HETA 92-140-2264
OCTOBER 1992
T-L IRRIGATION COMPANY
HASTINGS, NEBRASKA

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I. SUMMARY

In February 1992, the National Institute for Occupational Safety Health (NIOSH) received a confidential employee request for a He Hazard Evaluation (HHE) concerning adverse health effects possib resulting from exposures occurring during the operation of a tub in Building 41 at the T-L Irrigation Company in Hastings, Nebras Specifically, the requestors were concerned about metal fume fev (MFF) from exposure to the galvanizing process, carbon monoxide farm tractor used in the building, and unsafe machinery.

On April 15 - 16, 1992, NIOSH investigators conducted a walkthro inspection of Building 41 and collected personal breathing zone and general area (GA) air samples for metal fumes and carbon mon (CO), performed GA noise measurements, evaluated local exhaust ventilation at the tube mill, and conducted medical interviews w seven of the workers present. The OSHA 200 Logs from 1990, 1991 the first quarter of 1992, were reviewed to ascertain the types injuries and illnesses encountered at the facility.

Fourteen PBZ samples and one GA sample for metals were collected the foreman, the scarfer, and the remaining five employees produ hydraulic tubing. Eight-hour time weighted average (TWA) PBZ concentrations of zinc oxide ranged from 0.27 to 2.8 mg/m^3. The hour TWA PBZ concentration of results for iron oxide fume ranged 0.003 to 0.02 mg/m^3. The GA sample above the welder indicated e: hour TWA concentrations of 1.8 mg/m^3 for zinc oxide fume and 0.003 mg/m^3 for iron oxide fume. All sampling results were belov relevant evaluation criteria. Seven PBZ samples for CO revealed eight-hour TWA concentration of 6 ppm, well below the NIOSH REL ppm. Face velocity measured at the canopy hood over the high-fr welder was 350 feet per minute (fpm). Air velocity measured nea point of fume generation was 125 fpm. This is within the range capture velocities of 100-200 fpm recommended for welding. Whil velocity was not assessed at this facility, a duct velocity of 1400-2000 fpm has been recommended for zinc oxide fume. Noise measurements collected in Building 41 were in excess of 90 Db(A) three different areas of the process; the high frequency welder, tube cutting area, and the tube testing area.

Private medical interviews revealed that four of the seven worke no complaints or symptoms. One employee had occasional irritati the nose and throat. One worker occasionally noted a metal tast

galvanizing but denied any other medical symptoms. One worker noted a acute illness involving headaches, nausea, chills, and fever while wor a scarfer. He was subsequently given different duties and has had no since his job relocation. Review of the OSHA 200 logs for 1990, 1991, January through March, 1992, showed that the two entries from Building secondary to crush injuries. There were no entries of MFF, asthma, or respiratory illnesses.

Based on the medical interviews, the occurrence of metal fume fever (MFF) or any symptoms attributable to metal fumes do not appear to be an ongoing problem at this facility. This investigation identified only one possible case of MFF at this facility in the past three years. Metal fume and carbon monoxide exposures were well below relevant evaluation criteria and do not appear to be a health hazard with this process. Noise level evaluations indicated that worker noise exposures may be excessive and further testing should be done by the employer to determine the extent of the employees' exposures.

Keyword 1: SIC 352 (Farm Machinery and Equipment), Tubes Mfg, Zinc Oxide, Iron Oxide, Metal Fume Fever, Noise.

II. INTRODUCTION

On April 15-16, 1992, investigators from the National Institute Occupational Safety and Health (NIOSH) conducted a Health Hazard Evaluation (HHE) at T-L Irrigation Company in Hastings, Nebraska HHE was the result of a February 5, 1992 request concerning adve health effects among employees working at the tube mill in Build Specifically, employees were concerned about metal fume fever (M from exposure to airborne contaminants from the galvanizing proc exposure to carbon monoxide from a farm tractor used in the buil unsafe machinery, and ceiling exhaust fans reportedly covered wi plywood.

On April 15, 1992, NIOSH investigators held an opening conferenc employer and employee representatives and conducted a walkthroug inspection of Building 41. On April 16, 1992, NIOSH investigato returned to Building 41 and collected personal breathing zone (P general area (GA) air samples for metal fumes, performed GA nois measurements, evaluated local exhaust ventilation at the tube mi conducted medical interviews with all seven of the workers prese the end of the day, preliminary results and recommendations were presented to employee and employer representatives in a closing conference.

III. BACKGROUND

T-L Irrigation Company manufactures hydraulic pivot irrigation s for farming. The company employs approximately 100 people, who ten production and two warehouse buildings. Approximately 80 of employees have worked for T-L for at least five years, and 60 fo than ten years.

Building 41 houses the tube mill. The building is approximately 200 feet long and 75 feet wide. The building, constructed of br concrete, was built in 1945 as part of a Naval Ammunition Depot. has been modified to accommodate the current process, which bega operation about ten years ago. Two to five people work in Build when the tube mill is not running, and about seven employees wor when the mill is in operation. The mill normally runs nine hour day, one day a week. At the time of the site visit, however, th was running two days a week.

The tube mill forms half-inch, one-inch, or one and one-quarter- hydraulic tubing from coiled galvanized steel. A coil of galvan steel is placed on a spindle (the uncoiler) using a propane-powe fork-lift truck. The beginning of the new coil is gas tungsten arc-welded to the end of the old coil. Rollers form the flat st into tubing, and the edges are then joined using high-frequency welding. The welding apparatus is ventilated by a canopy hood. employee (the scarfer) removes excess metal from the newly welde

A metallizing gun sprays zinc, from zinc wire, onto the seam to galvanize the seam. The metallizing gun is fully enclosed and t enclosure is equipped with local exhaust ventilation. The tubin then cooled (the coolant is a hydrotreated napthenic base oil wi germicide; the germicide contains approximately 50% tris (hydroxymethyl) nitromethane). The coolant is used throughout t process, from forming through pressure testing. Next, the tubin cut into 40-foot lengths, which dimples the ends. The ends are (de-dimpled), compression fittings are attached at either end, a tubes are pressure tested to 3000 pounds per square inch. Follo pressure testing, the tubes are blown dry with compressed air to the remaining coolant. The end of the tubing from which the coo escapes is placed in a small enclosure equipped with local exhau ventilation. The tubing is next capped to protect the interior contamination, bundled in groups of 32 tubes, and loaded onto a using an electric hoist. Coolant collects in a floor sump and i cycled through the process again. When the trailer is fully loa is backed out of the building with a farm tractor. The trailer moved out of and back into Building 41 once on the day samples w collected.

The process runs at about 180 feet per minute, resulting in the production of 1200 to 1500 lengths of tubing each day. On April 1992, 1263 lengths of tubing were produced by the tube mill. At end of the process, an employee cleans the rollers and welding a using water. The enclosure for the metallizing gun is also clea with a putty knife, which produces large amounts of zinc-contain dust. On days the tube mill is not running, employees process t tubing remaining from the previous production run.

T-L Irrigation Company requires employees to wear safety shoes a protection. The company recently purchased a half-mask air-puri respirator and required the scarfer to use it without fit-testin determination of the employee's medical fitness to wear a respir Disposable respirators and ear plugs are available to employees, these are rarely used. T-L Irrigation Company does not have a respiratory protection program or a hearing conservation program employee who is an emergency medical technician responds to inju and provides first-aid. Medical care is provided by a local hos with a local physician serving as the company physician when one needed.

IV. MATERIALS AND METHODS

A. Medical

All seven employees present in Building 41 were interviewed t elicit information regarding job tasks, duration of employmen of personal protective equipment, possible exposures, medical symptoms potentially related to work, and health concerns. T OSHA 200 Logs were reviewed from 1990, 1991, and the first qu

of 1992 to ascertain types of injuries/illnesses encountered facility.

B. **Environmental**

On April 16, 1992, fourteen PBZ and one GA air samples were collected for metals in Building 41. The GA air sample was collected at the scarfer's work station. PBZ samples were collected for all seven employees fabricating tubing on April 1992. Two partial-period, consecutive samples were collected the breathing zone of each employee. The first sample was collected from the beginning of production, at approximately 8:00 a.m., to around 12:30 p.m. The second sampling period b at approximately 12:30 p.m. and ended when tube mill clean-up following the day's production of tubing, at about 2:00 p.m. area sample ran from 8:12 a.m. to 1:50 p.m. Samples were col and analyzed in accordance with NIOSH Method 7300.[1] Samples w collected on 37-mm diameter, 0.8-µm pore-size mixed cellulos ester filters in three-piece polycarbonate cassettes, connect a battery-powered sampling pump via a length of Tygon tubing. Samples were collected at a flow rate of 2 liters per minute. PBZ samples were collected for carbon monoxide using length o stain diffusion tubes.

Both the face velocity and capture velocity of the canopy hoo the high frequency welder were evaluated using a thermoanemom (Series 490 mini-anemometer, Kurz Instruments, Inc., Carmel V CA). Noise in Building 41 was measured using a type II sound meter operating in the slow response mode and the A-weighted (Model 215 sound level meter, Quest Electronics, Oconomowoc, The sound level meter was field calibrated before and after sampling according to the manufacturer's directions.

V. **EVALUATION CRITERIA**

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation cri for the assessment of a number of chemical and physical agents. criteria are intended to suggest levels of exposure to which mos workers may be exposed up to ten hours a day, forty hours a week working lifetime without experiencing adverse health effects. H it is important to note that not all workers will be protected f adverse health effects if their exposures are maintained below t levels. A small percentage may experience adverse health effect because of individual susceptibility, a pre-existing medical con and/or a hypersensitivity (allergy). In addition, some hazardou substances may act in combination with other workplace exposures general environment, or with medications or personal habits of t worker to produce health effects even if the occupational exposu controlled to the limit set by the evaluation criterion. These

combined effects are often not considered by the evaluation crit
Also, some substances are absorbed by direct contact with the sk
mucous membranes, and thus potentially increase the overall expo
Finally, evaluation criteria may change over the years as new
information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the
workplace are the following: 1) NIOSH Criteria Documents and
Recommended Exposure Limits (RELs), 2) the U.S. Department of La
OSHA Permissible Exposure Limits (PELs), and 3) the American Con
of Governmental Industrial Hygienists' (ACGIH) Threshold Limit V
(TLVs).[2-4] The OSHA PELs may be required to take into account th
feasibility of controlling exposures in various industries where
agents are used; in contrast, the NIOSH-recommended exposure lim
primarily based upon the prevention of occupational disease. In
evaluating the exposure levels and the recommendations for reduc
those levels found in this report, it should be noted that emplo
are legally required to meet those levels specified by an OSHA P

A time-weighted average exposure level (TWA) refers to the avera
airborne concentration of a substance during a normal eight- to
ten-hour workday. Some substances have recommended short-term e
limits (STELs) or ceiling values which are intended to supplemen
TWA where there are recognized toxic effects from brief high exp

A. **Noise**

Occupational deafness was first documented among metalworkers
the sixteenth century.[5] Since then, it has been shown that w
have experienced excessive hearing loss in many occupations
associated with noise. Noise-induced loss of hearing is an
irreversible, sensorineural condition that progresses with
exposure. Although hearing ability declines with age (presby
in all populations, exposure to noise produces hearing loss g
than that resulting from the natural aging process. This noi
induced loss is caused by damage to nerve cells of the inner
(cochlea) and, unlike some conductive hearing disorders, cann
treated medically.[6]

While loss of hearing may result from a single exposure to a
brief impulse noise or explosion, such traumatic losses are m
less common than the insidious hearing loss due to chronic no
exposure. Typically, the latter begins to develop at 4000 or
6000 Hz (the hearing range is 20 Hz to 20000 Hz) and spreads
lower and higher frequencies. Often, material impairment has
occurred before the condition is clearly recognized. Such
impairment is usually severe enough to permanently affect a
person's ability to hear and understand speech under everyday
conditions. Although the primary frequencies of human speech
from 200 Hz to 2000 Hz, research has shown that the consonant

sounds, which enable people to distinguish words such as "fis from "fist," have still higher frequency components.[7]

The OSHA standard for occupational exposure to noise (29 CFR 1910.95) specifies a maximum PEL of 90 dB(A)-slow res for a duration of eight hours per day.[8] The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship. This means that in order for a person to be ex to noise levels of 95 dB(A), the amount of time allowed at th exposure level must be cut in half in order to be within OSHA PEL. Conversely, a person exposed to 85 dB(A) is allowed twi much time at this level (16 hours) and is within his daily PE Both NIOSH, in its Criteria for a Recommended Standard, and t ACGIH, in their TLVs, propose an exposure limit of 85 dB(A) f eight hours, 5 dB less than the OSHA standard.[4,9] Both of the latter two criteria also use a 5 dB time/intensity trading relationship in calculating exposure limits.
Time-weighted average (TWA) noise limits as a function of exp duration follow:

Duration of Exposure (hrs/day)	Sound Level (dB(A))	
	NIOSH/ACGIH	OSHA
16	80	85
8	85	90
4	90	95
2	95	100
1	100	105
1/2	105	110
1/4	110	115
1/8	115	*
		**

* No exposure to continuous or intermittent noise in exces 115 dB(A).
**Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

The OSHA regulation has an additional action level (AL) of 85 dB(A), at which an employer shall administer a continuing, effective hearing conservation program when the TWA value exc the AL. The program must include monitoring, employee notification, observation, an audiometric testing program, he protectors, training programs, and recordkeeping. All of the requirements are included in 29 CFR 1910.95, paragraphs (c) t (o). The OSHA noise standard also states that when workers a exposed to noise levels in excess of the OSHA PEL of 90 dB(A) feasible engineering or administrative controls shall be

implemented to reduce the workers' exposure levels. Also, a continuing, effective hearing conservation program shall be implemented.

B. **Carbon Monoxide**

Carbon monoxide (CO) is a colorless, odorless, tasteless gas produced by incomplete burning of carbon-containing materials e.g., natural gas. The initial symptoms of CO poisoning may include headache, dizziness, drowsiness, and nausea. These i symptoms may advance to vomiting, loss of consciousness, and collapse if prolonged or high exposures are encountered. Com death may occur if high exposures continue.[10-15]

Both the NIOSH REL and the OSHA PEL for CO are an eight hours day, 40 hours per week TWA exposure of 35 ppm, and a ceiling of 200 ppm.[2,3] The NIOSH REL of 35 ppm is designed to protect workers from health effects associated with COHb levels in ex of 5%.[10] The ACGIH recommends an eight-hour TWA TLV of 50 ppm with a ceiling level of 400 ppm. Currently, the ACGIH has published a notice of an intent to change the TLV to 25 ppm a eight-hour TWA.[4] In addition to these standards, the Nationa Research Council has developed a CO exposure standard of 15 p based on a 24 hours per day, 90-day TWA exposure.[16]

C. **Zinc**

Zinc metal is used in galvanizing, in electroplating, in dry in alloys, and as zinc oxide in pigments. Inhalation of fres formed zinc oxide fume causes a self-limited influenza-like i termed metal fume fever (MFF).[13] MFF is characterized by a complex of symptoms that includes fever, chills, sweats, naus fatigue, throat irritation, cough, headaches, muscle aches, a joint pain.[21] The onset of symptoms is usually preceded by th and a metallic taste. An attack usually occurs 4 to 8 hours exposure and may last up to 24 hours, usually with complete recovery. Symptoms commonly affect previously unexposed work workers who have returned to work after a several day rest pe hence, attacks tend to be most severe on the first day of the workweek.[22]

The OSHA PEL for zinc oxide fume is 5 mg/m^3 as an eight-hour with a STEL of 10 mg/m^3.[3] The 1992-1993 ACGIH TLV and the NIO REL for zinc oxide fume are identical to the OSHA values.[4,17]

D. **Iron**

Inhalation of iron oxide fume causes siderosis, an asymptomat condition often referred to as a "benign pneumoconiosis" beca its appearance on chest x-ray. Exposures of six to ten years usually required before changes recognizable by x-ray occur;

retained iron material produces x-ray shadows that are indistinguishable from a true pneumoconiosis.[13] In one study welders exposed to iron oxide fume at concentrations ranging 0.65 to 47 mg/m^3 for an average of 18.7 years, eight had shad chest x-ray consistent with siderosis, but there was no reduc in pulmonary function.[13]

The OSHA PEL for iron oxide fume (as iron) is 10 mg/m^3 as an hour TWA.[3] Both the ACGIH TLV and the NIOSH REL are 5 mg/m^3.[4]

VI. Results

A. Medical

1. Interviews

Private medical interviews were conducted with all seven employees present in Building 41 on April 16, 1992. Three the seven employees had been employed one month or less. of these three workers had no complaints or symptoms, and employee had occasional irritation of the nose and throat. worker presently acting as a scarfer in Building 41 (emplo at T&L for 19 years) performs this job only periodically a needed. This worker occasionally noted a metal taste afte galvanizing but denied any other medical symptoms. The th remaining employees had worked in building 41 for five or years. One worker noted a past acute illness, including headaches, nausea, chills, and fever, after exposure to fr zinc oxide fume while working as a scarfer. He was subsequently given different job duties and has had no pro since. The other two employees denied any medical symptom All those interviewed denied any knowledge of previous employees being ill or injured. Four of the seven were cu smokers and smoked while working.

2. OSHA 200 Log Review

Review of the OSHA 200 Logs for the entire facility for 19 1991, and January through March, 1992, showed the majority injuries were musculoskeletal, such as strains or contusio lacerations, or ocular foreign bodies. The two entries fr Building 41 were secondary to crushing injuries. There we entries of metal fume fever, asthma, or other respiratory illnesses.

B. Environmental

1. Metals

Fourteen PBZ samples and one GA sample for metals were collected on April 16, 1992. PBZ samples were collected f

the foreman, the scarfer, and the remaining five employees producing hydraulic tubing. The samples were analyzed for following metals in accordance with NIOSH Method 7300: aluminum, arsenic, barium, beryllium, calcium, cadmium, co chromium, copper, iron, lithium, magnesium, manganese, molybdenum, nickel, lead, phosphorous, platinum, selenium, silver, sodium, tin, tellurium, thallium, titanium, tungst vanadium, yttrium, zinc, and zirconium.[1] A small quantity aluminum was detected on one of the fourteen samples, and small quantity of magnesium was detected on two of them. Eight-hour TWA concentrations of zinc oxide fume ranged fr 0.27 to 2.8 mg/m^3. Eight-hour TWA iron concentrations ran from 0.003 to 0.02 mg/m^3. The GA sample above the welder eight-hour TWA concentrations of 1.8 mg/m^3 for zinc oxide and 0.003 mg/m^3 for iron. All of these results are less t the evaluation criteria for zinc oxide and iron oxide fume

2. **Carbon Monoxide**

Seven PBZ samples for carbon monoxide were collected on Ap 16, 1992. Potential carbon monoxide sources in Building 4 include the farm tractor, the fork-lift truck, and cigaret smoke. Carbon monoxide sampling revealed a mean eight-hou concentration of 6 ppm; all exposures were well below the evaluation criteria for carbon monoxide.

3. **Ventilation**

The air velocity measured at the face canopy hood was 350 per minute (fpm). Air velocity measured near the point of generation was 125 fpm. This is within the range of captu velocities of 100-200 fpm recommended for welding.[18] Altho replacement air* is not provided to Building 41, an overhe door in the wall opposite the tube mill is partially open except on the coldest days, according to employees in the building. According to the employee responsible for maintaining the ventilation system, the ductwork must be cleaned periodically to maintain adequate system performar This may be the result of inadequate duct velocity, which to particulate depositing in the duct. A duct velocity of 1400-2000 fpm has been recommended for zinc oxide fume.[18]

4. **Noise**

Area noise measurements collected in Building 41 revealed (a) in excess of 90 dB(A) at the high frequency welder (probably as a result of the tube cutter nearby), at the t

*Replacement air is a ventilation term used to indicate the volume of controlled outside air supplied to a building to replace air being exh

cutter, and at the apparatus that receives tubing after th
cutter and advances it to the de-dimpler; and (b) greater
95 dB(A) at the hood designed to receive coolant blown fro
tubing by compressed air.

VII. CONCLUSIONS

Based on employee interviews, and review of the OSHA 200 Logs, o
possible episode of metal fume fever, occurring three years ago,
identified. While zinc oxide fume, which is a common cause of m
fume fever, is produced in the welding of galvanized steel and m
spraying with zinc wire, the processes in this facility appear t
adequately ventilated and controlled.

Further evaluation of noise in Building 41 is required to determ
extent of employee exposure. If employees are over-exposed to n
then noise controls can be devised that are based on the noise
evaluation and analyses.

Excessive carbon monoxide exposure does not appear to be a probl
The limited use of the tractor to move the trailer, during the N
investigation, did not result in carbon monoxide concentrations
excess of the relevant evaluation criteria.

VIII. RECOMMENDATIONS

The following recommendations should reduce potential exposures
workplace which may adversely affect the health and safety of th
workers at T-L Irrigation Company. They are based on observatio
the process and work areas, medical interviews, and environmenta
sampling results.

A. Noise

Although a consultant had recently performed noise measuremen
Building 41 prior to our HHE, noise dosimetry and detailed no
analyses are necessary to assess more thoroughly the employee
noise exposure and to determine the sources of, and means to
control, excessive noise.

Noise dosimetry should be performed for each employee during
typical day of the tube mill operation to obtain representati
noise exposure levels. If eight-hour TWA levels equal or exc
85 dB(A), a hearing conservation program which complies with
OSHA standard, 29 CFR 1910.95, must be implemented. The prog
must include monitoring, employee notification, observation,
audiometric testing program, hearing protectors, training pro
and recordkeeping requirements. All of these requirements ar
included in 29 CFR 1910.95, paragraphs (c) through (o). The
noise standard also states that when workers are exposed to n

levels in excess of the OSHA PEL of 90 dB(A), feasible engine or administrative controls shall be implemented to reduce the workers' exposure levels. NIOSH recommends that these measur implemented when noise levels exceed 85 dB(A).

B. **Respiratory Protection**

If T-L Irrigation Company requires the scarfer to utilize respiratory protection, a respiratory protection program must developed and implemented as required by the OSHA standard, 29 CFR 1910.134. This standard applies to the use of both respirators with elastomeric facepieces and disposable respir The results of air sampling conducted in the scarfer's breath zone indicated that this job does not require the use of a respirator. The respiratory protection program must include following provisions:

1. Written standard operating procedures governing the select and use of respirators

2. Selection of respirators based upon the hazards to which workers are exposed

3. Instruction and training of the user in the proper use of respirators and their limitations

4. Regular cleaning and disinfection of respirators. Respira used by more than one worker must be cleaned and disinfect after each use

5. Respirator storage in a convenient, clean, and sanitary location

6. Inspection and maintenance of respirators

7. Regular surveillance of work area conditions and the degre employee exposure or stress

8. Regular evaluation of the program to assure that it remair effective

9. Initial and periodic review of an employee's physical abil to wear a respirator

10. The use of respirators approved or accepted by NIOSH and t U.S. Department of Labor, Mine Safety and Health Administration.

C. **Metal Particulate Exposure**

While no over-exposures to metal fume were noted as a result sampling, workers should be educated about the potential heal effects from exposure to metal fume (e.g., metal fume fever). symptoms associated with exposure to metal fume do arise, the workplace should be promptly evaluated to determine whether c measures are functioning properly.

D. **Safety and Health Training**

During interviews, many workers, including those with several experience, had little knowledge of safety and health issues relates to this process. Periodic worker training specific t hazards encountered in the tube mill should be instituted.

E. **Safety**

1. Because of the possibility of eye contact with coolant spl and sprays, Building 41 should be provided with an eyewash capable of delivering at least 1.5 liters of water per mir for 15 minutes.[20] Several models are available at reasonab cost.

2. Eye protection which meets the requirements of ANSI Z87.1- including prescription glasses, should be the only eyeware permitted to be worn in Building 41.

3. A guard or warning device should be placed between the spc where the coil is unwound and the beginning of the tube mi prevent accidental laceration by the coil strip.

4. A safety concern raised in the HHE request was the result injury that occurred to an employee who was pinched by the that holds tubing for pressure testing. A guard or other protective mechanism should be placed on the clamps which couple with the tubing during pressure testing.

F. **Coolant and its Components**

1. Potential exposures to coolant and its components that may result from using compressed air to remove coolant from tu following pressure testing should be evaluated.

2. Due to the use of coolant throughout the process, the comp should provide sufficient work clothing to allow workers t change their clothes daily or when they become saturated w coolant. The continuous wearing of dirty or coolant-satur garments and/or contact with coolants can lead to problema skin dryness, irritation, and dermatitis.

While interviewed employees were not presently experiencir skin problems from exposures to workplace coolants, this c become a future problem. Gloves and barrier creams may be to reduce hand exposures. Additionally, hand moisturizing creams should be made available, and their usage encourage for workers with frequent coolant exposure.

G. **Personal Hygiene**

1. Currently, employees eat at a small table adjacent to the production area. They should not be allowed to eat and dr in the work area. Instead, eating and drinking should be in an uncontaminated area removed from the production area

2. Smoking should be prohibited in the work area and smoking cessation encouraged. NIOSH recommends that workers shoul be involuntarily exposed to tobacco smoke.[19] Exposure to environmental tobacco smoke (ETS) may be responsible for irritant symptoms and can exacerbate allergic symptoms. Further, NIOSH has determined that ETS poses an increased of lung cancer and possibly heart disease to occupationall exposed workers.[19] The best method for controlling worker exposure to ETS is to eliminate tobacco use from the workp and to implement a smoking cessation program. Until tobac use can be completely eliminated, the employer should make efforts to protect nonsmokers from ETS by isolating areas smoking is permitted. Separate smoking areas with dedicat ventilation are a means to accomplish this. Air should be exhausted directly outside and not recirculated within the building or mixed with the general dilution ventilation fo building. ASHRAE recommends 60 cubic feet per minute (cfm person of outside or transfer air be supplied to the smoki area. A negative pressure should be provided to prevent airflow back into the non-smoking workplace.[19]

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