should be replaced as they become frayed.

4. The canopy hood located in the rear of the wood shop was non-functional due to its current design (i.e., not enclosed). The lack of enclosure allows vapors from stains and paints to flow past an individual's breathing zone before being captured by the LEV system. The hood should be enclosed on all three sides, with clear sheeting used in the front to allow visibility for individuals working under the hood. The system must also be designed to meet fire, safety, or environmental codes that apply to the school. This will increase the capture velocity of the hood and provide better exhaust ventilation to those working at the painting/staining bench, reducing the possibility of vapors flowing past an individual's breathing zone.

General

1. Check the filters used in the HVAC system on a regular basis and change as needed.

2. Replace all stained ceiling tiles in the basement hallway and elsewhere if needed. The source of the leakage that caused the stains should be investigated and repaired to prevent further damage and mold growth. NIOSH is aware that an indoor air quality (IAQ) program, based upon the Environmental Protection Agency's *Tools for Schools* document, is currently being developed by the administration of the Norwin School district. This program is recommended and encouraged by NIOSH and should be valuable in addressing IAQ issues should they arise in the future.

3. Improve general housekeeping throughout the school building. During confidential interviews, teachers reported a lack of routine cleaning in classrooms.

4. During the site visit, NIOSH was informed that the school district is in the early phases of designing a new middle school building. The location of the fresh air intakes for the HVAC system and the wood shop should be considered when designing the new building. All air intakes for the new building should be located in areas that are free from potential contaminants or pollutants; thereby eliminating the possibility of entraining potential contaminants or pollutants into the HVAC system.

5. Form a joint committee of management and employees to address the implementation of health and safety programs.

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Table 1
Air Monitoring Data
Norwin Middle School East
HETA 2003-0080-2905
February 25, 2003

Location	Type	Sample Time (minutes)	Results (mg/m^3)
Wood shop	Personal, total dust	350	0.643
Wood shop	Personal, inhalable fraction	386	6.34
Wood shop, sanding table	Area, total dust	350	0.14
Wood shop, band saw	Area, total dust	352	0.142
Wood shop, band saw	Area, inhalable fraction	353	0.226
Room 204	Area, total dust	392	0.027
Room 204	Area, inhalable fraction	392	0.056
Room 208	Area, total dust	405	0.047
Room 208	Area, inhalable fraction	405	0.055

mg/m^3 = milligrams per cubic meter

Table 2
Local Exhaust Ventilation Measurements
Norwin Middle School East
HETA 2003-0080-2905
February 25, 2003

Equipment	Duct diameter (inches)	Location of measurements	Number of measurements	Average velocity (fpm)
Sanding Table	8"w x 4.5"h slot	face	12	1860
Sanding Table	8"w x 4.5"h slot	6" away	12	230
Sanding Table	8"w x 4.5"h slot	12" away	12	80
Table saw	10"w x 0.5"h slot	face	12	555
Jigsaw # 1	4"	face	9	3580
Jigsaw # 1	4"	4" away	9	140
Jigsaw # 2	4"	face	9	3810
Jigsaw # 2	4"	5" away	9	120
Jigsaw # 3	4"	face	9	3850
Jigsaw # 3	4"	6" away	9	200
Floor Sweep	16"w x 1.5"h slot	face	8	3300

fmp = feet per minute

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