HETA 97–0153–2694
The Grand Experience Salon
Chicago, Illinois

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PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Daniel Almaguer, MS, RS, and Robert Malkin, DDS, DrPH, of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Ana Navarrete–Contreras, MD. Analytical support was provided by Data Chem Laboratories and Leroy May, Measurements Research Support Branch, Division of Physical Sciences and Engineering. Desktop publishing was performed by Nichole Herbert. Review and preparation for printing was performed by Penny Arthur.

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Health Hazard Evaluation Report 97–0153–2694
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Chicago, Illinois
June 1998

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SUMMARY

On March 28, 1997, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request to evaluate employee exposures at The Grand Experience Salon, Chicago, Illinois. The requestors expressed concern that certain health effects (i.e., allergic reactions, asthma, cancer) experienced by employees of the salon may be associated with inadequate ventilation and exposures to chemical ingredients of products used in the salon.

On June 11–13, 1997, NIOSH investigators conducted a site visit and collected general area air samples for total and respirable particulate during the application of artificial nails; measured temperature, relative humidity (RH), and carbon dioxide (CO_2) concentrations at various locations within the salon; traced the ventilation system ducting to determine the source of outside air; and conducted employee interviews. Verbal recommendations were provided to the salon management at the closing conference on June 13, 1997.

Visual inspection of the ventilation system and duct work revealed that there was no provision for the introduction of outside air to the salon. Consequently, the lack of adequate ventilation caused the CO_2 concentrations to rapidly rise after the salon was opened for the day, and it is expected that concentrations of other substances present (e.g. cigarette smoke, allergens, chemical substances used in the salon) would also increase. All indoor CO_2 readings, with the exception of the morning readings, exceeded the NIOSH guideline of 800 parts per million parts of air (ppm). Many temperature readings exceeded the range recommended by the American Society of Heating, Refrigerating, and Air–Conditioning Engineers (ASHRAE) for indoor summer comfort, 73°F to 79°F. All relative humidity readings were within the range (30% to 60%) recommended by ASHRAE, although the majority of readings were at the upper extreme of the range.

During the application of artificial nails, total and respirable particulate concentrations were below the analytical limit of detection, and the samples did not contain either quartz or cristobalite. Analysis of the acrylic polymer powder used during the application of artificial nails did not reveal detectable quantities of quartz or cristobalite.

The salon did not have material safety data sheets (MSDSs) for products used in the salon, nor did they keep an OSHA Log and Summary of Occupational Injuries and Illnesses (OSHA Form 200). The latex gloves issued to employees for use when mixing bleaches, permanent wave solutions, and other chemicals, are not appropriate protection against the potential skin hazards involved.

NIOSH investigators were unable to determine the nature and extent of employees' past exposures to hair dyes, due to a number of unknown variables including changes in dye formulations. Thirty (3 males and 27 females) of the 54 employees were interviewed regarding symptoms occurring at work. Nine reported a history of health problems they thought might be related to their job. Three reported possible allergic reactions (involving cough and nasal congestion) to some of the hair sprays used at the salon. In the last year, two workers reported having had skin or eye irritation, two reported carpal tunnel syndrome, and two reported either headaches or sneezing associated with pedicures. Two reported upper respiratory tract irritation at work, but they reported having had those problems before working in this salon.

There was no provision for the introduction of outside air to the salon, resulting in CO_2 levels exceeding 800 ppm. Additionally, there were some potential chemical exposures and a number of occupational safety and health administrative deficiencies. Although few symptoms were reported by most employees, some symptoms reported by employees are plausibly related to inadequate ventilation which resulted in increased CO_2 concentrations and possibly other substances (e.g. chemicals, allergens, cigarette smoke) present in the salon. Recommendations include: redesigning the ventilation system to provide outside air to the salon, establishing a written hazard communications program, keeping an occupational illness and injury log, obtaining MSDSs for all products used in the salon, providing the appropriate gloves to protect employees from chemical hazards to the skin, and prohibiting smoking in the workplace.

Keywords: SIC 7231(Beauty Shops), beauty salons, beauticians, cosmetology, cosmetologists, hairdressers, ventilation, HVAC, outside air

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INTRODUCTION

On March 28, 1997, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request to evaluate employee exposures at The Grand Experience Salon, Chicago, Illinois. The requestors expressed concern that certain health effects (i.e., allergic reactions, asthma, cancer, etc.) experienced by employees of the salon might have been associated with inadequate ventilation and exposures to chemical ingredients of products used in the salon.

On June 11–13, 1997, NIOSH investigators conducted a site visit to evaluate the ventilation system effectiveness and interview employees. The temperature, relative humidity (RH), and carbon dioxide (CO_2) concentrations were measured at the beginning of the workday, in the early afternoon, and the early evening at several locations within the salon to determine the efficiency of the ventilation system. The ventilation system ducts were traced to determine if the location of outside air (OA)–intakes. General area air samples were collected for total and respirable dust during the application of artificial nails, and employee interviews were conducted. At the closing conference on June 13, 1997, verbal recommendations were provided to the management.

BACKGROUND

The Grand Experience Salon opened in April 1989 at its present location on the first floor of a multi–story condominium building. The salon is physically separated from the condominium portion of the building by concrete fire walls. The portion of the building occupied by the salon is owned by the owner of the salon business, while the condominium portion is owned by the condominium owners association.

The salon ceilings are approximately 26 feet above floor level, except in the north central portion of the salon, which is divided into two floors with ceiling heights of about eight feet (from floor to ceiling). The salon contains approximately 3,500 ft^2 of floor space (800 ft^2 on the second floor). On the first floor of the salon there are 20 hairstyling chairs, 6 hair drying stations/chairs, 5 hair washing basins/chairs, five nail stations, small office (5' x 5'), dispensary (8' x 8'), restroom, waiting area, reception desk, and refreshment area. The second floor of the salon (approximately 800 ft^2) contains a hairstyling room with four hairstyling chairs, one hair wash basin/chair, facial room, message room, an employee break room, storage room, and restroom. The dispensary/product storage area is located in the back of the salon. A washer/dryer unit located in the dispensary is used for cleaning towels used on the clients. Chemical mixtures (e.g., permanent wave solutions, hair bleaches, etc.) are prepared in the dispensary, which is equipped with general exhaust ventilation.

The salon is served by one air–conditioning package unit, which is located on the roof of the second floor, between high rise buildings. The air handling unit (AHU) for the system is located above the first floor restroom, and is accessible by ladder. The false ceiling serves as the return air plenum for the cooling system. Air is supplied and distributed to the various areas of the salon through a system of hard/flexible ducting.

The salon is open for business from 8 a.m. to 9 p.m. weekdays, and from 9 a.m. to 4 p.m. Saturdays. At the time of the NIOSH survey the salon employed 54 full– and part–time employees (49 of whom are women), including 18 hairdressers, 6 nail technicians, as well as make–up artists, message therapists, skin care technicians, receptionists, and cleaning personnel. The owner reported that the salon averages approximately 200–250 clients per day.

METHODS

Industrial Hygiene

A walk–through evaluation was conducted on June 11, 1997, during which the NIOSH personnel

familiarized themselves with the floor layout of the salon. On June 12, 1997, a ventilation system evaluation was conducted and general area air samples for particulates were collected at one artificial nail application station.

Ventilation, Temperature, Relative Humidity and Carbon Dioxide (CO_2)

The ventilation system effectiveness (or adequacy of OA supply) was evaluated by measuring CO_2, temperature, and RH at 12 locations throughout the salon and, for comparison, outside the building. "Real–time" CO_2 concentrations were measured using a Gastech Model RI–411A portable CO_2 indicator set in the 60–sec average mode. This battery–powered instrument uses a non–dispersive infrared–absorption detector to measure CO_2 in the range of 0–4975 parts per million (ppm), with a sensitivity of ±25 ppm. Instrument zeroing and calibration were performed prior to use with "zero air" and a known concentration (800 ppm) of CO_2 "span gas."

The air temperature and RH were measured using a Vaisala Model HM 34 battery–powered, direct reading meter. This instrument is capable of providing direct readings for dry–bulb temperature and relative humidity, ranging from –4°F to 140°F and 0% to 100%, respectively. Instrument calibrations are performed monthly using primary standards. The ventilation system evaluation also included a visual inspection of accessible parts of the AHUs and following the ductwork to determine the location of the outdoor air intakes.

Particulates

Acrylic powders are used in the application of artificial nails. To determine if the acrylic powder used at this salon contained silica, a bulk sample of the acrylic powder used was obtained and analyzed for silica content via x–ray diffraction according to NIOSH method 7500.[1] To determine airborne concentrations of particulates general area air samples for total and respirable particulate were collected at one of five nail application stations. Total particulate samples were collected on pre–weighed polyvinyl chloride (PVC) filters connected via Tygon® tubing to battery–powered sampling pumps calibrated to provide a volumetric airflow rate of 2.0 liters per minute (ℓpm). Respirable particulate samples were collected on pre–weighed PVC filters attached to a 10–mm cyclone and connected via Tygon® tubing to battery–powered sampling pumps calibrated to provide a volumetric airflow rate of 1.7 ℓpm. The filters were analyzed gravimetrically for total and respirable particulate according to NIOSH Methods 0500 and 0600, respectively and via x–ray diffraction for silica according to NIOSH method 7500.[1]

Medical

Fifty–four employees work at the salon (5 males and 49 females). All professional employees (hairdressers, nail technicians, colorists, and hair coloring specialist) and front desk personnel present on the day of the evaluation were interviewed (n=30). Questions asked during the interview specifically concerned the presence of respiratory symptoms, rashes, and eye irritation. Employees were also asked about the existence of any other symptoms that they felt were related to working at the salon. MSDSs were obtained from the Goldwell company, which is a major supplier of products to the salon.

EVALUATION CRITERIA

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

effects because of individual susceptibility, a pre–existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially 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, OSHA Permissible Exposure Limits (PELs)[4]. NIOSH encourages employers to follow whichever are the more protective criterion. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard and that the OSHA PELs included in this report reflect the 1971 values.

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 (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short–term.

Particulates, Not Otherwise Classified

Often a specific airborne particulate does not have an established occupational health exposure limit. It has been the convention to apply a generic exposure criterion in such cases. Formerly referred to as nuisance dust, the preferred terminology for the non–specific particulate ACGIH TLV criterion is now *"particulates, not otherwise classified (PNOC),"* [or *"particulates, not otherwise regulated" (PNOR)* for the OSHA PEL]. In comments to OSHA on August 1, 1988, on their "Proposed Rule on Air Contaminants," NIOSH questioned whether the proposed PEL for PNOR (10 mg/m^3) was adequate to protect workers from recognized health hazards.[2]

The OSHA PEL for total PNOR is 15.0 mg/m^3 and 5.0 mg/m^3 for the respirable fraction, determined as an 8–hour TWA. The ACGIH TLV® for exposure to a PNOC is 10.0 mg/m^3 (total dust, 8–hour TWA). These are generic criteria for airborne dusts originally intended for those that do not produce significant disease or toxic effect when exposures are kept under reasonable control.[5] These criteria are not appropriate for dusts that have a biologic effect.

Silica (Quartz, Cristobalite, Amorphous)

Crystalline silica (quartz) and cristobalite have been associated with silicosis, a fibrotic disease of the lung caused by the deposition of fine particles of crystalline silica in the lungs. Symptoms usually develop insidiously, with cough, shortness of breath, chest pain, weakness, wheezing, and non–specific chest illnesses. Silicosis usually occurs after years of exposure, but may appear in a shorter period of time if exposure concentrations are very high. The NIOSH RELs for respirable quartz and cristobalite are 50 µg/m^3, as TWAs, for up to 10 hours per day during a 40–hour work week.[2] These RELs are intended to prevent silicosis. However, evidence indicates that crystalline silica is a potential occupational carcinogen.[6,7,8,9] The OSHA PEL for

respirable quartz is 10 mg/m^3 divided by the value "%SiO_2+2." The PEL for cristobalite is ½ the calculated value for quartz.[12] The ACGIH TLVs for respirable quartz and cristobalite are 100 and 50 µg/m^3, as 8–hour TWAs, respectively.

Amorphous silica does not have a crystalline lattice molecular configuration. Historical evaluations of amorphous silica suggest that it is of low toxicity and, unlike crystalline silica (quartz), it has not been reported to produce the fibrotic nodules in lung tissue that are characteristic of crystalline silica exposure.[10,11] The NIOSH REL for exposure to amorphous silica is a full–shift, total particulate TWA of 6 mg/m^3, providing the silica contains less than 1% crystalline forms.[12] The OSHA PEL is 80 mg/m^3 divided by the %SiO_2, as an 8–hour TWA. The ACGIH TLV for amorphous silica containing less than 1% crystalline silica is 10 mg/m^3, inhalable particulate TWA over eight hours, and a respirable particulate TWA of 3 mg/m^3.

Ventilation and Carbon Dioxide Concentrations

The OA ventilation criteria usually referenced by NIOSH investigators 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).[13] Table 2 of that document specifies outdoor (fresh) air requirements for ventilation in commercial facilities. ASHRAE recommends an OA ventilation rate of 25 cfm/person for beauty shops.

Carbon dioxide is a normal constituent of exhaled breath and, if monitored, can be used as a screening technique to evaluate whether adequate quantities of OA are being introduced into an occupied space. Indoor CO_2 concentrations are normally higher than the generally constant ambient CO_2 concentration (range 300–350 ppm). Carbon dioxide concentration is used as an indicator of the adequacy of outside air supplied to occupied areas. When indoor CO_2 concentrations exceed 800 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected.[14] Elevated CO_2 concentrations suggest that other indoor contaminants may also be increased. It is important to note that CO_2 is not an effective indicator of ventilation adequacy if the ventilated area is not occupied at its usual level.

Temperature and Relative Humidity

Temperature and RH measurements are often collected as part of an indoor environmental quality (IEQ) investigation because these parameters affect the perception of comfort in an indoor environment. The perception of thermal comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperature.[15] Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. The American National Standards Institute (ANSI)/ASHRAE Standard 55–1992 specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally acceptable.[16] Assuming slow air movement and 50% RH, the operative temperatures recommended by ASHRAE range from 68–74° F in the winter, and from 73–79°F in the summer. The difference between the two is largely due to seasonal clothing selection. ASHRAE also recommends that RH be maintained between 30 and 60% RH.[16] Excessive humidities can support the growth of microorganisms, some of which may be pathogenic or allergenic.

Health Effects Reported Among Hairdressers

Services performed by hairdressers include haircutting, cleansing, conditioning, and corrosive treatments for the hair and scalp, as well as treatments designed to hold the hair in place or change its shape, configuration, or color.[17] Cosmetologists also perform other beauty services

such as massaging the face and neck with creams and oils, coloring eyebrows and lashes, manicuring fingernails and toenails, and hair removal.[18]

Many chemical compounds contained in beauty products (e.g., hairsprays, permanent wave products, dyes, bleaches, etc.) are capable of causing contact dermatitis (skin irritation), respiratory problems including bronchial irritation and occupational asthma, and other symptoms through inhalation or dermal absorption. [17,18,19,20]

Contact dermatitis is a well–recognized, and possibly the most frequent, occupational disease among cosmetologists. Dermatitis can seriously inhibit the effectiveness and ability of a beautician to perform the basic services of the profession.[21,22] Many of the products used by beauticians, including permanent wave solutions and oxidation–type hair coloring preparations, contain both dermal irritants and sensitizers.

Occupational asthma has been linked to hairdressers because of some of the chemicals used in the job. Asthma is a lung disorder characterized by reversible obstruction of the lung airway system (bronchial tubes) and causes episodic respiratory symptoms, including shortness of breath, wheezing, chest tightness, and cough. In occupational asthma, airway obstruction is caused or made worse by workplace exposure to dusts, fumes, gases, or vapors.[23] In the U.S., asthma occurs in about 5–10% of the general population; 15% of these cases are thought to be occupational.[24] Occupational asthma among hair stylists has been associated with persulphate salts used in hair bleaches, henna, and hair dyes containing paraphenylenediamine.[19,20] In addition to asthmatic symptoms (i.e., shortness of breath, cough, wheezing, and chest discomfort), eye, nose, and throat irritation, headache, nausea, and vomiting following exposure to various aerosols in hairdressing salons have been recorded.[19,25,26,27]

Cancer Among Hairdressers

The question of whether exposure to hair dye is associated with an increased risk of cancer, particularly cancer of the breast, bladder, and non–Hodgkins lymphoma, has been examined in many epidemiologic studies of hairdressers and women who had their hair dyed. Increased risk of developing cancer is determined by having either a statistically significant increased odds ratio (the odds of having a given disease given a particular exposure [OR]) or a statistically significant increased relative risk (the risk of disease in an entire population that is associated with a particular exposure [Relative Risk–RR]).[28] Statistical significance is determined by having a confidence interval (CI) that does not include the number one. Recent studies of a possible link between breast cancer and the use of dyes have not shown a statistically significant association. One study of over 118,000 women found that the rate of breast cancer among women who used hair dye was similar to that among women who did not use dye[29] and another found an odds ration of 1.04 (95% CI 0.9–1.2).[30] Studies of a possible link between hair dye use, increased risk of bladder cancer, and hematopoietic cancers, including multiple myeloma and non–Hodgkins lymphoma, found conflicting results, although the associations are strongest for non–Hodgkins lymphoma. One incidence study found increased risks for non–Hodgkins lymphoma (RR 2.0; 95% CI 1.3–3.0) and leukemia (RR 1.8; 95% CI 1.1–2.7)[31] and another case control study found similar increased risk of hematopoetic cancers, particularly non–Hodgkins lymphoma.[32] In a prospective study, use of *black* hair dye for 20 years or more was associated with elevated rates of hematopoetic diseases in women (for non–Hodgkins lymphoma RR 4.4; 95% CI 1.3–15.2 and for multiple myeloma RR 4.39; 95% CI 1.1–18.3). This association was not seen in women who had "ever" used hair dye of varying colors.[33] However, a prospective cohort study of nurses found no increased risk from the use of hair dye "ever" for hematopoietic cancers including non–Hodgkins lymphoma (RR=1.1; 95% CI 0.8–1.6) or chronic lymphocytic leukemia (RR 0.8; 95% CI 0.3–1.9).[34] A review of patients diagnosed with multiple myeloma found no relation in females between myeloma and use of hair dyes (OR 1.0; 95% CI

0.7–1.4) or previous employment as a hairdresser (OR 1.1, 95% CI 0.75–2.9).[35]

The data for bladder cancer risk from exposure to hair dyes is also conflicting. A retrospective cohort study of cancer rates in Nordic countries found an increase in bladder cancer (RR 2.1; (95% CI 1.5–2.8) for hairdressers in Denmark, but not for hairdressers in Norway or Finland. The authors noted that cigarette smoking was unlikely to account for these findings.[36] Another study of hairdressers in Geneva, Switzerland, found an excess of bladder cancer in male hairdressers, but not in females, and the authors speculate that the study suggests an exposure to a "less potent" carcinogen than found in other dye workers. According to the study authors, most male hairdressers had never dyed hair and the authors hypothesized (and state that there is no firm evidence for this hypothesis) that the excess disease might be due to the use of brilliantines containing para–dimethylaminobenzene, which causes tumors in dogs. These brilliantines may also have been contaminated with 2–napthylamine, a known bladder carcinogen. Brilliantines have not been used extensively since approximately 1950.[37] Other studies have failed to find an association between hair dye and bladder cancer.[38,39]

RESULTS AND DISCUSSION

Industrial Hygiene

The results of CO_2, temperature, and RH measurements are presented in Table 1. These results show that indoor CO_2 concentrations rose throughout the day of the survey, as is typical of indoor CO_2 concentrations. However, all CO_2 readings, with the exception of the morning readings, exceeded the NIOSH guidelines of 800 ppm. Additionally, many temperature readings exceeded the range recommended by ASHRAE for indoor summer comfort, 73°F to 79°F. While all RH readings were within the range (30% to 60%) recommended by ASHRAE, the majority of readings were at the upper end of the range.

The CO_2 readings in the front section of the salon (i.e., the artificial nail area, the reception area, and the waiting area) were consistently the lowest. This is most likely due to the infiltration of OA through the front door of the salon, which is the only source of OA. The temperature and RH readings in the front section of the salon closely paralleled the outside air temperature and RH readings, which further suggests that OA is entering the salon through the front entrance. The highest CO_2 readings were generally in the dispensary, a small 8 foot by 8 foot room, located in the back of the salon, and the furthest point away from the front entrance. The lowest CO_2 readings were generally located in the stairway/upstairs area of the salon. This area had the fewest occupants at any one time during the day.

Visual inspection of the HVAC system and duct work revealed that there was no source of OA. The inspection and discussions with the salon owner and building maintenance personnel revealed that, at one time, OA was supplied to the salon by two routes, neither of which were operable at the time of the NIOSH survey. The building maintenance representative reported that the main OA intake had been located above the front entrance to the condominium lobby. However, inspection of the salon AHU revealed that the air duct leading into the AHU room begins just outside the fire wall separating the salon from the condominium building, thereby drawing air from the dead space above the lobby ceiling, as well as the ceiling plenum of the salon. Further discussions revealed that the condomium lobby had undergone renovations (sometime in the past two years). During the remodeling the air duct may have been disconnected, and the OA grill removed.

A second OA source was reported to come from an OA intake grill located on the face of the building, at the eastern end of the salon, about 10 feet above the sidewalk. However, inspection revealed that the duct leading from this OA intake grill to the second floor hair styling room was disconnected. It was reported

that these flexible ducts are connected only during the cooler months of the year, and then disconnected during the warmer months to prevent the introduction of hot, humid air to the occupied space. Visually tracing the duct from the OA intake grill to the second floor revealed that the duct leads directly to the second floor hair styling room (i.e., the air is not properly filtered or tempered prior to being introduced to the area).

Sampling for airborne particulates during the application of artificial nails showed that total particulate and respirable particulate concentrations were less than the analytical limit of detection. These samples showed no detectable quantitites of either quartz or cristobalite. Additionally, the chemical analyses of the bulk material sample of the acrylic polymer powder used during the application of artificial nails showed that the powder did not contain detectable quantitites of quartz or cristobalite.

General Industrial Hygiene Observations

The salon dispensary was equipped with a general exhaust vent that led to the area above the ceiling of the condominium lobby. The area above the ceiling was inaccessible and there were no building plans available, resulting in an inabilty to trace the duct past this point. It is unknown where the exhaust duct leads or whether the dispensary exhaust is properly discharged to an appropriate outdoor area.

Two ozone generators were used in the salon. Ozone generators are marketed as air–purification devices to reduce or remove chemical and particulate contaminants and odors in indoor spaces. However, ozone is a potent lung irritant and exposure to elevated levels is a contributor to the exacerbation of lung disease; it is especially dangerous for persons with asthma and other chronic lung diseases, children, and the elderly. Residential ozone is produced directly by ozone generators and indirectly by ion generators and some other electronic air cleaners. There is no difference, despite some manufacturers' claims, between outdoor ozone and ozone produced by these devices.[40] In an evaluation of ozone generators to determine if the use of ozone had any effect on reducing formaldehyde concentrations, the authors concluded that the use of ozone is ineffective in reducing airborne concentrations of formaldehyde. The authors further concluded that because ozone has demonstrated health hazards, and is a regulated air contaminant in both the occupational and ambient environment, the use of ozone to improve the quality of indoor air does not appear to be warranted.[41] In a separate literature review, which appeared in the June 1995 issue of the American Industrial Hygiene Association Journal, the author concluded that "ozone is not a practical and effective means of improving indoor air, especially in light of its potentially serious risk to health." The author further concluded "introducing ozone in indoor air may present a risk to human health" and that "detrimental effects, primarily to the respiratory system, have been well documented."[42]

Medical Interviews

Thirty (3 males and 27 females) of the 54 workers employed at the salon were interviewed. The occupations of the employees interviewed included: hairdresser, manicurist, hair coloring specialist, and front desk personnel. Nine employees reported a history of health problems they thought might be related to their job. Three workers reported possible allergic reactions (involving cough, nasal congestion) to some of the hair spray used at the salon. In the last year, two workers reported having had skin or eye irritation, two reported carpal tunnel syndrome, and two reported either headaches or sneezing associated with pedicures. Two reported upper respiratory tract irritation at work, but they reported having had those problems before working in this salon. The remaining 21 interviewed employees did not report any work–related health problems. One hairdresser reported a malignancy (bladder cancer) and was concerned that it might be due to an exposure incurred at work.

Employees were permitted to smoke in the back room and in the front (waiting area) of the salon, but NIOSH investigators observed several employees smoking in other areas of the salon and some patrons were observed smoking while in the hairdressers' chair. The salon owner reported that it was the salon's policy to allow the patrons to do so. All employees interviewed who stated that they used hair dyes or permanent wave solutions reported wearing "personal protective clothing" (i.e., latex gloves and smocks) which was provided by the owner of the salon.

Hairdressers are licensed professionals in the State of Illinois. The Illinois State Board of Cosmetology requires 1200 hours of schooling, and 20 hours of continuing education per year. This salon had no written safety procedures for the mixing and handling of the chemicals used by hairdressers. According to the salon attorney, because safety training is done at school, no further training is considered necessary by the salon owners. At the time of the site visit, the salon did not keep an OSHA Log and Summary of Occupational Injuries and Illnesses (Form 200) or MSDSs for the products used in the salon.

CONCLUSIONS

Visual inspection of the ventilation system showed that at the time of the NIOSH site visit, the system was not designed for the introduction of OA to the occupied spaces of the salon. Additionally, all indoor CO_2 measurements collected exceeded the NIOSH guidelines of 800 ppm, with the exception of those collected at the beginning of the workday. The CO_2 measurements showed that CO_2 concentrations rapidly rose after the salon was open for the day, suggesting that other indoor contaminants may also increase. The build–up of chemical emissions generated by the use of the various beauty products (i.e, permanent wave solutions, hair sprays, hair dyes, artificial nail applications, etc.) may be partially responsible for employee complaints of upper respiratory tract irritation. Additionally, the use of ozone generators and tobacco products in the workplace (i.e., the reception area and waiting area) may contribute to employee complaints. As indicated in the Evaluation Criteria Section of this report, CO_2 concentrations are used as an indicator of the adequacy of OA supplied to the occupied areas. Because of the lack of an active OA–intake, the excess CO_2 concentrations measured, and the use of chemical compounds in the salon, the ventilation system should be redesigned to provide an OA ventilation rate of 25 cfm/person as recommended by the ASHRAE.

The salon management did not have MSDSs for products used in the salon, nor did they keep an OSHA Log of Injuries and Illnesses (Form 200) as required by the Occupational Safety and Health Act. Employees did not receive hazardous substances training as required under the OSHA Standard (29 CFR 1910.1200). Latex gloves issued to employees for use when mixing bleaches, permanent wave solutions, and other chemicals are not appropriate protection against the potential skin hazards involved.

NIOSH investigators were unable to determine the nature and extent of employees' past exposures to hair dyes due to a number of unknown variables including changes in dye formulations over the years.

RECOMMENDATIONS

The basic principles for controlling airborne contaminants in the occupational environment consist of substitution, isolation, and ventilation. Product substitution and ventilation are the two choices best suited for controlling airborne contaminants in beauty salons. Product substitution (i.e., elimination) is the first and most effective method of controlling airborne contaminants and should be used whenever possible. In instances where product substitution is not feasible, local exhaust or dilution ventilation should be used to remove chemical contaminants generated from the various beauty products used. Reports from the Surgeon General and the National Research Council (NRC) have concluded that exposure to

environmental tobacco smoke (ETS) may be associated with a wide range of health (e.g., lung cancer) and comfort (e.g., eye, nose, and throat irritation and odor) effects. [43,44,45,46,47,48] NIOSH has concluded that ETS may be related to an increased risk of lung cancer and possibly heart disease in occupationally–exposed workers who do not themselves smoke.[49] As discussed at the closing conference on June 13, 1997, the following recommendations are offered to alleviate employee symptoms.

Ventilation

The architectural redesign of the salon should incorporate the ASHRAE recommendations for acceptable indoor air quality to avoid the inherent design problems that contributed to the current indoor environmental quality problems in the building.

1. The general exhaust duct leading from the dispensary to the area above the condominium ceiling lobby was inaccessible, and it should be determined where this duct ultimately ends. The dispensary should be designed to include a local exhaust ventilation system to discharge potentially contaminated air directly outdoors. The exhaust stack should be located away from any area where outside air intakes are located to prevent the potential reentrainment of contaminated air. The dispensary should be under negative pressure in relation to the salon.

2. The HVAC system should be connected to an OA intake and should introduce OA at a rate sufficient for sustained occupancy of the maximum number of persons expected in the salon at any one time. The ASHRAE guidelines suggest that outside air be supplied at a rate of 25 cfm/person for beauty salons. To ensure adequate distribution of OA (currently 100% recirculated air) the ventilation system should be modified to provide OA intakes, or it should be replaced with a system that has this capability. The OA intake rate should then be adjusted, and these flowrates measured, to assure a minimum total rate based on the maximum number of persons expected to occupy the salon at any one time.

3. Negative pressure conditions are generally not recommended for buildings for numerous reasons. These include the possibility of capture and/or re–entrainment of contaminants and odors exhausted from inside the building and/or sources outside (e.g., vehicle exhausts), respectively, as well as interference with the flue draw on gas– or oil–fired appliances. Also, air infiltrating due to negative pressure will enter by paths of least resistance rather than according to any plan, so its distribution may not occur in a desirable pattern (e.g., drafts may occur, temperatures in some areas may be hard to control, etc.). Also, if the building is under negative pressure, exhaust flow for at least some of the exhaust fans will be partially restricted as they work against a greater–than–designed pressure differential. Negative pressure leading to the infiltration of substantial quantities of air may also lead to high relative humidities in the building during the summer, as humid outside air enters the building without passing the cooling coils in the AHUs first. To avoid these problems, total outside–air intake rates for buildings should typically exceed total exhaust rates by about 5% to 10% to ensure that the building remains under slight positive pressure.[50] However, there are current theories suggesting that during the winter in northern climates, positive pressure will force moisture in the building to migrate from the interior building spaces through the interstitial space of the exterior walls.[51] Therefore, a qualified engineering firm should be consulted to insure the proper placement of vapor barrier systems.

4. Preventive maintenance is a critical component in controlling biological growth in indoor environments. The AHU should be inspected on a monthly basis and cleaned as necessary. The air supply should be properly filtered and the filters should be changed regularly. The evaporator coils and condensate drain pans should be cleaned routinely to prevent the growth and/or accumulation of microorganisms that could enter the airstream and affect the indoor air quality. A record of all cleaning

performed should be kept and any potential problems corrected.

Hazard Communications Program

Employers cannot comply partially, or on occasion, with the hazard communications standard. In order to be effective, worker protections must be complete, ongoing, and permanent. Although many safety issues are addressed in the hairdressers' training, workplace–specific hazard communication training is a requirement of OSHA and must be incorporated by the salon. At the time of the NIOSH site visit, there was no written hazard communications program and no MSDSs for any products used in the salon.

The OSHA hazard communications standard (29 CFR 1910.1200) states that employers shall develop and implement a written Hazard Communications (HAZCOM) Program that consists of: (1) labeling; (2) MSDSs; (3) employee information training; (4) a current list of all chemicals used in the workplace updated to include all new chemicals as they are received. The information shall be kept in a central location that is easily accessible to all employees, including any contractor or subcontractor.

Employee Training: The OSHA standard specifies that employees shall be trained in the following: (1) methods used to detect the presence of hazardous chemicals; (2) physical and health hazards of chemicals used; (3) measures to protect themselves from exposure; (4) the Hazard Communications program itself; and (5) how to read and understand an MSDS. Training shall be conducted annually, and upon initial employment.

1. An inventory of all products used in the salon should be conducted, and MSDSs for all products used should be obtained from the manufacturer or distributor.

2. Hairdressers should receive regular and repeated education about the potential hazards in the workplace. When possible, products that contain known chemical allergens should be replaced by those that do not. Hairdressers should remain aware of proper work practices, such as handwashing, and should be provided with appropriate protective gloves, to minimize exposure to chemical compounds.

3. Hairdressers with a history of asthma or allergic reaction to chemicals, or who experience respiratory or skin irritation problems, should inform their physicians about their exposures at work.

General

1. To prevent hand–to–mouth transfer of workplace chemicals, eating and drinking should be prohibited at work stations.

2. Personal hygiene measures should be practiced, such as washing prior to eating, drinking or smoking, and prior to leaving the workplace.

3. Communication between management and employees should be increased to facilitate the exchange of concerns about environmental conditions in the building. Employees should be made aware of the problems with the building and decisions made by management to address those problems.

4. Worker exposure to ETS is most efficiently and completely controlled by eliminating tobacco use from the workplace. To facilitate elimination of tobacco use, employers should implement smoking cessation programs for employees. Customers should be instructed not to smoke while in the salon due to potential heath effects to employees. Management and employees should work together to develop appropriate policies consistent with the following principles:

(a) The smoking policy should provide a smoke-free environment for all employees. This recommendation is in accordance with

NIOSH guidelines which recommend a smoke-free environment in the workplace and applies to smoking by clients and visitors, as well as by employees.[49]

(b) The most direct and effective method of eliminating ETS from the workplace is to prohibit smoking in the workplace. However, if smoking is permitted in the workplace, it should be restricted to designated smoking areas. These areas should be enclosed and provided with a *dedicated exhaust system* (room air directly exhausting to the outside), an arrangement which eliminates the possibility of re–entrainment and recirculation of any secondary cigarette smoke. In addition, *the smoking area should be under negative pressure relative to surrounding occupied areas*. ASHRAE recommends that ventilation systems supplying the smoking lounge should be capable of providing at least 60 cfm of outdoor air per person.[13] This air can also be obtained from the surrounding spaces (transfer air) if it is relatively uncontaminated.

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The Grand Experience Beauty Salon
Chicago, Illinois
HETA 97–0153

Thursday June 12, 1997			
Time/Location	**Carbon Dioxide (ppm)**	**Temperature (°F)**	**Relative Humidity**
Morning (9:08 a.m. to 9:44 a.m.)			
front (reception, waiting, nails)	650–750	75–76	55–57
middle (first floor hair styling/shampoo areas)	650–675	76–78	53–55
dispensary	825	79	52
second floor (hairstyling, message, facial)	725–800	75–79	51–52
outdoors	450	74	57
Midday (1:32 p.m. to 2:04 p.m.)			
front	1500–1525	72–77	55–58
middle	1600–1675	79–82	52–54
dispensary	1850	83	51
second floor	1425–1550	78–82	50–51
outdoors	425	71	57
Early evening (6:29 p.m. to 7:20 p.m.)			
front	1550–1575	73–74	54–57
middle	1625–1750	76–78	52–53
dispensary	1725	80	52
second floor	1200–1500	74–80	49–51
outdoors	400	73	56
NIOSH Guidelines ASHRAE Recommendation	< 800 < 1000	73 –79 (summer)	30–60

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