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SUMMARY

In September 1991, NIOSH received an employee request to perform a hea hazard evaluation (HHE) in building 500 of the Veterans Administratior Center in Los Angeles, California. The request concerned exposures tc chemicals, particularly formaldehyde, in the laboratory department; ex heat and humidity, and "lack of airflow" in the kitchen area of the di department; and carbon monoxide (CO) exposures inside the building as of CO entering the building from outdoors.

Air monitoring conducted in the laboratory department to evaluate form exposures consisted of five personal breathing zone (PBZ) air samples area air samples. (Formaldehyde is used in the histopathology laborat the preservation of specimens.) Direct-reading measurements for CO we outside the air inlets of three air handling units. Morning and after measurements of temperature, relative humidity, and carbon dioxide wer at four locations in the kitchen. Private medical interviews were cor among employees currently working in the histopathology laboratory, bacteriology lab, and the kitchen area.

Formaldehyde was detected in three of the five PBZ samples, at concent up to 0.17 ppm, and in all four area air samples, at concentrations up 1.1 ppm. NIOSH considers formaldehyde to be a potential occupational carcinogen, and recommends that exposures be reduced to the lowest fea level (LFL).[1] For the purposes of this report, the limit of quantitat (LOQ) is used as a target value to which efforts to reduce formaldehyc exposures should be aimed. (The LOQ for the 8-hour PBZ samples collec this survey was 0.07 ppm). The OSHA and ACGIH occupational guidelines formaldehyde are 0.75 and 1 ppm, respectively, for 8-hour time-weighte average exposures, and 2 ppm for short-term exposures.[2,3]

Carbon monoxide levels were all less than 5 ppm (the limit of detectic temperatures at all measured locations in the kitchen were above the r operative temperatures (68-74°F) recommended by the American Society o Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for a level of work activity.[4] Relative humidity levels at all measured loc were below the range recommended by ASHRAE (30 - 60%)[5].

During informal interviews, laboratory workers reported that the predc symptoms associated with formaldehyde exposure were occasional headach nose/throat irritation. A few workers also experienced infrequent mil episodes of dermal irritation and rash. The symptoms that employees m commonly associated with working in the kitchen area were: headaches, irritation, and skin dryness and irritation.

A potential carcinogenic risk exists for workers in the laborator which use formaldehyde. This is based on one PBZ air sample, and area air samples which resulted in air concentrations of formalde that were above the limit of quantitation of the method. Specifi recommendations to reduce formaldehyde exposures in the laborator department are provided in the recommendation section of this rep

KEYWORDS: SIC 8062 (General Medical and Surgical Hospitals), labora kitchens, formaldehyde, HCHO, carbon monoxide, CO, indoor air quali

INTRODUCTION

In September 1991, NIOSH received an employee request to perform a hea hazard evaluation (HHE) in building 500 of the Veterans Administratior Medical Center in Los Angeles, California. The request concerned chem exposures among laboratory workers, particularly formaldehyde exposure excessive heat and humidity, and "lack of airflow" in the kitchen area dietetics department; and carbon monoxide (CO) exposures inside the bu as a result of CO entering the building from outdoors. NIOSH investig met with representatives of employees and management on January 29, 19 discuss the HHE request and the scope of the planned investigation. Environmental monitoring and medical interviews were conducted with em on January 30, 1992. On January 31, 1992, NIOSH investigators met wit representatives of employees and management to present preliminary fir and recommendations.

BACKGROUND

Building 500 of the West Side VA Medical Center, is a six story, 500 b in-patient hospital facility built in 1976. It is one of 140 building 500 acres of land which make up the medical center complex. Approxima 4300 people are employed at the center.

The request from laboratory personnel concerned chemical exposures in histopathology laboratory, which includes cytology, surgical pathology neuropathology, and histopathology, and the bacteriology laboratory, w includes parasitology and mycology. Approximately five employees work histopathology laboratory and eight work in the bacteriology laborator Employees work 8-hour shifts between 0600 and 1730. The laboratories generally staffed five to seven days per week. Formaldehyde use is li the histopathology laboratory.

Approximately 50 employees work various 8-hour shifts in the kitchen b 0500 and 2030. The kitchen is staffed seven days a week. The maximum of workers reported to be present in the kitchen at any one time is 30 Information on the heating, ventilation, and air conditioning system (was provided by Engineering Services at the hospital. The air handlir (AHU) which services the kitchen is a constant volume design. The sup is heated with hot water and cooled with chilled water. Reheat coils to provide localized heating. The AHU does not provide for humidifica the supply air. Filtering of the supply air is provided by three fil series: a low efficiency particulate filter, a carbon filter for remo organic compounds, and a high efficiency particulate air filter (HEPA) Outside air makes up 100% of the air supplied by the system, reported 32,000 cubic feet per minute (cfm).

Employees suspected that CO-containing emissions from diesel trucks ar diesel-powered generators used to transport and power mobile health ur

entering the building. A discussion with the safety manager revealed entrainment of CO-containing emissions into the building had been a pr However, the use of two of the three mobile units had been terminated time of the NIOSH visit, and the remaining unit had been moved to a lo farther away from the building and outside air intakes.

METHODS

Industrial Hygiene:

To address the general concerns of exposures to chemicals in the labor department, a walk-through inspection of the area was conducted and th training guide used by this department was reviewed. The guide is des fulfill the OSHA requirement that information and training be provided laboratory workers who may have contact with hazardous chemicals.[6] Ai monitoring was performed by NIOSH in the laboratories where formalin w Area air samples were collected in the histology storage room (1300E), surgical pathology room (1299), histopathology room (1300F), and histo technology room (1299A). The sample from room 1299A was collected approximately one foot from the breathing zone of the histology techni while he disposed of preserved tissue. Personal breathing zone (PBZ) were collected on the following workers: one cytology technician, one neuropathology histologist, one pathology resident, and two histology technicians. Area air samples were collected using NIOSH Method 3500 samples were collected using NIOSH Method 2541.[7] In using Method 3500 was drawn through a midget impinger containing 20 milliliters (ml) of sodium bisulfite solution at a flow rate of 0.9 liters per minute (lpm a battery-powered sampling pump. In Method 2541, air was drawn throug sorbent tube (catalog # 226-30-15-2) at a flow rate of 0.05 lpm using battery powered pump. The sampling time and location of each sample a provided in Table 1.

To address the employee concerns of thermal discomfort and lack of air air temperature, relative humidity (RH), and carbon dioxide (CO_2), concentrations were measured twice during the day at several locations kitchen. The reason for sequential measurements was to observe fluctu in levels during the course of the day. Temperature, RH, and CO_2 meas were also made in the laboratory and outdoors, for comparison.

To determine if CO was entering the building through the heating, vent and air conditioning system (HVAC), measurements of CO were made near intakes of three air handling units (AHUs), using Drager short-term de tubes. Measurements were made once in the afternoon at a time when ve traffic near the building appeared to be high. The three AHUs, which the laboratory, dietetics, and radiation departments, were also inspec signs of microbial contamination and general physical condition.

Medical:

To identify workplace health hazards and generate leads concerning the etiology of adverse health effects, private medical interviews were co with employees from the laboratory and dietetic areas. The NIOSH medi officer interviewed all five employees currently working in the histop laboratory, six of the eight workers employed in the bacteriology lab, eight of the 50 workers employed in the dietetics area. Interviewed e were selected at random from the laboratory and dietetic areas to det specific job requirements, workplace exposures, medical symptoms, and concerns.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by work place exposu NIOSH field staff employ environmental evaluation criteria for the ass of a number of chemical and physical agents. These criteria are inter suggest levels of exposure to which most workers may be exposed up to per day, 40 hours per week for a working lifetime without experiencing health effects. It is, however, important to note that not all worker be protected from adverse health effects if their exposures are mainta below these levels. A small percentage may experience adverse health because of individual susceptibility, a pre-existing medical condition a hypersensitivity (allergy). In addition, some hazardous substances in combination with other work place exposures, the general environmer with medications or personal habits of the worker to produce health ef even if the occupational exposures are controlled to the level set by evaluation criterion. These combined effects are often not considered evaluation criteria. Also, some substances are absorbed by direct cor with the skin and mucous membranes, and thus potentially increase the exposure. Finally, evaluation criteria may change over the years as n information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the work are: 1) NIOSH Criteria Documents and Recommended Exposure Limits (REL the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs), and 3) the U.S. Department of Labor (OS Permissible Exposure Limits (PELs). The OSHA PELs may be required to into account the feasibility of controlling exposures in various indus where the agents are used; the NIOSH-recommended exposure limits, by c are based primarily on concerns relating to the prevention of occupati disease. In evaluating the exposure levels and the recommendations fo reducing these levels found in this report, it should be noted that ir is legally required to meet those levels specified by an OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8 to 10-hour workday. So substances have recommended short-term exposure limits (STELS) or ceil

values (C) which are intended to supplement the TWA where there are re
toxic effects from high, short-term exposures. Short-term exposure li
defined as 15 minute TWA exposure which should not be exceeded at any
during the day. Ceiling values are limits for instantaneous exposures
should not be exceeded at any time during the day.

Formaldehyde:

Formaldehyde is a colorless gas with a characteristic pungent odor. F
is an aqueous solution containing 37 to 50% formaldehyde.[8] Air concen
of formaldehyde at levels of 0.1 to 5 parts per million (ppm) may caus
burning of the eyes, tearing, and general irritation of the upper resp
tract.[1] Skin contact with formalin may cause skin irritation, contact
dermatitis, and skin sensitization. Sensitization refers to an immune
response to low levels of an antigen thought to be caused by 1) exposu
a high concentration of the antigen and/or 2) repeated exposures to lo
of the antigen. Skin sensitization reactions refer to an immune-media
response to low exposure levels of a specific antigen resulting in cli
effects such as dermatitis, urticaria, itching.[9] Ingestion of formali
results in gastrointestinal toxicity which may be severe enough to cau
death.[2] Symptoms include nausea, vomiting, and severe abdominal pain.

Formaldehyde is recognized by NIOSH to be a potential occupational car
In two studies, rodents developed a rare form of nasal cancer followir
inhalation of formaldehyde. Because of its carcinogenic potential, NI
recommends that exposures to formaldehyde be reduced to the lowest fea
level (LFL). The OSHA PEL is 0.75 ppm as an 8-hour TWA and 2 ppm as a
(The OSHA PEL was reduced from 1 ppm to 0.75 ppm on June 26, 1992). A
designated formaldehyde to be a suspected human carcinogen.[3] The curr
ACGIH TLV is 1 ppm as a 8-hour TWA and 2 ppm as a STEL. ACGIH has pro
ceiling limit of 0.3 ppm in their notice of intended changes for 1991-

Carbon Monoxide and Carboxyhemoglobin:

Carbon monoxide is a colorless, odorless, tasteless gas produced by ir
burning of carbon-containing materials. The initial symptoms of CO po
may include headache, dizziness, drowsiness, and nausea. These initia
symptoms may advance to vomiting, loss of consciousness, and collapse
prolonged or high exposures are encountered. Coma or death may occur
exposures continue.[8]

Both the NIOSH REL and the OSHA PEL for CO are TWA exposures of 35 ppm
hours per day, 40 hours per week, and a ceiling limit of 200 ppm.[10,11]
ACGIH recommends an 8-hour TWA TLV of 50 ppm, with a ceiling level of
ACGIH has proposed an 8-hour TWA TLV of 25 ppm in their notice of inte
changes for 1991-1992.[3]

Thermal Comfort and Ventilation:

The perception of comfort is related to metabolic heat production, the transfer of heat to the environment, physiological adjustments, and bo temperatures. Heat transfer from the body to the environment is influ factors such as temperature, humidity, air movement, personal activiti clothing. ANSI/ASHRAE Standard 55-1981 and ASHRAE Standard 62-1989 pr guidelines for indoor temperature and RH levels, for which 80% or more occupants are expected to find the environment thermally comfortable.[4]

Figure 1 provides the range of indoor temperatures recommended by ASHR occupants at a sedentary level of activity. Examples of a sedentary l activity are sitting while doing office work or standing relaxed. ASH recommends a different temperature range for winter and summer months, of the difference in insulation level provided by the typical clothing during the two seasons. Based on outdoor temperatures and observation clothing worn by employees, the range for summer months was chosen as appropriate guideline. The temperature range recommended for summer m 30% RH and a sedentary activity level is 74 to 80°F. This is an appro level for laboratory workers but not for employees in the kitchen. Ba observation, these employees were assigned a medium level of activity. temperature range recommended for summer months at 30% RH and a medium activity level is approximately 68 to 74°F. The calculation of these is provided as Appendix I. The recommended range of RH is 30 to 60%. designed to minimize 1) the drying and irritation of mucous membranes RH), and 2) the growth of allergenic or pathogenic organisms (at high

The monitoring of CO_2, a normal constituent of exhaled breath, can be as a screening technique to evaluate whether adequate quantities of ou air are being introduced into an occupied space. Indoor CO_2 concentra are normally higher than the generally constant ambient CO_2 concentrat (range 300-350 ppm). When indoor CO_2 concentrations exceed 1000 ppm i where the only known source is exhaled breath, inadequate ventilation suspected. ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Quality, recommends outdoor air supply rates of 15 cubic feet per minu person (cfm/person) for kitchen areas.[5]

RESULTS

Industrial Hygiene:

The air monitoring results for formaldehyde are provided in Table 1. in Table 1 are the limits of detection (LOD) and quantitation (LOQ) of analytical methods. The highest PBZ air concentration was 0.17 ppm. sample was collected on a pathology resident who was dissecting tissue bench in surgical pathology (room 1299). The highest area air concent 1.1 ppm, was collected during the disposal of tissue.

The air concentrations of CO near the outside air intakes of the AHUs below the LOD for the method (reported to be 5 ppm).[12] Monitoring resu temperature, RH, and CO_2 are provided in Table 2. Temperatures measur the kitchen (76-96°F) were above the recommended range of 68 to 74°F. area of highest air temperature was measured at the clean-dish receivi station. Measurements at this location were 82°F in the morning witho dishwasher operating, and 96°F in the afternoon with the dishwasher op At the time of the afternoon measurement was made, a large fan was ope nearby. With the exception of one measurement, temperatures in the la were in the range recommended by ASHRAE (74-80°F). All RH levels meas the building (13-26%) were below the range recommended by ASHRAE (30 - RH).[5] Indoor CO_2 concentrations ranged from 425 to 625 ppm. The volur outside air supplied to the kitchen (32,000 cfm) provides approximatel 1000 cfm/person, which meets the ASHRAE recommendation of 15 cfm/perso minimum of outside air for kitchen areas. Signs of microbial growth w observed during the inspection of the three AHUs. Several air diffuse surrounding ceiling tile near in the kitchen were dirty. This indicat either the filters of the AHU are not effectively cleaning the supply and/or the supply ducts are dirty. The outside air inlet of the AHU w services the radiation department was also dirty.

Medical:

Symptoms that employees of the histopathology laboratory most commonly associated with working in the laboratory were: 1) headaches, 2) nos throat irritation, and 3) infrequent skin irritation or rashes. Emplo reported that these symptoms appeared to be related to exposure to formaldehyde vapors. For example, workers stated increased symptoms d the disposal of tissue preserved in formalin. These workers also repo that exposure to other chemicals used for tissue fixation, such as xyl occasionally caused skin and mucous membrane irritation. Other worker concerns in the histopathology area included: 1) insufficient exposur specific safety training, 2) inadequate labelling of chemical containe for tissue fixation, and 3) inadequate ventilation in the cytology are

Employees in the microbiology laboratory did not associate any symptom their workplace and felt that they had been given excellent health and training. These workers did, however, express concerns regarding: 1) inadequate ventilation in the Acid Fast Bacillus (AFB) Laboratory a 2) ill-defined procedures for fire evacuation, and 3) previous episode mucosal irritation and headaches secondary to exhaust fumes from a mob parked below the laboratory's air intakes.

The symptoms that employees of the kitchen most commonly associated wi workplace were: 1) headaches; 2) eye, nose, and throat irritation (es after areas were washed with cleaning solutions); and 3) skin dryness irritation of the hands. These symptoms were experienced by employees performing different jobs throughout the various work areas (food prep food tray assembly line, and dish washing).

Other commonly reported concerns from workers in the dietetics departm were: 1) noticeable odors; 2) inadequate ventilation throughout the department; 3) inadequate temperature regulation; 4) insufficient work procedure, whereby food tray assembly line workers can take washroom c work breaks; and 5) upper extremity exposure to hot steam when manuall loading certain types of food trays into the dishwasher. Temperatures reported to be particularly uncomfortable at the station where the cle dishes are received from the dishwasher. Workers generally occupy thi station for 1 to 1.5 hours per day.

DISCUSSION

Because NIOSH considers formaldehyde to be a potential occupational carcinogen, it is recommended that exposures be reduced to the lowest level (LFL). NIOSH does not numerically define the LFL, however a tar value for which reduction efforts could be aimed at is the limit of quantitation (LOQ) of the analytical method. Formaldehyde measurement the LOQ are considered semi-quantitative because of the reduced precis the method at these levels, and are difficult to distinguish from ambi formaldehyde levels. Three air measurements were above the LOQ (one P two area measurements). These results indicate that air concentration the LOQ can occur during tissue dissection, tissue disposal, and in th of tissue storage.

Latex gloves were used in the histopathology and surgical pathology laboratories during the disposal and handling of tissue specimens. Bu nitrile rubber are more resistant to formalin than the thinner latex m However, unlike latex, these gloves are generally not disposed of afte use. It is not known how often butyl or nitrile rubber gloves can be before their resistance to formalin penetration is reduced. The choic which gloves to use should be based on the known protective properties glove for the chemical being used, as well as the particular procedure performed.

Also of concern are formaldehyde exposures during tissue disposal in t morgue. Although the NIOSH investigation did not include this area, a employee from the morgue reported that the volume of tissue disposal w greater there than in the histopathology laboratory. He further repor the odor was much stronger in the morgue, which suggests that exposure greater.

Evaluation of the health and safety training program for laboratory pe suggests that significant improvements have been made in this area ove last few years. Although it is not complete, the training guide being developed for personnel in the laboratory department appeared to be co with the OSHA standard for occupational exposures to hazardous chemica the laboratory (29CFR 1910.1450). However, NIOSH investigators noted cleaning solution used in the microbiology lab was not labelled, which

inconsistent with the chemical hygiene plan.

Discussion of the current medical surveillance system with the Directo Laboratory Safety and Health suggests that further emphasis needs to b on integrating the efforts of the medical and safety departments. Pre there is no formal program for collaboration between the medical and s departments which would allow for the systematic identification and surveillance of work related health problems. The most effective mear protect workers from the harmful effects of exposures to toxic chemica control the exposures at their source. However, a medical surveillanc program with periodic health assessments should be viewed as an adjunc controlling the work environment.[13] The OSHA laboratory standard[6] requ that employers provide employees with an opportunity to receive approp medical examinations whenever: 1) the employee exhibits signs or symp associated with exposure to a hazardous chemical, 2) an event takes pl (i.e., spill, leak) in a workplace resulting in the likelihood of a significant exposure to a hazardous chemical, and 3) exposure monitori reveals an exposure level routinely above the action limit or PEL for regulated substance.

Appropriate medical surveillance varies with the nature of the work ac and exposures. A well-designed medical surveillance program may identi adverse health effects despite optimal efforts to control exposure or identify deficiencies with the exposure controls that would otherwise undetected. Earlier detection may lead to earlier intervention and pr of adverse health effects, thus reducing work-related morbidity. Anot benefit of periodic medical surveillance is that it can increase emplo awareness of potential workplace hazards and thereby encourage safe wo practices.[13] The medical surveillance program should strive for the following: 1) timely follow-up evaluations of specific work areas inv a workplace incident resulting in elevated exposure levels; 2) consist coordinated interaction between the safety and medical departments cor occupational illness/injury; 3) tracking of all incidents to enhance identification and future prevention of health problems; and 4) exposu specific medical monitoring of workers.[13]

Air temperatures were above the recommended range for operative temper in all areas of the kitchen. This supports worker' perceptions that temperatures were too warm, particularly near the frying grills and dishwasher. Air temperatures measured in the kitchen and laboratories used as surrogates for operative temperatures. Operative temperatures for air velocity and radiant heat sources in the area being measured. temperatures provide a good approximation of operative temperatures if temperatures near the measured location are close to the air temperatu air flow velocities are low (< 0.4 meters per second [m/s]). There ar locations in the kitchen where these conditions may not always be met. such locations, operative temperatures should be measured as directed ASHRAE standard[4] to better determine if the ASHRAE recommendations for comfort are being met.

A potential hazard for workers in hot environments is heat-induced ill
The physical signs of heat-induced illness range from fatigue to loss
consciousness, and in severe situations, death.[14] Temperatures of 96°F
even higher will not necessarily lead to heat-induced illness. Other
such as the humidity level and air movement determine whether or not t
can be sufficiently cooled through the evaporation of liquids and conv
A measurement which accounts for these factors is the wet-bulb globe
temperature (WBGT) index. The WBGT index was not measured during the
survey. WBGT indices in the kitchen were however, measured by a consu
May of 1991. Measured locations included the clean-dish receiving sta
The WBGT values from this survey were reported to be well within the v
recommended by NIOSH[14] and ACGIH[3].

Low RH levels may cause drying and irritation of the mucous membranes.
low RH values measured indoors (13-26%) reflect the low RH level outdo
(19%). Increasing the RH indoors when the outdoor level is low requir
mechanical humidification of the air with either a portable humidifier
unit incorporated into the HVAC system. Because mechanical humidifica
systems provide an environment suitable for biological growth, proper
maintenance is important.

Carbon dioxide concentrations measured in the kitchen (425-625 ppm) ir
that the AHU was providing an adequate volume of outside air. The
environmental measurements represent conditions with the AHU operating
Employees in the kitchen reported that the system is often turned off,
particularly during the evening hours and on the weekends. During the
meeting, the acting chief of engineering reported that AHUs were somet
turned off as an energy saving measure. Employees in the kitchen repo
that the environment was noticeably hotter and felt stagnant during ti
the AHU was not operating. (Employees reported that they could hear t
when they were operating).

Employees in the kitchen associated eye, nose and throat irritation wi
use of cleaning solutions in the area. Many chemicals in cleaning and
disinfecting products, such as chlorine and ammonia, are irritants.
Performing cleaning operations at night after kitchen employees have g
home, followed by operation of the AHU through the night, should reduc
exposures to the chemicals used for cleaning. Symptoms of skin drynes
skin irritation were also reported by employees in various areas of th
kitchen. Those employees required to use cleaning chemicals or have t
hands in water for extended periods of time should use gloves to reduc
exposures. The worker at the pot scrubber station was observed to wea
nitrile rubber gloves. The shift supervisor reported that these glove
available to employees upon request.

The following additional concerns were observed by the NIOSH investiga
brought to the attention of hospital management during the closing cor

1. There was a leak in the hot water line of the potwasher located in
   kitchen. Employees reported that the leak had been there for over
   months. A can placed under the leaking hose was full, causing wate
   spill onto the floor. This represents a safety hazard as well as a
   additional source of heat to the area.

2. There was ice present on the surfaces inside of a large walk-in fre
   the kitchen. Ice had accumulated along the refrigerant line, as we
   on the fans and floor. An employee reported that at times, the dep
   ice on the floor was as much as several feet. NIOSH investigators
   initially thought that this may be due to refrigerant leak but were
   informed that the ice was due to water vapor condensing on the surf
   The source of the water was reported to be a leak in one of the cor
   lines and was being fixed.

3. The hospital chlorinates their water supply to prevent microbiologi
   contamination. The chlorination was initiated in response to a the
   outbreak of legionnaires disease at the hospital in the 1970s. Emp
   reported that the water did not taste good and expressed concern th
   additional chlorine may be harmful. Hospital management reported t
   water is tested daily for a variety of organic compounds, both befo
   after chlorination. The results of one day's testing were provided
   NIOSH investigators. These results revealed that chlorination of t
   water increased the level of trihalomethanes (THM). The THM of gre
   health concern is chloroform. Chloroform is a central nervous syst
   depressant, causes liver damage, and is considered by NIOSH to be a
   potential occupational carcinogen. The total THM results reported
   water which had been chlorinated by the hospital, was approximately
   micrograms per liter (ug/L). The federal standard for municipal dr
   water set by EPA is 100 ug/L total THMs.

4. In reviewing the laboratory results from water analyses, NIOSH
   investigators noted that the limit of detection (LOD) for vinyl chl
   was 50 ug/L; this is well above the EPA standard of 2 ug/L. This s
   is based on the carcinogenic potential of vinyl chloride. A more
   sensitive analytical method should be used to improve the monitorin
   vinyl chloride levels. The EPA method utilizes a purge and trap sy
   with analysis done by gas chromatography; the reported LOD for the
   is less than 0.5 ug/L.[15]

RECOMMENDATIONS

Laboratories:

1. Formaldehyde concentrations in the laboratory should be reduced be of the carcinogenic potential represented by exposure to formaldeh This should also reduce symptoms of irritation and the risk of der sensitization. Specific efforts to reduce formaldehyde exposures the disposal of preserved tissue, tissue dissection, and tissue st by using local exhaust ventilation should be considered. During t disposal, concentrations should be reduced by providing local exha ventilation above the waste drum or performing the procedure insid fume hood. Tissue dissection could also be performed inside of a hood instead of at the laboratory bench. NIOSH recommends that pr specimens be stored under local exhaust ventilation to minimize formaldehyde exposure.[16]

2. Complete and implement the chemical hygiene plan required by OSHA 29CFR part 1910.1450 as of January 31, 1991.

3. The proper gloves should be used when working with formalin to mir dermal exposure. For the disposal of tissue in the histopathology laboratory, a procedure which lasts approximately 15 minutes, a disposable glove which provides an adequate breakthrough time is recommended; glove manufacturers generally have information on breakthrough time.

4. To determine if employees are exhibiting signs or symptoms associa with exposures to hazardous chemicals, a medical surveillance prog appropriate to the activities and exposures of each work station s be implemented. A synopsis of a few of the OSHA medical surveilla recommendations concerning employees exposed to formaldehyde[2] is p as Appendix II.

Kitchen:

5. To provide a more comfortable workplace with the recommended amour outside air, the AHUs should be run continuously during occupied h

6. Reduce temperatures in the kitchen to provide a more comfortable w environment. The temperature of the supply air should be chosen s provide operative temperatures in the workspace of between 68 and For isolated areas such as the grills and dishwasher, heat can be through improved local exhaust ventilation. ACGIH has recommendat ventilation design for dishwashers and kitchen range hoods.[17] More localized cooling is recommended to provide a more comfortable environment for workers at the clean-dish receiving station.

7. Job tasks involving the dish-washing area should be monitored to a that workers are not being exposed to conditions which may lead to stress.

8. Educate those employees exposed to cleaning chemicals, as to the p strength, usage, and health effects of the cleaners used in the ki

9. Emphasize the appropriate use of gloves by those employees of the who have dermal exposure to cleaning chemicals and/or excessive wa

10. Hand moisturizing creams should be made available to all employees frequent hand exposure to chemicals and water. Usage of moisturiz creams should be emphasized in those employees experiencing dermal dryness and irritation.

11. Repair the leak in the hot water line of the pot scrubber in the k

12. Implement a functional scheduling system that allows for necessary breaks for workers at the food tray assembly lines.

13. Identify and resolve the source of dirt entering the kitchen throu supply air ducts.

General:

14. Health and safety personnel at the hospital should determine the formaldehyde exposures of workers in the morgue.

15. Clean the grill of the outside air supply of the AHU that services radiation department.

16. Ensure that outside air intakes are well maintained and that vehic engine exhaust fumes and other potential air contaminants are loca safe distance away.

17. Ensure that all employees have a clear understanding of fire evacu procedures and escape routes.

18. The risks presented from the potential exposure to *Legionella* and need to be evaluated by hospital management in order to determine level of chlorination of the water supply is most effective at red the overall health risk to workers and patients. Representatives Centers for Infectious Disease, Respiratory Diseases Branch (404) 3052, can provide information concerning the control of *Legionella*

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6) OSHA Region Nine

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

Table 1
Results from Formaldehyde Air Sampling

Veterans Administration Medical Center
Los Angeles, California
January 30, 1992
HETA 91-395

Sample No.	Sample Type	Job Title/Location	Sampling Time	Formaldehyde Concentration (ppm)
1	PBZ	Technician/Cytology (Room 1300D)	0755-1210	ND
2	PBZ	Histologist/Neuropathology (Room 1300D)	0805-1540	ND
3	PBZ	Histology Technician/Histopathology (Room 1300)	0807-1611	(0.05)
4	PBZ	Histology Technician/Surgical Pathology (room 1299)	0830-1521	(0.05)
5	PBZ	Pathology Resident/Surgical Pathology (room 1299)	1055-1525	0.17
6	area	Histology storage, Room 1300E (near long-term specimen storage)	0835-1100	0.13
7	area	Surgical Pathology, Room 1299 (near short-term specimen storage)	0837-1105	(0.02)
8	area	Histopathology, Room 1300F (center of the room)	0843-1110	(0.02)
9	area	Histology technology, Room 1299A (during tissue disposal)	1320-1333	1.1

PBZ Personal breathing zone sample.

ND Formaldehyde not detected on sample. Limit of detection (LOD hour PBZ sample is 0.02 ppm. The LOD for a 2.5 hour area sam ppm.

( ) Formaldehyde concentration between the LOD and limit of quant (LOQ). The LOQ for an 8-hour PBZ sample is .07 ppm. The LOQ hour area sample is 0.03 ppm.

Table 2
Indoor Air Quality Data

Veterans Administration Medical Center
Los Angeles, California
January 30, 1992
HETA 91-395

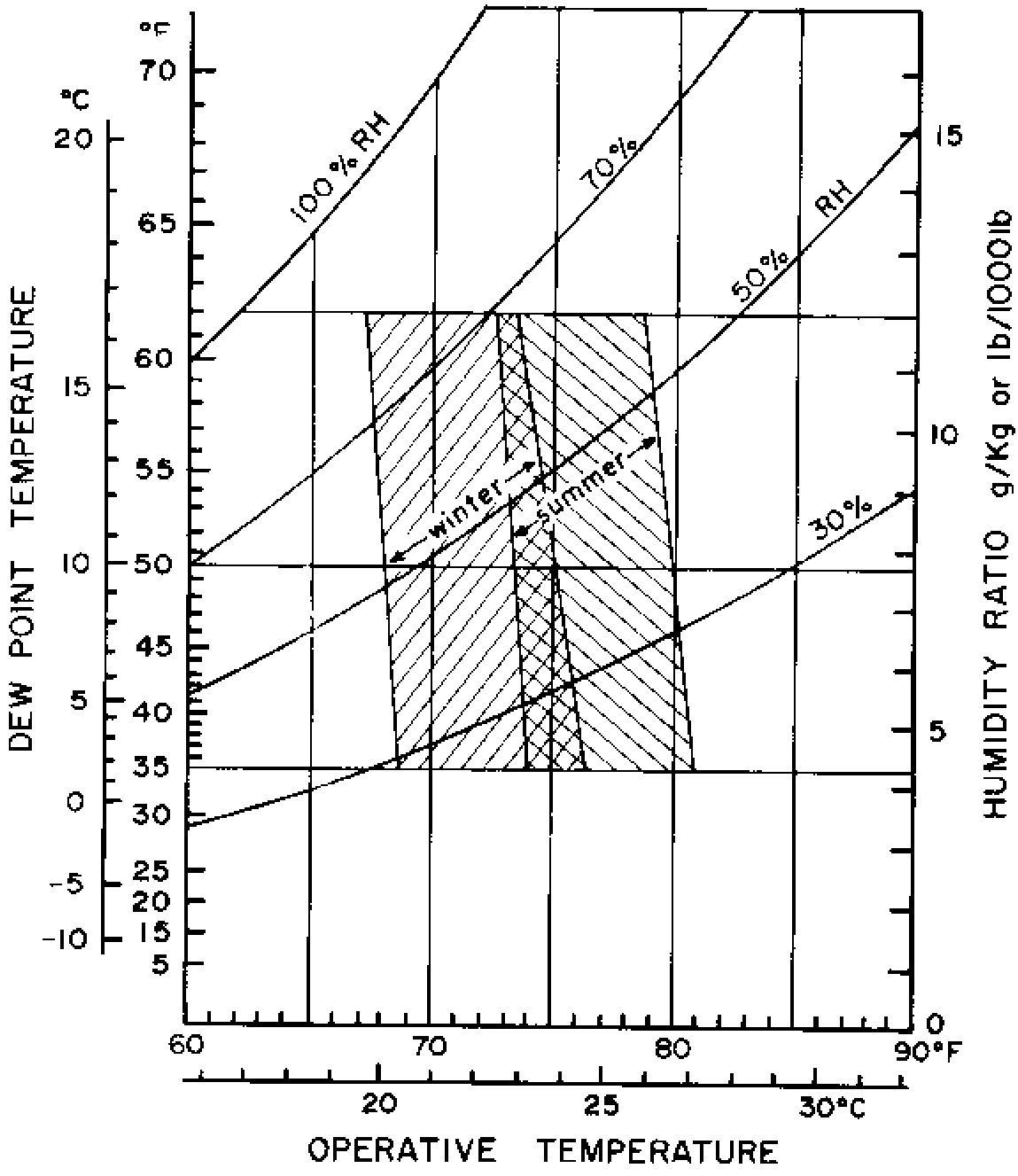
Location	Time	Temp (°F)	CO_2 (ppm)	RH (%)	No. of Occupants
1300 F *	0900 1435	77 81	500 425	17 13	1 1
1299 *	0905 1438	78 80	525 450	17 14	1 2
1286 *	0910 1440	77 78	500 425	18 13	2 2
1296 *	0912 1445	77 77	625 450	20 15	2 1
TRAY ASSEMBLY	0915 1505	76 79	525 475	23 17	2 1
HOT FOOD PREP AREA	0917 1508	77 79	550 1508	23 **	2 0
CLEAN DISH RECEIVING	0930 1455	82 96	525 425	26 17	2 1
DISHWASHER LOAD AREA	0935 1511	77 79	500 475	22 **	5 4
OUTSIDE	0938 1515	77 78	450 425	19 **	0 0

* The numbered locations refer to laboratory rooms.

** The values were not recorded.

Veterans Administration Medical Center
Los Angeles, California
HETA 91-395

Figure 1. Thermal-comfort criteria, from ASHRAE Standard 55–1981.



Acceptable ranges for persons, at light activity levels, wearing typic
summer and winter clothing.

Appendix I
Adjusted Values of Recommended Operative Temperatures

Veterans Administration Medical Center
Los Angeles, California
HETA 91-395

To adjust the recommended temperature range for activity levels other sedentary, ASHRAE[4] provides the following equation:

$$t_{o(active)} = t_{o(sedentary)} - 5.4\ (1 + clo)(met - 1.2)$$

$t_{o(active)}$ are the acceptable operative temperatures (^oF) at the activity in question.

$t_{o(sedentary)}$ are the acceptable operative temperatures (^oF) at a sedentary of activity.

clo are the units for estimating insulation from clothing. A clo valu was chosen which corresponds to light slacks and a short sleeve shirt. is the clo value used by ASHRAE for summer months.

met are the units of metabolic rates. A met value of 2.0 was chosen f kitchen employees. This corresponds to a medium level of activity.[4]

Using the above assigned values, the calculated value of $t_{o(active)}$ in ^oF

$$t_{o(active)} = t_{o(sedentary)} - 6\ ^oF.$$

Adjusting the recommended operative temperature range of 74-80^{o}F for a level of activity provides a recommended range of 68-74^{o}F (74-6^{o}F to 8(

Appendix II
Synopsis of OSHA Medical Surveillance
Recommendations for Formaldehyde Exposures

Veterans Administration Medical Center
Los Angeles, California
HETA 91-395

1. The employer shall institute medical surveillance for all employees exposed to formaldehyde concentrations at or exceeding the short te exposure limit (STEL).

2. All medical procedures, including medical questionnaires, shall be performed under the supervision of a licensed physician, without co the employee.

3. The employer shall make medical surveillance available to employees to assignment to a job where formaldehyde exposure is at or above t action level or above the STEL, and annually thereafter. The emplo shall also make medical surveillance available to employees experie signs and symptoms indicative of possible overexposure to formaldeh Medical surveillance will consist of; a) medical disease questionna concerning symptoms associated with formaldehyde exposure (i.e., ey nose, or throat irritation; chronic airway problems or hyperactive disease; allergic skin conditions or dermatitis; and upper and lowe respiratory problems); and b) physical examinations with emphasis o evidence of irritation or sensitization of the skin and respiratory system, shortness of breath, or irritation of the eyes.

4. Medical examinations shall be given to any employee who may be at increased risk to formaldehyde exposure at the time of initial assi and at least annually thereafter to all employees required to wear respirator for formaldehyde exposure.

5. The employer shall make prompt medical examinations available to al employees exposed to formaldehyde in an emergency.

6. The employer shall make information concerning this standard, medic examinations, and environmental testing available to the examining physician.[2]