HETA 97–0112–2738
Handi–Shop, Inc.
Mexico, Missouri

Steven W. Lenhart, CIH

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.

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was written by Steven W. Lenhart of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Medical aspects were reviewed by Dr. Mitchell Singal of DSHEFS. Field assistance was provided by Joshua Harney and Gene Moss of the Division of Surveillance, Hazard Evaluations and Field St. Desktop publishing was done by Ellen Blythe. Preparation for printing was done by Penny Arthur.

Copies of this report were sent to management representatives at Handi–Shop, OSHA Regional Office VII in Kansas City, Missouri; the Missouri Department of Elementary and Secondary Education and the Missouri Department of Mental Health in Jefferson City, Missouri; and Handicapped Services of Audrain Co. in Mexico, Missouri. This report is not copyrighted and may be freely reproduced. Single copies will be available for three years after the date of this report. To expedite a request, include a self–addressed mailing label with your written request to:

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Health Hazard Evaluation Report 97–0112–2738
Handi–Shop, Inc.
Mexico, Missouri
May 1999

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SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation (HHE) at Handi–Shop, Inc. in Mexico, Missouri. Handi–Shop is a sheltered workshop, a nonprofit business employing predominantly people with developmental disabilities or other chronic mental or physical impairments. Most of the 60 workers at Handi–Shop assembled, packaged, sorted, recycled, or labeled various materials to fulfill contracts with other businesses. The HHE requester was concerned that health risks may have been associated with exposures to Vinsol® NVX when workers packaged this alkaline dust. The requester noted "there may be other work areas that should be checked also." The requester also reported that, in 1995, a Handi–Shop employee collapsed while working and died later the same day in a hospital.

Two NIOSH site visits were made. During a walk–through tour of Handi–Shop, a NIOSH industrial hygienist identified the plastisol coating room as a work area having potential for worker exposures to solvent vapors and heat. Thus, area air samples were collected to evaluate solvent exposures and air temperature and relative humidity measurements were taken to evaluate heat stress risk. During the second site visit, air sampling was done to estimate the airborne dust exposure of a worker while he packaged Vinsol® NVX, and measurements were taken to evaluate further the potential for heat stress in the plastisol coating room. A search was made for investigations of the fatality at Handi–Shop to learn whether the occupational environment contributed to the worker's death.

Area air sampling for methyl ethyl ketone, methyl isobutyl ketone, and toluene showed that air levels of these chemicals were less than their occupational exposure limits. Methylene chloride and propylene oxide levels were less than their Occupational Safety and Health Administration (OSHA) permissible exposure limits. However, using an improved storage method would likely reduce air concentrations of these potential occupational carcinogens. High air concentrations of dust were aerosolized during a short–term packaging activity. Heat stress measurements showed that a heat stress risk existed in the plastisol coating room. No evidence was found to determine whether a Handi–Shop worker's death was related to workplace exposures or environmental conditions.

Handi–Shop's employees would benefit from increased management awareness of worker exposures and a more proactive approach to occupational health and safety. Recommendations are provided for changes that should be made at Handi–Shop and for improvements at the state agency that certifies and monitors Missouri's sheltered workshops. Occupational health and safety issues related to jobs done by workers with developmental disabilities are discussed in this report.

Keywords: SIC 8331 (job training and vocational rehabilitation services), alkaline dust, heat stress, sheltered workshop, solvents, workers with disabilities.

TABLE OF CONTENTS

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation (HHE) at Handi–Shop, Inc. in Mexico, Missouri. The HHE requester was concerned that health risks may have been associated with dust exposures of workers who packaged "NVX, STPP, and forta fiber" and noted "there may be other work areas that should be checked also."

Workers' health problems reportedly included allergies, rashes, sinus problems, and sneezing. The requester also reported that "several workers throughout the years have had doctors' orders to stop working in the dust – Since 1995, there have been two breast cancer cases, one respiratory death, and one non–Hodgkin's lymphoma of the nasopharynx." Regarding the respiratory death, the requester reported that a worker collapsed while packaging sodium tripolyphosphate (STPP) on July 13, 1995, and died later that day in a hospital.

Handi–Shop is a sheltered workshop, a nonprofit business employing people with developmental disabilities or other chronic mental or physical impairments. Sixty workers at Handi–Shop daily assembled, packaged, sorted, recycled, or labeled various materials to fulfill contracts with local companies.

Two NIOSH site visits were conducted at Handi–Shop. A technical field supervisor from Extended Employment Sheltered Workshops, a section of the Missouri Department of Elementary and Secondary Education, was present during both site visits. Descriptions of the activities and findings of each site visit and recommendations were provided in letters dated October 2, 1997, and January 20, 1999.

Handi–Shop's facilities consisted of two one–story buildings and a storage building. Worker activities occurred only in "the new main building" and "the old main building."

In Handi–Shop's *new* main building, approximately 45 workers did a variety of hand–intensive tasks while seated at tables. At the *old* main building, most workers did recycling tasks. One group stood on a wooden platform beside a conveyor belt and sorted metal cans, plastic jugs, and bottles. Another group added newspapers and other recyclable paper to a baling machine. Two employees and their supervisor worked in a separate area of the old main building called the plastisol coating room, where metal parts were mechanically dipped in vinyl plastisol, heated in an oven, and hung on stands to dry and cool.

Both STPP and forta fiber are packaged on a table in the recycling area. Vinsol® NVX is packaged in a small room beside the table. Packaging activities were done infrequently every few weeks. Because contract orders for STPP, forta fiber, and Vinsol® NVX were completed before the first NIOSH site visit, packaging activities were not seen then, but they were observed during the second visit.

BACKGROUND

Developmental Disabilities

Developmental disability is a term that functionally describes the impairments of people who have had one or more disabilities from an early age. Examples include people with cognitive impairments (e.g., mental retardation), sensory impairments (e.g., blindness and deafness), neurological disorders (e.g., autism, epilepsy, and cerebral palsy), or genetic disorders (e.g., Down syndrome and fragile X syndrome). Approximately 1.6% of school–age children and 1.5% of adults in the U.S. are developmentally disabled.[1]

According to the Developmental Disabilities Assistance and Bill of Rights Act Amendments of 1994, a developmental disability is "a severe, chronic disability of a person five years of age or older that –

- is attributable to mental or physical impairment or combination of mental and physical impairments;

- is manifested before the person attains age 22;
- is likely to continue indefinitely;
- results in substantial functional limitations in three or more areas of major life activity including self–care, receptive and expressive language, learning, mobility, self–direction, capacity for independent living, and economic self–sufficiency;
- reflects the individual's need for a combination and sequence of special, interdisciplinary, or generic services, supports, or other assistance that is of lifelong or extended duration and is individually planned and coordinated, except that such term, when applied to infants and young children means individual from birth to age 5, inclusive, who have substantial developmental delay or specific congenital or acquired conditions with high probability of resulting in developmental disabilities if services are not provided."

Many people have multiple disabilities that interact and have a multiplicative effect on their ability to function.[1] The four categories into which multiple disabilities fall are cognitive disabilities, physical disabilities, sensory disabilities, and behavioral or psychiatric disorders.[1] The most common concomitant physical disabilities include cerebral palsy and other motor impairments (present in 20% to 30% of people with mental retardation) and seizure disorders (present in 15% to 30% of people with mental retardation). Visual or hearing impairments are present in 10% to 20% of people with mental retardation. Behavioral or psychiatric disorders are present in 15% to 35% of people with mental retardation.[2]

Mental Retardation

Mental retardation is the most common developmental disability.[2,3] Mental retardation refers to substantial functional limitations that are manifested before age 18.[2,4] It is characterized by "significantly subaverage intellectual functioning, existing concurrently with related limitations in two or more of the following adaptive skill areas: communication, self–care, home living, social skills, community use, self–direction, health and safety, functional academics, leisure, and work."[2,4]

Prevalence estimates of mental retardation vary with sex, age, data collection method (i.e., total population screening or data from case registries or agencies for people with mental retardation), and definition of mental retardation.[2,5,6] The Arc of the United States, a national organization on mental retardation, reviewed prevalence studies in the early 1980s and concluded that from 2.5% to 3% of the U.S. population was mentally retarded.[7] Other prevalence estimates are lower and vary from 0.7 % to 1.25%.[2] Using the more conservative estimates and a 1998 U.S. population of 270 million people suggests that at least 1.9 to 3.4 million people are mentally retarded.

An estimated 0.66% of working–age adults (ages 18 to 64) in the U.S. are mentally retarded.[3] State–based percentages range from 0.25% in Alaska to 1.57% in West Virginia. The percentage of working–age adults in Missouri with mental retardation is estimated to be 0.88%.[3] Thus, of the 2.9 million working–age adults in Missouri, approximately 25,000 are mentally retarded.[8]

Workers with Developmental Disabilities

Most people with developmental disabilities are unemployed. The authors of a 1990 report found 81% of adults with mental retardation not working.[9]

Most people with developmental disabilities who are employed work in facility–based settings. Facility–based settings include sheltered workshops and non–work, day–habilitation programs. Authors of a study investigating employment trends of workers with developmental disabilities reported that approximately 300,000 adults with developmental disabilities worked in the United States in 1990. Of these workers, 82% were in facility–based settings and 18% worked in integrated employment.[10] Integrated employment includes both competitive and supported employment. Competitive employment is a job in the community done by workers with and without

disabilities. Supported employment is also a job in the community, but it is done by workers with disabilities who need assistance in learning job requirements or adapting to a competitive employment setting.

The number of working people with developmental disabilities may be increasing in the United States. In 1996, approximately 305,000 people with developmental disabilities worked in facility–based settings, and almost 91,000 people worked in supported employment.[2] The wages of supported employment employees averaged $107 per week in 1993, and most workers were employed part–time.[2]

In Missouri, 8,000 people with developmental disabilities work in 91 sheltered workshops.[11] According to the Missouri Division of Vocational Rehabilitation, 600 Missourians with developmental disabilities worked in supported employment in 1997, and approximately 4,000 workers with developmental disabilities had been placed in competitive employment during the 10–year history of the placement program.[12]

Sheltered workshop workers in Missouri do hundreds of different jobs.[11] They are involved in **manufacturing** (e.g., making pallets, shipping crates, fishing lures, furniture, and asphalt shingles), **services** (e.g., printing, labeling, collating, quality control inspection, sewing, soldering, furniture stripping and refinishing, and lawn care), **reclamation** (e.g., reclaiming metal, paper, film, and batteries), **assembly** (e.g., toys, bicycles, electric motors, wire harnesses, and plumbing supplies), **machining operations** (e.g., operating drill and punch presses, spot welding, and grinding), and **packaging** (e.g., doing heat sealing and blister packaging; and packaging stationary supplies, fertilizer, pet food, and tractor parts).

A sheltered workshop employee is paid a piece–rate wage. A commensurate wage is determined using the prevailing wage paid to experienced workers for essentially the same type of work. It is based on the quantity and quality of work produced by the worker with a disability compared to experienced workers. In 1997, the hourly wage of sheltered workshop employees in Missouri averaged $1.82. To pay sub–minimum wages, a sheltered workshop must obtain certification from the U.S. Department of Labor.[11]

A local board of directors manages each of Missouri's sheltered workshops. However, before a sheltered workshop can operate, it must first be certified by the Missouri Department of Elementary and Secondary Education. The Extended Employment Sheltered Workshops section of the Division of Special Education certifies and monitors the activities of Missouri's sheltered workshops. Its staff consists of a director, two secretaries, and three technical field supervisors. Technical field supervisors are assigned regions of the state, and they advise, counsel, evaluate, and analyze the financial and administrative operations of the workshops in their regions.

Compliance with standards of the Occupational Safety and Health Administration (OSHA) is required for a sheltered workshop to be certified in Missouri. Staff members of Missouri's Extended Employment Sheltered Workshops section help sheltered workshop managers develop occupational safety and health procedures and techniques. Before certification, a sheltered workshop must also pass an inspection by Extended Employment Sheltered Workshops staff.[11]

METHODS

Site Visit Activities

The first NIOSH site visit at Handi–Shop occurred on June 17–19, 1997. During the opening meeting, a NIOSH industrial hygienist and Handi–Shop's manager discussed the issues of the HHE request. Afterward, a walk–through tour was made of Handi–Shop's facilities. The next day, the NIOSH industrial hygienist collected air samples to evaluate solvent exposures and took air temperature and relative humidity measurements to evaluate the potential for heat stress.

A second NIOSH site visit occurred on September 10, 1998. Air sampling was done to estimate workers' exposures to airborne dust, and

measurements were taken to evaluate further the potential for heat stress.

Hepatitis B

The Centers for Disease Control and Prevention (CDC) has identified staff members of sheltered workshops attended by known carriers of Hepatitis B virus (HBV) to have a substantial risk of HBV infection. Thus, HBV infection was discussed during the opening meeting, and CDC's document *Protection against Viral Hepatitis* was given to Handi–Shop's manager.[13]

OSHA Form 200

The OSHA Log and Summary of Occupational Injuries and Illnesses (OSHA form 200) is kept at Handi–Shop. Copies of OSHA form 200 for 1995, 1996, and 1997 were reviewed.

Literature Searches

The HHE requester reported that Handi–Shop employees had received medical care for breast cancer and nasopharyngeal cancer. Thus, literature searches were done to identify personal and environmental risk factors for these conditions. A primary concern was to learn whether any of the chemicals used at Handi–Shop were potential occupational carcinogens. A search was also done to learn whether workers with developmental disabilities have been suggested to be at greater risk of developing occupational diseases than workers without disabilities.

Workplace Fatality

A search was made for investigations of the fatality at Handi–Shop to learn whether the occupational environment contributed to the worker's death. OSHA standard 29 CFR Part 1904.8 requires that an employer report within eight hours the death of any employee or the inpatient hospitalization of three or more employees resulting from a work–related incident. Thus, OSHA's Integrated Management Information System was searched on the Internet.[14] Also, the HHE requester noted that the incident may have been investigated by the Missouri Department of Mental Health. A letter was sent to the General Counsel of the Missouri Department of Mental Health requesting any information concerning the worker's death.

Industrial Hygiene Sampling

The following descriptions detail the methods used to evaluate worker exposures to chemical vapors, airborne dust, and heat stress.

Chemical vapors

No hazardous ingredients were listed in the material safety data sheet (MSDS) for vinyl plastisol. However, the MSDS's health hazard section had a warning that the material may be an eye, skin, and respiratory tract irritant. Before dipping some parts in liquid plastisol, the workers first dipped them in a tank of primer paint, which was also in the room. The primer paint contained methyl ethyl ketone, methyl isobutyl ketone, and toluene.

Worker exposures to two other chemicals may have existed when rejected parts were placed in a bucket containing vapor degreasing–grade methylene chloride, a mixture of 99.5% methylene chloride and 0.5% propylene oxide. This liquid was used to remove unsatisfactory coatings.

Area air sampling was conducted at six locations in the plastisol coating room. One sample was taken beside the exhaust ventilation hood of a tank of primer paint, three near the plastisol tank operator, one at a central location in the room, and one on the drying rack between a desk and the primer hood. Sampling was done using charcoal tubes connected by flexible tubing to personal sampling pumps operated at an air flow rate of 100 cubic centimeters per minute. Air sampling durations were 15, 82, and 170 minutes.

At the end of a sampling period, each charcoal tube was immediately removed from its sampling train, capped, and stored in a refrigerator's freezer. Cold storage was necessary to reduce the migration of collected chemicals, especially methylene chloride and propylenene oxide, from the tubes. All air

sampling tubes were shipped in a cold container to the NIOSH laboratory in Cincinnati, Ohio.

An air sampling tube placed beside the primer hood was analyzed qualitatively. This was done to check whether chemicals were present in the air of the plastisol coating room that were not listed in the MSDSs for vinyl plastisol and the primer. (Air sampling during a previous NIOSH health hazard evaluation of a plastisol coating operation showed worker exposure to benzene.[15])

The remaining air sampling tubes were shipped in a cold container to the NIOSH contract laboratory for quantitative analysis. These charcoal tubes were analyzed by standard analytical methods for methylene chloride, propylene oxide, methyl ethyl ketone, methyl isobutyl ketone, and toluene.

Packaging Vinsol® NVX

Air samples were collected to measure a worker's exposure to total and respirable dust while he packaged Vinsol® NVX. The task lasted one hour. Besides personal air samples, area air samples were collected at two locations in the packaging room and one location near the paper baling machine. Total dust air samples were collected and analyzed according to NIOSH method 0500 using an air flow rate of 2 liters per minute (Lpm).[16] Respirable dust samples were collected and analyzed according to NIOSH method 0600 using a nylon cyclone and an air flow rate of 1.7 Lpm.[17] Sampling durations at all but one location were approximately 15 minutes for total dust samples and 47 minutes for respirable dust samples. The sampling duration of the air samples collected near the paper baling machine was 147 minutes.

Heat stress measurements

During the first site visit, apparent temperatures were determined from air temperature and relative humidity measurements taken in the plastisol coating room using a Vaisala HM 34 humidity and temperature meter (Vaisala, Inc., Woburn, Massachusetts). During the second site visit, measurements of both apparent temperature and wet bulb globe temperature (WBGT) were taken in the plastisol coating room and in the recycling area. A WiBGeT® (Imaging and Sensing Technology, Horseheads, New York) was used to take WBGT measurements.

EVALUATION CRITERIA

General Guidelines

To assess health hazards posed by workplace exposures, NIOSH investigators use a variety of occupational evaluation criteria. The primary sources of such criteria are NIOSH criteria documents and recommended exposure limits (RELs),[18,19] the American Conference of Governmental Industrial Hygienists (ACGIH®) threshold limit values (TLV®),[20] and OSHA permissible exposure limits (PELs).[21] These values are usually based on a time-weighted average (TWA) exposure, which refers to the average air concentration of a substance over an entire 8– to 10–hour workday. Evaluation criteria may change when new information concerning an agent's toxic effects becomes available. Air concentrations are usually expressed in parts per million (ppm), milligrams per cubic meter of sampled air (mg/m^3), or micrograms per cubic meter of sampled air ($\mu g/m^3$).

Some substances have a short-term exposure limit (STEL) to supplement a TWA limit when toxic effects from short-term exposures are possible. A STEL is a 15–minute TWA concentration that should not be exceeded anytime during a workday, even if the 8–hour TWA is within the TLV®–TWA. The ACGIH® recommendation for a substance without a STEL is that "excursions in worker exposure levels may exceed three times the TLV®–TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed five times the TLV®–TWA, provided that the TLV®–TWA is not exceeded."[20] The basic concept is that excursions above a substance's TWA exposure limit should be maintained within reasonable limits in well–controlled processes. Additionally, some chemicals have a skin notation to show that the

substance may be absorbed through direct contact of the material with the skin and mucous membranes.

NIOSH RELs are based primarily on the prevention of occupational disease. In contrast, when developing PELs and other standards, OSHA must take into account the economic feasibility of reducing exposures in affected industries, public notice and comment, and judicial review. In evaluating worker exposure levels and NIOSH recommendations for reducing exposures, the fact remains that employers are legally required to meet OSHA standards.

An additional complication is that a Court of Appeals decision vacated the OSHA 1989 Air Contaminants Standard in AFL–CIO v OSHA, 965F.2d 962 (11th cir., 1992).[22] Although OSHA now enforces the previous 1971 standards,[23] some states having OSHA–approved state plans have continued to enforce the more protective 1989 OSHA PELs.[24] NIOSH encourages use of the most protective limits among NIOSH RELs, ACGIH® TLV® s, and OSHA PELs.

Methylene Chloride

Methylene chloride is a colorless liquid used in paint removers, cleaning and degreasing agents, and aerosol propellants. It is also used in the manufacture of photographic film and polyurethane foam.[25,26] The boiling point of methylene chloride is 40°C (104°F).[19,25]

Methylene chloride is a mild central nervous system depressant and an eye, skin, and respiratory tract irritant; it is carcinogenic in experimental animals and is considered a suspected human carcinogen.[26] Carbon monoxide is a metabolic product of methylene chloride, but slightly elevated carboxyhemoglobin levels associated with moderate methylene chloride exposure are not expected to cause adverse effects in healthy people. However, a person with a compromised cardiovascular system may be at increased risk.[26]

NIOSH considers methylene chloride a potential occupational carcinogen and recommends that exposures to it are controlled to the lowest feasible concentration.[18,19] The OSHA PELs for methylene chloride are an 8–hr TWA of 25 ppm and a 15–min STEL of 125 ppm.[27] In 1996, ACGIH® reclassified methylene chloride from a suspected human carcinogen to a confirmed animal carcinogen with unknown relevance to humans,[20] but retained the 8–hr TLV®–TWA of 50 ppm established in 1988.[25]

Odor thresholds reported for methylene chloride range from 25 to 300 ppm, but air concentrations of 100 ppm are not easily perceptible by most people.[25] Because it has poor odor–warning properties, a person could be exposed to unhealthful air concentrations and not smell methylene chloride.

Methyl Ethyl Ketone

Methyl ethyl ketone is a colorless liquid used as a solvent; in the surface coating industry; in the dewaxing of lubricating oils; and in the manufacture of colorless synthetic resins, artificial leather, rubbers, lacquers, varnishes, and glues.[25] It is an irritant of the eyes, nose, throat, and skin.[25,26] Methyl ethyl ketone is seldom used alone and is usually found in mixtures with acetone, ethyl acetate, n–hexane, toluene, or alcohols.[25] Central nervous system effects and peripheral neuropathy have been reported in industrial settings following overexposures to such solvent mixtures.[25]

The NIOSH RELs for methyl ethyl ketone are a TWA of 200 ppm and a STEL of 300 ppm.[18,19] These air concentrations are the same ones established by ACGIH® for their TLV®–TWA and STEL.[20,25] The OSHA PEL for methyl ethyl ketone is also a TWA of 200 ppm.[21] Methyl ethyl ketone's odor threshold is 5 ppm.[28] Thus, its odor can be smelled by most people at air concentrations less than its exposure limits.

Methyl Isobutyl Ketone

Methyl isobutyl ketone is a colorless liquid used as a solvent in synthetic resinous paints, lacquers, and varnishes and for adhesives, rubber cements, and aircraft dopes.[25] It is an irritant of the eyes, nose, throat, and skin.[25,26]

The NIOSH RELs for methyl isobutyl ketone are a TWA of 50 ppm and a STEL of 75 ppm.[18,19] These air concentrations are the same as the ones established by ACGIH® for their TLV®–TWA and STEL.[20,25] The OSHA PEL for methyl isobutyl ketone is a TWA of 100 ppm.[21] Methyl ethyl ketone's odor threshold is less than 1 ppm.[25,28] Thus, its odor can be smelled by most people at air concentrations less than its exposure limits.

Propylene Oxide

Propylene oxide is a colorless liquid used as a fumigant and as an intermediate in the manufacture of polyols for urethane foams, propylene glycol, propylene glycol ethers, surfactants and detergents, in specialty tapioca starches, and synthetic lubricants.[25] The boiling point of propylene oxide is 34°C (94°F).[19,25] Propylene oxide is an irritant of the eyes, mucous membranes, and skin, and is carcinogenic in experimental animals.[25,26]

NIOSH considers propylene oxide a potential occupational carcinogen and recommends that exposures to it are controlled to the lowest feasible concentration.[18,19] Based on the limit of quantitation of its analytical method, propylene oxide's lowest feasible concentration is 8.4 ppm.[18] The OSHA PEL of propylene oxide is an 8–hr TWA of 100 ppm.[21] In 1996, ACGIH® classified propylene oxide as a confirmed animal carcinogen with unknown relevance to humans, but the 8–hr TLV®–TWA of 20 ppm established in 1981was retained.[25] In 1999, ACGIH® proposed lowering their TLV®–TWA to 5 ppm.[20] The Dow Chemical Company recommended a TWA exposure limit of 3 ppm for propylene oxide in its MSDS for vapor degreasing–grade methylene chloride.

Propylene oxide's odor threshold has been reported to be 44 ppm.[28] Except for OSHA's PEL, propylene oxide's exposure limits are less than its odor threshold. Thus, a person could be exposed to unhealthful air concentrations of propylene oxide and not smell this chemical.

Toluene

Toluene is a colorless liquid used as a solvent in paints, coatings, and formulations for rubber, oil, resins, adhesives, inks, detergents, dyes, and pharmaceuticals.[25] Toluene is also present in many consumer products, including household aerosols, paints, varnishes, shellac, rust inhibitors, thinners, and solvent–based cleaning and sanitizing agents.[25] Toluene is a depressant of the central nervous system.[25,26] Subjects exposed to 50, 75, and 100 ppm in controlled conditions for 4 to 6 hours reported eye and nose irritation and, in some cases, headache, dizziness, and a feeling of intoxication.[25,26]

The NIOSH RELs for toluene are a TWA of 100 ppm and a STEL of 150 ppm.[18,19] The ACGIH® TLV®–TWA for toluene is 50 ppm with a skin notation.[20,25] OSHA PELs for toluene are a TWA of 200 ppm, a ceiling concentration of 300 ppm, and a 10–min maximum peak of 500 ppm.[21] Toluene's odor threshold is 3 ppm.[28] Thus, its odor can be smelled by most people at air concentrations less than its exposure limits.

Heat Stress

Many heat stress guidelines have been developed to protect people against heat–related illnesses such as heat cramps, heat syncope, heat exhaustion, and heat stroke. The objective of any heat stress index is to prevent a person's core body temperature from rising excessively. The World Health Organization concluded that "it is inadvisable for deep body temperature to exceed 38°C (100.4°F) in prolonged daily exposure to heavy work."[29] Many heat stress guidelines, including those of NIOSH and ACGIH®, also use a maximum core body temperature of 38°C as the basis for their environmental criteria.[20,30]

Because measuring deep body temperature is impractical, environmental factors most nearly correlating with deep body temperature and other physiological responses to heat are measured instead. The two most commonly used indexes of heat stress are the apparent temperature and the WBGT.[31] The former index is used more often to alert the public to heat stress conditions, and the latter is used more often to evaluate work settings.

Apparent temperature

Apparent temperature is a function of dry bulb air temperature and relative humidity. Four categories of apparent temperature are used to evaluate heat stress risk. Category I (caution) has an apparent temperature range of 80°F to 90°F and represents conditions for which fatigue is possible with prolonged exposure and physical activity. Category II (extreme caution) has an apparent temperature range of 90°F to 105°F and represents conditions for which heat cramps and heat exhaustion are possible with prolonged exposure and physical activity. Category III (danger) has an apparent temperature range of 105°F to 130°F. This category represents conditions for which heat cramps or heat exhaustion is likely and for which heat stroke is possible with prolonged exposure and physical activity. Category IV (extreme danger) is any apparent temperature that exceeds 130°F and represents conditions for which heatstroke is imminent.[31]

Wet bulb globe temperature

Both NIOSH and ACGIH® recommend the use of the WBGT index to measure environmental heat factors because of its simplicity and suitability for evaluating heat stress risk. The International Organization for Standardization (ISO), the American Industrial Hygiene Association (AIHA), and the U.S. Armed Services published heat stress guidelines that also use the WBGT index.[32–34] In general, these guidelines are similar; hence, the WBGT index has become the standard technique for assessing occupational heat stress.

The WBGT index takes into account environmental conditions such as air velocity and temperature, humidity, and radiant heat. WBGT is a function of dry bulb temperature, a natural (unaspirated) wet bulb temperature, and a black globe temperature.

Originally, NIOSH defined excessively hot environmental conditions as any combination of air velocity and temperature, humidity, and radiation that produced an average WBGT of 26°C (79°F) for unprotected workers.[35] However, in its 1986 revised criteria for occupational exposure to hot environments, NIOSH provided diagrams showing work–rest cycles and metabolic heat versus WBGT exposures that should not be exceeded.[30] NIOSH developed two sets of recommended limits: one for acclimatized workers (REL) and one for unacclimatized workers (recommended alert limit [RAL]).

Similarly, ACGIH® has recommended a TLV® for environmental heat exposure permissible for different work–rest regimens and work loads.[20] The ACGIH® TLV® criteria refer to heat stress conditions in which nearly all adequately hydrated, unmedicated, healthy workers, wearing light–weight summer clothing may be repeatedly exposed without adverse health effects.

OSHA does not have a heat stress standard. However, OSHA has used the requirements of Section 5(a)(1) of the Occupational Safety and Health Act of 1970 to cite employers for failing to protect their employees from heat stress conditions. Section 5(a)(1) is commonly called the general duty clause.

Vinsol® NVX

Vinsol® NVX is a trade name for sodium resinate, a rosin–based, brown powder with a soapy odor. Sodium resinate does not have an occupational exposure limit. The manufacturer of Vinsol® NVX considers the powder to be a "nuisance dust." The applicable OSHA PELs are those for particulates not otherwise regulated, which are 15 mg/m^3 for total dust and 5 mg/m^3 for respirable dust.[21] Similarly, the ACGIH® TLV® for insoluble particulates not otherwise classified are 10 mg/m^3 for inhalable dust and 3 mg/m^3 for respirable dust.[20] NIOSH does not have a REL for such "nuisance dusts."

Classifying sodium resinate as a nuisance dust may not be consistent with its potential health effects. Its MSDS includes a warning that dust exposure may cause severe eye irritation and skin and respiratory tract irritation. The health hazard is due to its alkalinity; a 10% solution of sodium resinate has a pH of 10.6. Alkalis are caustic substances. Once

dissolved in water, they form a solution having a pH higher than 7. In general, alkalis are more destructive to tissues than most acids.[36]

Though sodium resinate does not have a specific occupational exposure limit, most exposure limits of other alkaline dusts are lower than the exposure limits of particulates not otherwise regulated or classified. For example, calcium hydroxide has a pH of 12.4.[25] Its NIOSH REL and the ACGIH® TLV® are an 8–hour TWA of 5 mg/m^3.[18–20] (The OSHA PELs for calcium hydroxide are the same as those of particulates not otherwise regulated.[21]) Another example is sodium hydroxide, which has a pH of 13.4.[25] Sodium hydroxide's OSHA PEL is a 2 mg/m^3 8–hour TWA.[21] However, its NIOSH REL and ACGIH® TLV® are a 2 mg/m^3 *ceiling limit*.[18–20] A ceiling limit is a definite boundary that should not be exceeded during any part of a worker's exposure.[20] Since alkaline dusts are immediate irritants, ceiling limits may be more appropriate for them than 8–hour TWAs.

STPP and Forta Fiber

STPP is the abbreviation for sodium tripolyphosphate, a usually innocuous surfactant produced as white granules. Its MSDS includes statements that acute inhalation may be irritating and cause sneezing and that chronic exposure may cause allergic persons to develop a rash. The warning label on each bag of STPP reads as follows: "Airborne dust is irritating to nose and throat. Direct contact with eyes may produce irritation." The chemical name for forta fiber is homopolymer polypropylene, a product consisting of discrete synthetic fibers. According to their MSDSs, wearing personal protective equipment is not usually necessary when handling either STPP or forta fiber.

RESULTS

Site Visit Observations

A few of the 45 workers in the new main building were in wheelchairs. Some wheelchairs did not fit under the tables, which at times required the workers to reach to do their jobs.

Both workers in the plastisol coating room wore goggles, coveralls, and cotton work gloves. After parts were mechanically dipped in plastisol, the workers hung the parts on an overhead conveyor system that ran inside an oven operated at 400°F. The oven had one opening through which parts entered and exited. The plastisol tank and its controls were directly in front of the oven's opening. Besides the heat added to the room from the oven's opening, heat was added as hot parts cooled on stands. Large diameter fans had been put in the room in an attempt to control excessive heat buildup.

The local exhaust ventilation hood attached to the primer tank had a large hole in its top. Apparently, the duct work from the hood was moved to the back of the hood, and the hole left in the top was never covered. The hole decreased the hood's effectiveness, but the extent to which this problem affected worker exposures was not assessed.

Two potential safety hazards were noted. While working near a ceiling, an electrician stood approximately 6 feet above the floor on the raised forks of a forklift truck. Also, the forklift truck did not have a working backup alarm.

Hepatitis B

Handi–Shop's manager knew of the risks of HBV infection in a sheltered workshop. One Handi–Shop employee was an HBV carrier, and HBV vaccination had been offered to each of the facility's supervisors.

OSHA Form 200

Fourteen injuries and no illnesses were recorded on Hand–Shop's OSHA form 200 for 1995, 1996, and 1997. The injuries were four falls, three cuts, three bruises, one back strain, and one leg sprain. A fainting episode and a chest pain episode were also listed as injuries. Nineteen workdays were lost during these 3 years. Eight injuries caused no lost workdays. Supervisors had four injuries, and half of

all injuries occurred in the recycling area of the old main building.

Literature Searches

The following information was found concerning personal and environmental risk factors for breast cancer and nasopharyngeal cancer. The results of a search for information concerning the relative risk of workers with developmental disabilities for developing occupational diseases are also given.

Breast cancer

Breast cancer is the most common cancer among United States women and is also a major cause of death, second among cancers only to lung cancer.[37] An estimated 182,000 new cases were diagnosed and 46,000 women died of breast cancer in the United States in 1993.[37]

Personal characteristics associated with breast cancer include family history, obesity, diet, age of first menstrual period and first gestation, parity, age of menopause, use of estrogen therapy, breast secretions, and presence of other breast conditions.[37,38] Exposure to ionizing radiation is a risk factor for breast cancer, but studies of other environmental exposures have produced inconsistent results.[39]

Whether occupational exposures contribute to breast cancer development is uncertain, and "evaluating the relation between occupational exposures and breast cancer risk will continue to be difficult."[40] The author of a review of 115 studies reported evidence of an increased incidence of breast cancer among cosmetologists, beauticians, and pharmaceutical manufacturing workers but stated a need for additional studies before conclusions could be made.[39]

Authors of another article described evidence supporting their hypothesis that breast cancer may be associated with occupational exposures to organic solvents.[41] They cited references to laboratory animal studies suggesting that benzene, 1,2–dibromoethane, 1,1–dichloroethane, 1,2–dichloroethane, methylene chloride, styrene, 1,2,3–trichloropropane, and vinyl chloride may be potential human breast carcinogens.

Nasopharyngeal cancer

The lung is the predominant site of cancers of the respiratory system, accounting annually for almost 80 percent of all new cases in the United States. Cancers of the nasopharynx annually comprise approximately 2 percent of all new cases of respiratory cancer.[42] Agents suspected of being risk factors for nasopharyngeal cancer include tobacco smoke, wood dust, formaldehyde vapor, and textile dust. Drinking alcohol has also been suggested as a risk factor for nasopharyngeal cancer, but a consistent association has not been established.[42]

Health risks of workers with developmental disabilities

No studies were found addressing whether workers with developmental disabilities are at greater risk of developing occupational diseases than workers without disabilities. Persons with Down syndrome have an increased risk of developing leukemia,[43,44] but whether the risk associated with occupational exposures to carcinogenic agents differs between workers with and without Down syndrome is unknown. Whether a difference exists or not, measures should always be taken to protect all workers against potential occupational carcinogens.

Workplace Fatality

No information was found in OSHA's Integrated Management Information System concerning a fatality investigation at Handi–Shop. Handi–Shop's manager said that the incident was not reported to OSHA.

The Missouri Department of Mental Health (DMH) investigated the fatality because the worker had received their services. According to a DMH investigative report, the worker was 31 years old and had been diagnosed with multiple disorders,

including mild mental retardation, impulsive control disorder, Pierre Robin syndrome, sleep apnea, hypertension, and bilateral hearing loss. An autopsy was not done, but the death certificate included a statement that the worker's death was caused by "probable respiratory arrest due to blockage of the airway due to a congenital deformity."

The DMH investigative report concluded with the following findings:

- Department of Elementary and Secondary Education certification standards do not require Handi–Shop to have available staff trained in CPR and first aid because Handi–Shop is located within close proximity to a hospital.

- Two Handi–Shop employees are currently certified in CPR and first aid; however, these employees were out of the building when the worker collapsed. Another employee was familiar with CPR because of past training, but was not currently certified. He did not initiate CPR; he did not know where the micro–shield was kept.

- The worker had an extremely small tracheal opening; repeated attempts were necessary to successfully place an endotracheal airway.

No evidence was given in the DMH report to determine whether the worker's death was related to workplace exposures or environmental conditions.

Industrial Hygiene Sampling

Chemical vapors

Methylene chloride, methyl ethyl ketone, methyl isobutyl ketone, toluene, and limonene were recovered during qualitative analysis of an air sampling tube placed beside the primer hood. All were foreseen but limonene. Limonene is a natural hydrocarbon produced by distillation and extraction of citrus oils from lemon and orange peels.[45] It was present in a degreaser stored in the plastisol coating room. Air concentrations of limonene were not evaluated.

Air concentrations were less than 2 ppm for methyl ethyl ketone and methyl isobutyl ketone and less than 0.5 ppm for toluene. Air concentrations of methylene chloride ranged from trace concentrations to 2 ppm. Propylene oxide was not detected at the central sampling location or on the drying rack, and trace levels (less than 0.1 ppm) were measured at the three sampling locations near the plastisol tank operator.

Packaging Vinsol® NVX

Before packaging Vinsol® NVX, the worker dumped a large bag of the material into a galvanized wash tub on a table holding a scale. Then while holding a plastic bag open with one hand, he used a scoop to add material to the bag until the desired weight was achieved. Keeping a bag open with one hand was awkward, and the dust spilled frequently. A small, kitchen–type exhaust fan in the wall above the work table operated during the entire activity.

The manufacturer of Vinsol® NVX recommended that impervious gloves, goggles, protective clothing, and a respirator be used when dust exposures exceed acceptable exposure limits. Exposure estimates had not been determined previously at Handi–Shop. Besides wearing disposable latex gloves, safety glasses, and disposable coveralls, the worker wore a NIOSH–approved, N–95, filtering facepiece respirator. The worker had a beard.

The results of air sampling are shown in Table 1. The average of the three total dust air concentrations measured on the worker's lapel is 20 mg/m^3. Both the ACGIH® TLV® of 10 mg/m^3 and the OSHA PEL of 15 mg/m^3 would be exceeded if this concentration of airborne dust was maintained for an entire work shift. If the time spent packaging Vinsol® NVX continues to be brief, neither of these occupational exposure limits would likely be exceeded. However, because alkaline dusts like Vinsol® NVX may be immediately irritating, the short–term air concentrations are high and should be reduced.

The results of respirable dust air sampling suggest that a small proportion of the airborne dust consisted of particles small enough to reach the gas–exchange region of the lungs. None of the respirable dust air

concentrations exceeded either the ACGIH® TLV® of 3 mg/m^3 or the OSHA PEL of 5 mg/m^3. Nevertheless, because of the dust's alkalinity, these exposure limits may not be adequately protective.

Table 1
Results of Air Sampling during the Packaging of Vinsol® NVX

Sampling Location	Total Dust Concentration (mg/m^3)	Sampling Duration (minutes)	Respirable Dust Concentration (mg/m^3)	Sampling Duration (minutes)
Worker's lapel	28 18 16	15 16 15	0.6	47
NVX room, on wall below fan	15	15	0.7	48
NVX room, behind scale	8.6	14	0.5	47
Near paper baler	0.7	147	ND	147

mg/m^3 = milligrams per cubic meter of sampled air
ND = none detected; minimum detectable concentration was 0.08 mg/m^3.

Heat stress measurements

During the first site visit, temperatures in the plastisol coating room ranged from 35°C (95°F) to 40°C (104°F). The relative humidity was 35% throughout the day. These measurements represented an apparent temperature range of 37°C (98°F) to 42°C (108°F). The upper limit is within category III of the four categories of apparent temperature and represents conditions for which heat cramps or heat exhaustion is likely and for which heat stroke is possible with prolonged exposure and physical activity.[31]

During the second site visit, an apparent temperature of 35°C (95°F) was measured near the plastisol tank. An apparent temperature of 26°C (78°F) was measured in the recycling area. The temperature measured in the plastisol coating room is within apparent temperature category II and represents conditions for which heat cramps and heat exhaustion were possible with prolonged exposure and physical activity.[31]

A WBGT of 24°C (76°F) was measured in the plastisol coating room, and a WBGT of 19°C (67°F) was measured in the recycling area. Both temperatures are below the NIOSH recommended heat–stress limit for heat–acclimatized workers.[30] According to proposed revisions to the ACGIH® TLV® for heat exposure, these temperatures also represent conditions under which nearly all adequately hydrated, unmedicated, healthy workers, wearing light–weight summer clothing may be repeatedly exposed without adverse health effects.[20]

DISCUSSION AND CONCLUSIONS

Hepatitis B

CDC estimates that 4% of HBV cases are acquired from occupational exposures and recommends pre–exposure vaccination of persons at high risk of infection.[13] CDC has noted that "staff of nonresidential day–care programs (e.g., schools, sheltered workshops for the developmentally disabled) attended by known HBV carriers have a risk of HBV infection comparable to that among healthcare workers and therefore, should be vaccinated."[13] Though CDC commented that the risk of HBV infection for employees of a sheltered workshop may be lower than the staff's risk, they also recommended that vaccination of employees should be considered.

OSHA promulgated the bloodborne pathogens standard to protect workers against "pathogenic microorganisms that are present in human blood and can cause disease in humans, including HBV and human immunodeficiency virus."[46] OSHA defines an occupational exposure to a bloodborne pathogen as "a reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from an employee's duties."[46]

Employees of sheltered workshops are covered by OSHA's bloodborne pathogens standard. The standard requires an employer having employees at risk of exposure to bloodborne pathogens to prepare a written exposure control plan and an exposure determination. Employers are also required to provide a training program to employees. In addition, an employer must provide the HBV vaccine and vaccination series at no charge to all employees who have occupational exposure and post–exposure evaluation and follow–up to all employees who have had an exposure incident.

OSHA Form 200

Sheltered workshops are in Standard Industrial Classification (SIC) major group 83, social services. Employers in SIC 83 and 22 other major groups are exempt from keeping OSHA form 200, unless the Bureau of Labor Statistics sends written notice to do so.[47] The Bureau considers exempt employers to be low–hazard industries.[48]

All sheltered workshops in Missouri voluntarily maintain the OSHA form 200 at the suggestion of the Director of Extended Employment Sheltered Workshops. Each workshop posts its OSHA form 200 soon after the end of every year, but a copy is not sent to the Director.

Though most social service establishments (e.g., day care centers, family service agencies, and parole offices) may be categorized correctly as low hazard, many sheltered workshop employees do not have low hazard jobs. The results of this health hazard evaluation and similar studies show that sheltered workshop workers may have risks of occupational injuries and illnesses similar to those of workers in other industrial settings.[49,50]

Keeping the OSHA form 200 may help a sheltered workshop manager identify hazardous activities needing intervention to reduce worker injuries or illnesses. However, because most sheltered workshops in Missouri have fewer than 100 employees, injury or illness trends may not always be easily discerned. Workers may benefit if the OSHA 200 log from every sheltered workshop in Missouri was submitted to the Director of Extended Employment Sheltered Workshops for analysis of the overall data.

Literature Searches

A literature search revealed that methylene chloride was the only chemical used at Handi–Shop that may be a risk factor for breast cancer. However, air sampling results showed that methylene chloride levels were low in the plastisol coating room. Another search revealed no agents were used at Handi–Shop that may be risk factors for nasopharyngeal cancer.

Workplace Fatality

The OSHA medical services and first aid standard (29 CFR Part 1910.151) requires that a person or persons adequately trained in first aid be present in the absence of an infirmary, a clinic, or a hospital in near proximity to the workplace. For a situation where a life–threatening or permanently disabling injury or illness is likely, OSHA interprets *in near proximity* to mean a 3– to 4–minute response time after an event to the time when first aid is administered.[51] The response reported in the DMH investigative report suggests that, although some confusion may have occurred when a worker collapsed, Handi–Shop met the requirements of OSHA standard 1910.151.

The Commission on the Accreditation of Rehabilitation Facilities (CARF) has developed guidelines for facilities providing adult day services, employment and community services, behavioral health services, and medical rehabilitation.[52] CARF–accredited sheltered workshops fulfill standards pertaining to employment and community services. The health and safety segment requires that staff members are trained in specific safety techniques, including CPR, rescue breathing, first aid, and management of aggressive behaviors. CARF lists the identified needs of the people with disabilities employed at a facility as one of the factors upon which specific safety techniques should be based.

A significant finding of the DMH investigation was that repeated attempts were made before an endotracheal airway was placed in the collapsed worker. No information was found suggesting whether anyone at Handi–Shop was aware that the worker had a condition that may have hindered prompt medical care. Whether the presence of a person trained in CPR, rescue breathing, and first aid or awareness that the worker had a congenital tracheal abnormality would have altered the treatment approach or affected the outcome is unknown.

Industrial Hygiene Sampling

Chemical vapors

Air sampling for methyl ethyl ketone, methyl isobutyl ketone, and toluene showed that air levels of these chemicals were less than their occupational exposure limits. Methylene chloride and propylene oxide levels were less than their OSHA PELs. However, using an improved storage method would likely reduce the air concentrations of these potential occupational carcinogens. Substitution of a less toxic chemical should also be considered.

An occupational exposure limit is a guideline that suggests the level of a substance to which *most* workers may be exposed without experiencing adverse health effects. Because of variation in individual susceptibility, some workers may experience adverse health effects when exposures to a substance are less than its occupational exposure limit. Individual hypersusceptibility, pre–existing medical conditions, genetic factors, age, interactions with other workplace agents, medications taken by a worker, and environmental conditions are typically not all considered when occupational exposure limits are established.[20]

Wisconsin's Bureau of Occupational Health conducted 103 site visits at 51 sheltered workshops between 1976 and 1987.[49] "What are the *safe* levels of exposure to chemicals for developmentally disabled workers?" was an important question raised during the study. Another question was how to assess possible interactions between occupational exposures and prescription medications taken by many workers. In addition, because some workers with developmental disabilities are neurologically compromised, they may be at increased risk even with minimal occupational exposure to neurotoxic substances.[49,50,53]

Packaging Vinsol® NVX

High dust levels were created when Vinsol® NVX was packaged. Because the exhaust fan was so small and was not close enough to the packaging activity, it did little to reduce the airborne dust level in the room. The beard of the worker packaging Vinsol® NVX prevented a complete seal between his face and the respirator's facepiece. This likely caused greater dust exposure than if he had been clean shaven.

Heat stress measurements

Apparent temperature measurements showed that a heat stress risk existed in the plastisol coating room. The heat stress risk of the plastisol tank operator was likely increased because of the close proximity of the tank and its controls to the opening of the drying oven. The supervisor was aware of the heat stress risk. Starting times were adjusted during the summer so workers began working earlier to take advantage of cooler morning temperatures. The workers were also free to move to a cooler break room beside their work area whenever necessary.

Fans in the room may have increased the worker's heat stress burden. Fans can increase evaporative heat loss from skin and thus have a cooling effect on workers. However, fans in environments hotter than 95°F can be detrimental because a worker's convective heat gain is increased when this temperature is exceeded.[30,54] This air temperature is considered the cutoff point because it is the mean skin temperature.

Some medical conditions are known to increase a person's risk of heat stress. Heart disease limits maximum cardiac output and impairs the body's capacity to increase cutaneous circulation. Diabetic or atherosclerotic vascular disease impairs vasodilatation. People with diseases of the spinal

cord and central and peripheral nervous systems also exhibit inadequate thermoregulatory responses.[55]

Prescription and over–the–counter medications may also increase a person's heat stress risk. Antihistamines, phenothiazines, and cyclic antidepressants impair sweating. β–Adrenergic receptor blockers and calcium–channel blockers, used to treat hypertension, limit maximal cardiac output and alter normal vascular distribution of blood flow in response to heat exposure. Diuretics can limit cardiac output and affect heat tolerance and sweating.[55]

RECOMMENDATIONS

Handi–Shop's manager expressed concern for employees' health and safety. However, the overall findings of this health hazard evaluation suggest that Handi–Shop's employees would benefit from increased management awareness of worker exposures and a more proactive approach to occupational health and safety. The following recommendations include changes that should be made at Handi–Shop. Recommendations concerning administrative improvements that should be made in Missouri's Extended Employment Sheltered Workshops section are also given.

- Issues concerning occupational exposures of workers with disabilities are complex, and research is needed to address whether workers with developmental disabilities are at greater risk of developing occupational diseases than workers without disabilities. Thus, when evaluating exposures of workers with developmental disabilities, occupational exposure limits should be used carefully and with an understanding that they may not be applicable. Also, an informed decision may need to be made whether a worker with a developmental disability should be assigned to a job that may involve exposures to chemical or physical agents. Assessment of a worker's medical status by a physician or other licensed health care professional may be necessary. If a worker has a severe cognitive disability, a person authorized to make decisions on his or her behalf should also be involved in the decision–making process.

- All requirements of OSHA's bloodborne pathogens standard should be met. Of special importance is preparing a written exposure control plan and providing a training program concerning bloodborne pathogens to all employees. The training program should be tailored to accommodate employees with cognitive impairments. Ways to do this include frequently repeating the training, breaking down information into small increments, using basic language, and developing pictures that convey proper behavior.[56]

- Besides maintaining OSHA form 200, each sheltered workshop in Missouri should send a copy to the Director of Extended Employment Sheltered Workshops for annual compilation and analysis of overall injury and illness data.

- After a work–related incident, an employee's death or the inpatient hospitalization of three or more employees must be reported to OSHA. Also, Handi–Shop management should report such incidents to the Director of Extended Employment Sheltered Workshops.

- Handi–Shop staff members should be trained in CPR, rescue breathing, first aid, and management of aggressive behaviors.[52] Training should be based in part on the identified needs of the workers and include awareness of employees with medical conditions that may hinder prompt delivery of medical care if an injury or illness occurs.

- A plan for responding to medical emergencies should be developed.

- The hole in the local exhaust ventilation hood in the plastisol coating room should be repaired. Once the hole is covered, the effectiveness of the local exhaust ventilation system should be evaluated.

- Workers should be alerted whenever the forklift truck is being operated nearby. Automatic backup alarms and flashing lights are warning devices often found on forklift trucks, though such devices are not required by Federal OSHA's general industry standards. However, warning devices have been disconnected at sheltered workshops because of

concern that they may cause a worker to have an epileptic seizure. If this is a concern at Handi–Shop, a signal person should help the forklift driver warn nearby workers.

• The medical status of current employees having possible exposures to heat stress conditions should be evaluated by a physician or other licensed heath care professional. Employees being considered for hot jobs should first be cleared medically for such assignments.

• Methods should be investigated for reducing the heat released through the opening of the drying oven. In addition to reducing the workers' heat stress risk, savings in energy costs may be realized.

• Environmental conditions in the plastisol coating room should be monitored. When conditions are such that they may cause heat related illnesses, measures should be taken to ensure that the workers and their supervisors are protected.

• The suitability of degreasing agents other than methylene chloride should be evaluated. If methylene chloride continues to be used, its container should be stored in a cabinet ventilated to outside the building.

• Changes should be made to the Vinsol® NVX packaging procedures to reduce aerosolized dust. Instead of dumping the material into a wash tub, a scoop should be used to transfer the material. Also, to reduce spillage during transfer of Vinsol® NVX to a plastic bag, a frame should hold the bag open or an alternative container should be used.

• To ensure that a tight fitting respirator protects its wearer, nothing should interfere with the face–to–facepiece seal. Most important, respirators should be used with all of the measures of an acceptable respiratory protection program (including medical examinations, facepiece fit testing, and worker training) as required by OSHA standard 29 CFR Part 1910.134.

• Sodium resinate is a caustic material and may cause severe eye irritation requiring immediate treatment. Thus, an eye wash station should be put near the packaging room, and the workers should be taught how to use it. Then, if someone experiences eye irritation while packaging Vinsol® NVX or other irritating dusts, the eyes can be flushed immediately. (OSHA standard 29 CFR Part 1910.151 requires facilities for quick drenching or flushing of the eyes in a work area when a person's eyes may be exposed to harmful corrosive materials.)

• The technical field supervisors of Extended Employment Sheltered Workshops have no equipment for evaluating potential health and safety problems. For some situations (e.g., estimating worker exposures or measuring light levels), not having appropriate sampling equipment may handicap them from doing an effective job of helping workshops develop proper occupational safety and health procedures. Industrial hygiene equipment should be purchased and technical field supervisors should be trained to use the equipment so that potential health and safety problems can be evaluated.

• Availability of occupational health and safety expertise should be improved by creation of an occupational health and safety position in Missouri's Extended Employment Sheltered Workshops section. This would give every sheltered workshop in Missouri access to occupational health and safety expertise, which is essential for the recognition, evaluation, and elimination of occupational hazards.

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