HETA 88-153-2072
OCTOBER 1990
BUCKEYE HILLS CAREER CENTER
RIO GRANDE, OHIO

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I. SUMMARY

On February 9, 1988, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request from employees to conduct a Health Hazard Evaluation (HHE) at the Buckeye Hills Career Center, Rio Grande, Ohio. The requestors stated that the Cosmetology Instructors were experiencing dizziness, migraine headaches, nausea, blocked sinus passages, skin irritations, eye and nasal irritations, and other problems which were believed to be associated with exposures to hair care and cosmetology products used in the Cosmetology Clinic. On April 15, 1988, the Superintendent of the Buckeye Hills Career Center also requested NIOSH assistance in evaluating potential health hazards at this site.

On May 10-11, 1988, an initial environmental survey of the Vocational Building, Cosmetology Clinic, was conducted. An opening conference with representatives of the school administration was held, a walk-through of the Cosmetology Clinic was conducted, employees were interviewed, and environmental sampling was conducted. Environmental sampling included; heating, ventilation and air-conditioning (HVAC) system measurements, temperature and humidity measurements, and personal and general-area air sampling for formaldehyde, carbon dioxide (CO_2), and qualitative samples to allow screening for organic chemicals compounds. On October 14, 1988, and March 27-29, 1989, follow-up environmental surveys were conducted to evaluate the use of paraformaldehyde cabinet fumigants used in the Cosmetology Clinic and to sample for acrylic resins during application of sculptured nails.

Two brands of paraformaldehyde cabinet fumigants, containing 93% and 69% paraformaldehdye, were evaluated during these surveys. Full-shift general-area air samples collected when using 93% paraformaldehyde tablets showed airborne time-weighted average (TWA) concentrations of formaldehyde in the Cosmetology Clinic ranging from 0.014 parts of formaldehyde per million parts of air (ppm) to 0.038 ppm, and a concentration of 0.89 ppm inside the towel cabinet. General-area air samples collected when using 69% paraformaldehyde tablets showed airborne TWA concentrations of formaldehyde in the Cosmetology Clinic ranging from 0.011 ppm to 0.015 ppm and concentrations of 1.7 and 2.1 ppm inside the towel cabinets. More importantly, short-term (15-minute) sampling inside a student cosmetic kit showed a concentration of 15.2 ppm. Sampling for acrylic resins during application of sculptured nails showed levels of ethyl methacrylate and isobutyl methacrylate below 1 ppm. Currently there is no standard for exposure to either of these compounds.

Ventilation measurements collected during the May 1988 survey indicated that the Cosmetology Clinic was receiving only between 15 to 17 cubic feet per minute per person (CFM/person) of outside air. The American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) recommends 25 cfm/person of outside air for Beauty Shops. Additionally, CO_2 measurements ranged from 500 ppm to over 1000 ppm and temperature and humidity measurements were at or slightly above the upper level of the ASHRAE comfort zone.

On the basis of the data obtained during this investigation, it has been determined that the use of paraformaldehyde cabinet fumigants contributed to the overall airborne formaldehyde concentrations within this school. More importantly, source samples collected within towel cabinets, equipment drawers, and student cosmetic kits, showed airborne formaldehyde concentrations many times the short-term exposure limits, indicating a potential for personal exposures to formaldehyde in excess of the environmental criteria. Additionally, HVAC and CO_2 measurements showed that inadequate amounts of fresh outside air were being supplied to the Cosmetology Clinic.

KEYWORDS: SIC 8249 (Vocational School, Not Elsewhere Classified), formaldehyde, paraformaldehyde, fumigants, beauty schools, cosmetology, cosmetologists, hairdressers.

II. INTRODUCTION

On February 9, 1988, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request from employees to conduct a Health Hazard Evaluation (HHE) at the Buckeye Hills Career Center, Rio Grande, Ohio. The requestor stated that the Cosmetology Instructors were experiencing dizziness, migraine headaches, nausea, blocked sinus passages, skin irritations, eye and nasal irritations, and other problems which were believed to be associated with exposures to products used in the Cosmetology Clinic. The requestor also stated that some cosmetology students and personnel from adjoining classrooms were occasionally experiencing the same problems. On April 15, 1988, the Superintendent of the Buckeye Hills Career Center also requested NIOSH assistance in evaluating potential health hazards at this site.

On May 10 and 11, 1988, an initial environmental survey of the Vocational Building, Cosmetology Clinic, was conducted. An opening conference with representatives of the school administration was held, a walk-through of the Cosmetology Clinic was conducted, employees were interviewed, and ventilation measurements and industrial hygiene samples were collected. In June 1988, all parties involved were informed of our activities via written correspondence and environmental sampling results were transmitted via written correspondence in October 1988.

On October 14, 1988, a follow-up environmental survey was conducted to evaluate the use of a second type of paraformaldehyde cabinet fumigant within the Cosmetology Clinic. On March 27-29, 1989, further environmental sampling was conducted to reevaluate exposures to airborne formaldehdye released from the paraformaldehyde cabinet fumigants, and to identify other airborne organic chemicals present in the Cosmetology Clinic. Sampling for acrylic resins was also conducted during a short nail sculpturing demonstration. The results of this survey were transmitted via written correspondence to all parties involved in October 1989.

III. PROCESS DESCRIPTION

The Buckeye Hills Career Center is a four building campus, opened at the beginning of the 1974-75 school year. The vocational school district serves all school districts within Gallia, Jackson, and Vinton counties. The building housing the Cosmetology Clinic and Classroom is served by 15 separate heating, ventilation, and air-conditioning (HVAC) systems. The Cosmetology Clinic which is located in the northeast corner of the building, includes a reception area, the Cosmetology Instructor's office, the girls locker room/restroom, the clinic area, a facial room and laundry area, the boys restroom/janitors closet, and the dispensary room. These areas are all served by a single dedicated HVAC system while the Cosmetology Classroom is served by a separate HVAC system. The HVAC systems are reportedly inspected monthly by a Honeywell representative and are designed to supply up to 25% fresh air and 75% recirculated air. During cold weather, the system supplies less fresh air.

Prior to December 1989, the Ohio State Board of Cosmetology, Sanitary Rules, required that "Every beauty salon shall be equipped with at least one wet sanitizer and at least one cabinet sanitizer which must contain an effective fumigant. Sanitized instruments, combs and appropriate items must be stored in a closed cabinet containing an effective fumigant." The stated purpose of this regulation was to prevent the growth of microorganisms and to insure the sterility of stored towels and equipment. To comply with this regulation paraformaldehyde cabinet fumigants were placed in all cabinets and drawers where towels or cosmetic equipment was stored.

IV. MATERIALS AND METHODS

On May 10, 1988, a walk-through survey of the Cosmetology Clinic was conducted and the HVAC system examined and, on May 11, industrial hygiene sampling was conducted. Industrial hygiene sampling included general-area air sampling for formaldehyde and carbon dioxide (CO_2), and high-volume general-area air samples for qualitative analysis of organic chemical compounds were collected.

Formaldehyde samples were collected using impingers (containing an aqueous 1% sodium bisulfite solution) connected via Tygon tubing to battery-powered sampling pumps calibrated to provide a volumetric airflow rate of 1 liter per minute (LPM). Sodium bisulfite solutions were analyzed for formaldehyde by reaction with chromotropic acid and subsequent visible absorption spectrophotometry in accordance with NIOSH Method No. 3500.[1]

Ventilation measurements were collected using an Alnor Balometer (Model No. 6465). The Balometer is used to measure air distribution in HVAC systems. The Balometer directly reads the average air flow rate of either intake or outflow, at ceiling, wall or floor diffusers and provides measurement readings in cubic feet per minute (CFM). Smoke tubes were also used to observe air movement patterns.

Samples for CO_2 were obtained using a Gastech direct reading Portable CO_2 Monitor (Model RI411). Indoor CO_2 concentrations were obtained in Room 207 (Cosmetology Reception), the Cosmetology Instructor's office, Room 205 (Cosmetology Clinic), the Cosmetology Facial Room, the Cosmetology Dispensary, Room 203 (Cosmetology Classroom), and from a classroom across the hallway. For comparison, an ambient CO_2 sample was collected outside the building.

Temperature and humidity readings were collected throughout the Cosmetology Clinic area and the adjoining Cosmetology Classroom using a Vista Scientific Corporation psychrometer (Model #784).

On October 14, 1988, further sampling for formaldehyde was conducted to evaluate exposures to a substitute paraformaldehyde cabinet fumigant used in the Cosmetology Clinic. The school had changed to another paraformaldehyde product and requested that sampling be conducted to evaluate formaldehyde release from this product.

For this survey, a different formaldehyde sampling method was used. Formaldehyde samples were collected using solid-sorbent-containing tubes (XAD-2 resin, impregnated with N-benzylethanolamine reagent) connected via Tygon tubing to battery-powered sampling pumps calibrated at 0.08 LPM. Formaldehyde gas reacts with the reagent, and the sampling media were analyzed for the resulting oxazolidine derivative via gas chromatography in accordance with NIOSH Method No. 2502.[1] This method has since been replaced by NIOSH Method No. 2541.[1]

On March 27-29, 1989, sampling was conducted to reevaluate exposures to airborne formaldehdye released from the paraformaldehyde cabinet fumigants, and to identify other airborne organic chemicals present in the Cosmetology Clinic. Groups of sample pumps and appropriate collection media were placed within the Cosmetology Clinic, Classroom and various other locations within the building. Each group of samples collected contained environmental sampling media for formaldehyde, qualitative screening for organic chemical compounds, and a sample to quantitate concentrations of those organic chemicals identified in the qualitative screen. Sampling for acrylic resins was also conducted during a short nail sculpturing demonstration.

Formaldehyde samples were collected in accordance with NIOSH Method No. 3500.[1] During our three surveys, two different sampling methods were used for collecting airborne formaldehyde. In May 1988, samples were collected using the NIOSH Method No. 3500, and in October 1988, NIOSH Method No. 2502 was used to collect airborne formaldehyde samples. Because Method No. 2502 is not as sensitive as Method No. 3500, we returned to using NIOSH Method No. 3500 to collect airborne formaldehyde samples during the March 1989 survey. Additionally, a CEA Instruments, Inc., TGM 555 continuous gas monitor was used to characterize short-term exposures to formaldehyde. This instrument utilizes a modified-pararosaniline-reagent method and spectrophotometric detection to continuously monitor and record the airborne formaldehyde concentrations.

Qualitative and quantitative samples for organic vapors were collected side by side on charcoal tubes connected via Tygon tubing to battery-operated pumps operating at flow rates of 1.0 LPM and 0.1 LPM, respectively. These samples were analyzed for organic vapors via gas chromatography/mass spectrometry (GC/MS). Qualitative samples were screened for organic chemical compounds. Quantitative samples were then analyzed for those organic chemical compounds identified by the qualitative samples.

Acrylic resin samples were collected on solid-sorbent-containing tubes impregnated with XAD-2 resin to trap organic vapors present. These solid-sorbent-containing tubes were connected via Tygon tubing to battery-powered sampling pumps calibrated to provide volumetric airflow rates of 0.05 LPM, 0.2 LPM and 1 LPM and analyzed via GC/MS.

V. EVALUATION CRITERIA

A. Environmental Evaluation Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Recommended Exposure Limits (RELs),[2] 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),[3] and 3) the U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) occupational health standards.[4] Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA standards. Both NIOSH RELs and ACGIH TLVs usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH RELs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 (29 USC 651, et seq.) to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8 to 10-hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high, short-term exposures.

B. Formaldehyde

Formaldehyde is a colorless gas with a strong, pungent odor detectable at low concentrations. It is commonly utilized as formalin, an aqueous solution containing 37-50% formaldehyde by weight.[5] It is widely used in the production of resins, in the manufacture of many other compounds, as a preservative, as a sterilizing agent, and as an embalming fluid.[6]

Exposure to formaldehyde can occur through inhalation or skin absorption.[7] The primary non-carcinogenic effects associated with formaldehyde exposure are irritation of the mucous membranes of the eyes and respiratory tract, and allergic sensitization of the skin. The first signs or symptoms noticed on exposure to formaldehyde, at concentrations ranging from 0.1 to 5 ppm, are burning of the eyes, tearing, and general irritation of the upper respiratory passages. There does, however, appear to be a great deal of variation among individuals, both in terms of their susceptibility and tolerance.

Dermatitis due to skin contact with formaldehyde solutions and formaldehyde-containing resins is a well-recognized problem. Both primary skin irritation and allergic dermatitis have been reported.[5] Dermatitis may appear a few days following the commencement of work or may not appear for a number of years following exposure.[7]

In two separate studies, formaldehyde has induced a rare form of nasal cancer in rodents following repeated inhalation exposure.[8,9] Concern over the possible human carcinogenicity of formaldehyde has prompted several epidemiologic studies of workers exposed to formaldehyde. An association between formaldehyde exposure and cancer of the upper respiratory passages in humans has recently been reported.[10] In this proportionate mortality study of workers exposed to formaldehyde in the garment industry, a statistically significant excess in mortality from cancers of the buccal cavity and connective tissue were found. No cases of nasal cancer were observed, however. In a reanalysis of a National Cancer Institute study, "a statistically nonsignificant but suggestive increase for age-adjusted relative risk for buccal and pharyngeal cancer among employees with greater than 0.5 ppm average exposure in plants manufacturing formaldehyde resins" was found.[11]

In 1984, Ulsamer et al. reviewed 4 animal inhalation studies. No teratogenic effects were reported in these studies.[12] No birth defects were reported in a study which involved the application of formalin to the backs of pregnant hampsters.[13] No data were found linking formaldehyde with teratogenic effects in humans. There was one report in which an increased incidence of menstrual disorders, and of complications of pregnancy and delivery, were reported among women workers exposed to formaldehyde at a textile factory in the USSR.[14] The relevance of these findings has been criticized, however, due to a lack of information regarding the suitability of the control group and potential confounding factors.[15]

In April 1981, NIOSH issued Current Intelligence Bulletin 34, "Formaldehyde: - Evidence of Carcinogenicity", DHHS (NIOSH) Publication No. 81-111.[16] In this bulletin, NIOSH recommends that formaldehyde be handled as a potential occupational carcinogen and that appropriate controls be used to reduce worker exposure to the lowest feasible level. This recommendation was based primarily on a study in which nasal cancers developed in rats and mice following repeated inhalation exposures of approximately 15 ppm formaldehyde. In December, 1987, OSHA published an amended formaldehyde standard, 29 CFR 1910.1048. This standard reduced the PEL from 3 ppm to 1 ppm, as an 8-hour TWA.[17] In addition, a 15-minute short term exposure limit (STEL) was set at 2 ppm. ACGIH has given formaldehyde an A2 designation, indicating that ACGIH considers formaldehyde a suspected human carcinogen. The ACGIH TLV for formaldehyde is 1 ppm as an 8-hour TWA and 2 ppm as a 15-minute STEL.[3] ACGIH has recently proposed a ceiling limit of 0.3 ppm formaldehyde in their notice of intended changes for 1989-1990.[3] This value will be reconsidered for the adopted TLV list after 2 years.

C. Heating Ventilating and Air-Conditioning Systems

The outside air ventilation criteria recommended by NIOSH are those published by the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) in the ASHRAE Standard on Ventilation for Acceptable Indoor Air Quality (ASHRAE 62-1989).[18] Table 2 of that document specifies outdoor (fresh) air requirements for ventilation in commercial facilities. ASHRAE recommends a fresh air ventilation rate of 25 CFM/person for Beauty Shops.

D. Temperature and Relative Humidity

The majority of references addressing temperature and humidity levels as they pertain to human health frequently appear in the context of assessing conditions in hot industrial environments. However, ASHRAE has published guidelines describing thermal environmental conditions, (ASHRAE Standard 55-1981, Thermal Environmental Conditions for Human Occupancy).[19] These guidelines are intended to achieve thermal conditions in a given environment, that at least 80% of the persons who occupy that environment will find it acceptable or "comfortable." Development of a "comfort" chart by ASHRAE presents a comfort zone considered to be both comfortable and healthful. This zone lies between 73° and 77° F (23° and 25° C) and 20% to 60% relative humidity.

E. Carbon Dioxide

Carbon dioxide (CO_2) is a normal constituent of exhaled breath and, if monitored, can be used as a screening technique to evaluate if adequate quantities of fresh air are being introduced into a building. For example the outdoor, ambient concentrations of CO_2 is usually 250-300 ppm. If the indoor CO_2 concentration was determined to be 1000 ppm, or 3-4 times the outdoor level, inadequate ventilation would be suspected. Carbon dioxide concentrations are generally higher inside than outside, even in a well ventilated building. It is not uncommon to find the inside levels twice the outside levels in a building with no reported health complaints. The CO_2 concentration itself is not responsible for the complaints. However, a high concentration of CO_2 may indicate that other contaminants in the building may also be increased. When the inside CO_2 concentrations are 3 or more times the outside CO_2 concentrations, complaints of headache, eye irritation, and fatigue can be expected. If CO_2 concentrations are maintained below 600 ppm, with comfortable temperature and humidity levels, complaints about air quality should be minimal unless there is a specific contaminant source that requires additional control such as, certain cosmetology products (e.g. permanent wave solutions, hair sprays).[20]

VI. RESULTS

A. Formaldehyde

Results of samples collected for formaldehyde are presented in Table I. This table includes the results of all formaldehyde samples collected during all three surveys.

In May 1988, the cabinet fumigant being used was Formal Tabs*. The results of this survey showed that airborne concentrations of formaldehyde in the Cosmetology Clinic ranged from a low of 0.014 ppm to a high of 0.038 ppm. One sample collected inside a towel cabinet showed a relatively high formaldehyde concentration of 0.89 ppm.

In October 1988, the cabinet fumigant being used was Steri-Dry*. The results of this survey showed the two field blanks and three of the five samples collected for formaldehyde contained trace quantities of formaldehyde. Because the two field blanks contained quantities of formaldehyde at or above the analytical limit of detection (LOD) and in the same range as the three samples containing trace quantities, these samples are not considered to be reliable estimations of airborne formaldehyde. More importantly, the analytical method used is not as sensitive as the method used previously and is not capable of quantitating formaldehyde concentrations below 0.04 ppm.

In March 1989, Steri-Dry* was again the cabinet fumigant being used. Formaldehyde samples collected during this survey showed general-area airborne concentrations of formaldehyde ranging from 0.011 ppm to 0.015 ppm; however, source samples collected inside the towel cabinets showed airborne concentrations of 2.1 ppm and 1.7 ppm on March 28 and 29, 1989, respectively. The highest airborne concentration of formaldehyde found was on a source sample collected inside a student cosmetic kit. This sample showed a concentration of 15.2 ppm over a 15-minute sample period.

The results of air monitoring for formaldehyde conducted using the TGM 555 are not reported due to operational problems experienced with the instrument. This instrument developed an apparent "memory effect" after sampling air containing high formaldehyde concentrations (e.g. inside towel cabinets and cosmetic kits). Based on earlier measurements it was determined that after such excursions of concentration, the indicated concentration did not return to levels consistent with those expected in the areas being monitored. Subsequent attempts to "re-zero" the instrument by the introduction of formaldehyde-free "zero air" (same procedure used when calibrating the instrument to set the "zero", or baseline level) did not result in an indicated level of zero as should have occurred. The problem was isolated to the wet-chemistry portion of the instrument, rather than the electronics. Peak concentrations above 15 ppm of formaldehyde exceeded the operational limits of the instrument by saturating the working components of the instrument. Thorough cleaning of the wet-chemistry portion temporarily restored seemingly normal operation with little need to adjust the electronic "zero" or span controls. Attempts to further characterize and correct the problem were unsuccessful.

B. Qualitative and Quantitative Sample Results

During the initial survey (May 1988) general-area air samples collected for qualitative analysis of organic chemicals identified isopropanol, ethanol, toluene, n-butyl acetate, and xylenes as the major compounds present. Other compounds detected include ethyl acetate, 1,1,1-trichloroethane, limonene, a dichlorobenzene isomer, C_9H_{12}, aromatics, trichloroethylene, decamethylcyclopentasiloxane, and butanes.

During the survey of March 1989, general-area air samples for qualitative analysis of organic chemicals identified isopropanol as the major component on all samples. Other components detected included ethanol, trichloroethylene, ethyl methacrylate, isobutyl methacrylate, siloxane compounds, toluene, 1,1,1-trichloroethane, butanes, and camphor.

Based on the results of the qualitative screenings for organic chemical compounds, quantitative samples were analyzed for isopropanol, trichloroethylene, and camphor. The results of these samples showed only

trace quantities of isopropanol (less than 1% of the OSHA PEL) and no detectable quantities of either trichloroethylene or camphor.

C. Methacrylate Sample Results

Three of four samples for acrylic ester monomers during a short nail sculpturing demonstration showed airborne concentrations of ethyl methacrylate and isobutyl methacrylate; both analytes were present at concentrations below 1 ppm. However, it should be emphasized that samples were collected during a very short demonstration of how to apply sculptured nails. Currently, there is no standard for exposure to either of these chemical compounds.

D. Carbon dioxide, temperature and humidity.

Carbon dioxide sampling results for the May 1988 survey, are presented in Table II along with the temperature and relative humidity readings. These results show that outdoor CO_2 concentrations were 300 ppm and that indoor concentrations ranged from 500 ppm to over 1000 ppm. Indoor CO_2 concentrations approaching and exceeding 1000 ppm indicate that either inadequate amounts of fresh air are being delivered to the affected areas or poor air distribution. Readings of 1000 or more were obtained in the Cosmetology Instructors office and in the Cosmetology Clinic area.

Temperature readings collected in May 1988 ranged from 72° to 77°F and relative humidity readings ranged from 57% to 66%. Temperature readings were within the ASHRAE comfort zone and relative humidity readings were at or slightly above the upper level of the ASHRAE comfort zone.

Temperature readings collected in March 1989, ranged from 68° to 74°F and relative humidity readings ranged from 52% to 61%. The temperature readings were on the lower end of, and in some cases below, the comfort zone.

E. Ventilation Measurements

Ventilation measurements collected in May 1988 are presented in Table III. These measurements indicate that the Cosmetology Clinic area (room 205) and the Cosmetology Classroom (room 203) were not receiving the recommended amount of outside air. The Cosmetology Clinic was receiving between 15 and 17 CFM/person and the Cosmetology Classroom was receiving between 15 and 25 CFM/person of fresh outside air. The ASHRAE guideline for Beauty Shops recommends 25 CFM/person of fresh outside air.

VII. DISCUSSION

The main focus of this investigation was the use of paraformaldehyde cabinet fumigants. However, cosmetologists are potentially exposed to a multitude of chemical compounds in their daily work. The many different chemical compounds found within beauty products are capable of causing dermatitis, irritation, sensitization, and other symptoms through inhalation and dermal absorption.

At the time of these surveys the Ohio State Board of Cosmetology required the use of an "effective" fumigant (such as formaldehyde) inside towel cabinets and equipment drawers. However, considering the scientific information available indicating the potential of formaldehyde to induce cancer in laboratory animals, the NIOSH investigators recommended that the Board (letter of January 10, 1989) review its regulations to determine if the use of formaldehyde cabinet fumigants was necessary. Since that time the Board has issued new regulations regarding the use of formaldehyde cabinet fumigants. The new rules do not ban the use formaldehyde cabinet fumigants but, leaves the decision for using these products up to the facility management.

During the three surveys, two types of cabinet fumigants were used at this school, Formal Tabs* and Steri-Dry*. Both products contain a high percentage of paraformaldehyde which results in the off-gassing of formaldehyde vapors. These products were used as cabinet fumigants in towel cabinets, equipment drawers and in student cosmetic kits, as required by the State of Ohio, Board of Cosmetology.

VIII. CONCLUSIONS

The use of paraformaldehyde cabinet fumigants is one source of airborne formaldehyde and contributes to airborne formaldehyde concentrations within the Cosmetology Clinic. Sample results showed that the use of Formal Tabs* and Steri-Dry* resulted in high concentrations of formaldehyde inside towel cabinets and inside student cosmetic kits. Substantially lower concentrations were detected in the occupied work areas of the clinic. The relatively high concentrations detected inside the towel cabinets and student cosmetic kits indicate a potential for short-term exposures above background concentrations when opening the cabinets or kits.

Although sample results show high airborne concentrations of formaldehyde within towel cabinets and student cosmetic kits it should be understood that the samples collected were source samples and not personal-breathing-zone air samples. While no one is actually exposed to the concentrations of formaldehyde within the enclosed spaces (e.g. towel cabinets and equipment drawers), the measured concentrations indicate the potential for brief exposures (when opening enclosed cabinets and drawers) to concentrations substantially greater than the average levels measured in the rooms. It is clearly the intent of these products to release formaldehyde vapors which will contribute to the airborne formaldehyde concentrations. Additionally, formaldehyde has irritant properties and short-term peak exposures at the concentrations identified could possibly result in mild discomfort, eye and throat irritation.

It should be further noted and understood that paraformaldehyde cabinet fumigants are not the only source of formaldehyde within beauty salons. Any products or fixtures containing formaldehyde can contribute to airborne formaldehyde concentrations within the work environment. Therefore, the use of all products containing formaldehyde or any confirmed or suspected carcinogen should be discontinued where possible. In instances where this is not feasible, personnel should be protected by the use of engineering controls (i.e. ventilated cabinets). Towel cabinets and equipment drawers could be equipped with a local exhaust ventilation system which is actuated when the cabinet or drawer is opened. The system could be designed to remove the air in the space, thereby removing formaldehyde vapors before they can escape to the general workroom air.

IX. RECOMMENDATIONS

1. Because of the potential toxicity of certain chemicals contained in beauty products, an inventory of all products used should be conducted and Material Safety Data Sheets (MSDSs) for each product should be obtained and reviewed.

2. The use of all products containing formaldehyde and/or any suspect or confirmed carcinogen should be evaluated to determine the need for the product. If the use of the product is not necessarily justified, the use of the product should be eliminated.

3. If elimination is not a feasible alternative then an appropriate substitute of lessor toxicity should be used in each case.

4. If product elimination is not feasible and an appropriate substitute is not available then exposures should be controlled through the use of local exhaust ventilation.

5. All HVAC systems including the unit suppling the Cosmetology Clinic should be checked regularly to determine if they are operating properly and supplying the required amount of air to the areas they serve. ASHRAE recommends a fresh air ventilation rate of 25 CFM/person for Beauty Shops.

X. REFERENCES

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XII. DISTRIBUTION AND AVAILABILITY OF REPORT

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

1. John Schump, Principal Buckeye Hills Career Center
2. Confidential Requestor
3. OSHA Region V

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

Table I
General-area air samples for airborne concentrations of formaldehyde

Buckeye Hills Career Center
Rio Grande, Ohio
HETA 88-153

Room No./Location	Sample Time (minutes)	Sample Volume (liters)	Formaldehyde (ppm)
	May 11, 1988[a]		
205/On top of towel cabinet	377	377	0.030
205/Middle of clinic @ hair station	375	375	0.024
203/Middle of classroom	373	373	0.014
205/Instructors office on desk top	372	372	0.026
205/Clinic dispensary	364	364	0.038
205/Inside towel cabinet	350	350	0.89
	October 14, 1988[b]		
205/Clinic - back center	357	29.4	<LOQ
205/Clinic - front center	358	28	<LOD
203/Classroom - center	358	27.1	<LOD
Outside on Amphitheater Stage	272	21.5	<LOQ
Personal - in clinic	9	0.74	<LOQ
	March 28, 1989[b]		
205/Inside towel cabinet	353	353	2.1
205/Clinic - center station	352	352	0.013
203/Classroom - instructor's desk	352	352	0.011
At Main Office/Student services	347	347	0.011
Outside on Amphitheater Stage	343	343	<LOQ
	March 29, 1989[b]		
205/Inside towel cabinet	368	368	1.7
205/Clinic - center station	365	365	0.015
203/Classroom - instructor's desk	368	368	0.015
Corridor - outside Main Office	349	349	0.012
Inside Student Kit	15	15	15.2

ENVIRONMENTAL CRITERIA	
NIOSH REL	LFL
ACGIH TLV*	1.0
ACGIH STEL	2.0
OSHA PEL	1.0
OSHA STEL	2.0

Abbreviations:
ppm - parts of formaldehyde per million parts of air.
LFL - lowest feasible level
<LOQ - less than analytical limit of quantitation
<LOQ - less than analytical limit of detection

a - Formal Tabs* used as cabinet fumigant on this day.
b - Steri-dry* used as cabinet fumigant on this day.
* - ACGIH has proposed a ceiling limit of 0.3 ppm for formaldehyde.

Table II
Indoor Air Measurements

Buckeye Hills Career Center
Rio Grande, Ohio
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May 11, 1988

Room No./Area	Time	Carbon dioxide (ppm)	Temperature (°F)	Relative Humidity (%)
207/reception desk	9:15a	800	73	54
	10:45a	900	73	52
	1:15p	800	72	52
205/Instructors Office	9:15a	600	73	61
	10:45a	1050	74	52
	1:15p	900	72	52
205/clinic (front)	9:15a	800	73	54
	10:45a	900	72	54
	1:15p	800	72	54
(back)	10:45a	1000	73	52
(center)	1:15p	950	--	--
205/Facial room	9:15a	500	68	56
	10:45a	600	68	59
205/Dispensary	9:15a	600	70	56
	10:45a	800	68	60
	1:15p	700	70	54
203/Cosmetology Classroom	9:15a	600	71	55
	10:45a	600	68	59
	1:15p	600	69	56
202/across hallway	10:45a	800	69	56
Outside air	9:15a	300	63	70
	10:45a	300	60	73
	1:15p	300	66	54

Abbreviations:
ppm - parts of carbon dioxide per million parts of air.

Table III
Ventilation Measurements

Buckeye Hills Career Center
Rio Grande, Ohio
HETA 88-151

May 11, 1988

Room No./Area	No. of people	Measured supply Air Flow, CFM	CFM/Person 25% OA
207/Reception	1-3	445	111 (N=1) 37 (N=3)
205/Girls locker room	2-10	355	44 (N=2) 9 (N=10)
205/Clinic area	35-40	2400	17 (N=35) 15 (N=40)
205/Facial room	2-6	500	63 (N=2) 21 (N=6)
205/Boys room	1-2	290	73 (N=1) 36 (N=2)
205/Dispensary	2-3	340	43 (N=2) 28 (N=3)
203/Cosmetology Classroom	10-20	1210	25 (N=12) 15 (N=20)

Current ASHRAE Guidelines: smoking = 35 CFM
non-smoking = 20 CFM

Proposed ASHRAE Guideline: 25 CFM

Note: the proposed ASHRAE Guideline does not differentiate between smoking and non-smoking areas.

Abbreviations: CFM - cubic feet per minute
OA - outside air
N = number of people occupying the space