Assessing Occupational Exposure in Nail Salons

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Introduction

The nail salon industry has become one of the fastest growing categories of Asian American businesses; Vietnamese hold 40% of the licenses across the country and most workers are women. Many products used in nail salons contain volatile organic compounds (VOCs) that are linked with negative health effects. These chemicals can be found in polishes, removers, gels and acrylic nails. Some examples of VOC's in nails salons are acetone, formaldehyde, toluene, and ethyl methacrylate. Acetone is one of the most abundant chemicals found in nail products and is quickly absorbed into the body by inhalation and dermal exposure. It causes eye and nasal irritation as well as mild nervous system effects. Formaldehyde is a known carcinogen. Toluene has been shown to cause reproductive harm and affect the central nervous system. EMA was recommended to replace the more toxic methyl methacrylate that was banned from use in Boston. EMA, contained in nail polishes, is known to cause asthma, skin and eye irritation, and possible reproductive damages to women over long periods of exposure. Workers often work 40 or more hours per week. A study focused on nail technicians in Boston documented that these workers reported "musculoskeletal disorders, skin problems, respiratory irritation and headaches." To gain a deeper understanding of the exposures that occur in the nail salons and to provide a basis for change in Boston and the United States, the Environmental Health and Justice JBS (' 'Justice Brandeis Semester' ') at Brandeis University, in collaboration with a local community group (Viet-AID) and the Boston Public Health Commission, conducted a study that assesses nail salon workers' exposure to specific volatile organic compounds.

Results

Figure 1: 90th percentile of CO_2 levels as an indicator of ventilation

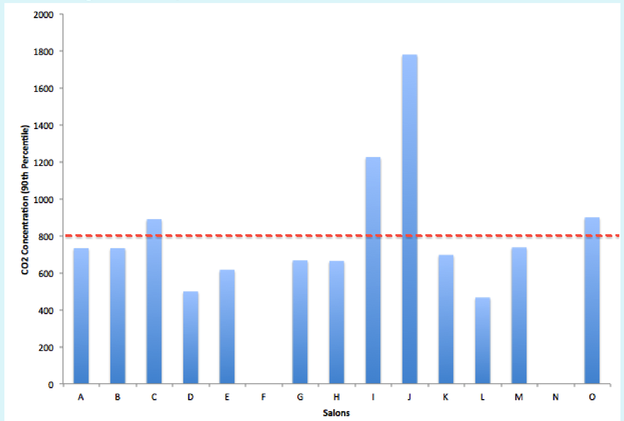
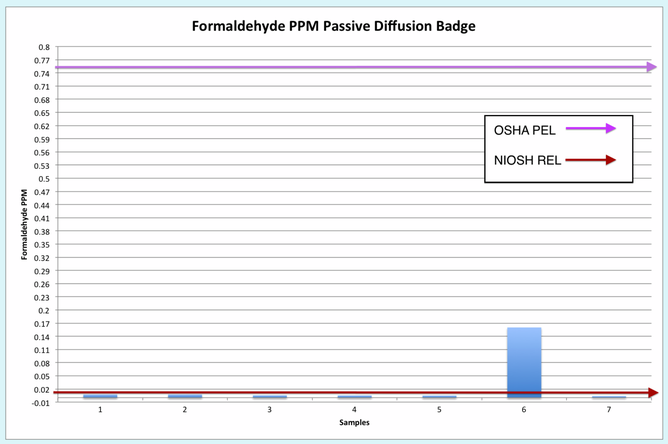


Figure 2: Formaldehyde results from passive diffusion badges



Methods

We conducted a study of occupational exposure to chemicals in 15 nail salons in the Boston area, from September to December, 2013. Full-shift (~8 hours) air monitoring in the nail salons consisted of two parts. The first part involved the use of sampling media to test for exposure to acetone, formaldehyde, toluene, and ethyl methacrylate (EMA) using colorimetric tubes. Second, a TSI Q-Trak (Model 8551/7565; TSI, Inc.) was used to demonstrate the efficiency of the salon's ventilation by measuring carbon dioxide (CO_2) levels, as well as relative humidity and temperature and a TSI DustTrak (Model 8520; TSI, Inc.) was used to record particulate matter ($PM_{2.5}$). To ensure the quality of measurements in this study, we collected duplicate and blank samples. Duplicate samples of all media tested were taken in two salons and showed good agreement and all blank samples were non-detect (ND). We also created a questionnaire and observation log that was to be completed upon entering and leaving sample sites that collected information such as: salon capacity, number of workers in the salon, the geographic location of the salon, whether the salon was in an enclosed building structure (i.e. a multiple floor office building v. a ground-level store front), the number and location of workstations, the number of acrylic and lacquer nail services performed during the sampling day, as well as other parameters. Data analysis was performed using Google Spreadsheet and Microsoft Excel. Descriptive statistics included calculating the average and range for the target compounds. To estimate steady-state ventilation conditions, 90th percentile CO_2 concentrations were calculated. In addition to our full shift testing, we video recorded one acrylic manicure done and two lacquer manicures while simultaneously recording changes in total volatile organic (TVOC), as measured with a ppbRAE photoionization detector.

Results

Table 1: Summary of Measured Concentrations in Nail Salons and Health-Based Limits

Parameter	Measured in # of salons	Average	Minimum	Median	Maximum	Guideline	Source
CO_2	13	816.76	467	734	1781.2	800 ppm	ASHRAE
$PM_{2.5}$	14	7.71	2	8	13	35 ug/m^3	EPA
Acetone (personal)[1]	15	15.97	0	12.5	66.67	1000 ppm 250 ppm	OSHA PEL NIOSH REL
Acetone (area)[1]	14	13.02	0	6.7	46.67	1000 ppm 250 ppm	OSHA PEL NIOSH REL
Formaldehyde (personal)[1]	15	1.93	0	2.38	3.27	0.75 ppm 0.016 ppm	OSHA PEL NIOSH REL
Formaldehyde (area)[1]	14	1.92	0	2.36	2.96	0.75 ppm 0.016	OSHA PEL NIOSH REL
Toluene (area)[1]	14	<1.25	<1.25	<1.25	<1.25	200 ppm 100 ppm	OSHA PEL NIOSH REL
Toluene (personal)[1]	15	<1.25	<1.25	<1.25	1.26	200 ppm 100 ppm	OSHA PEL NIOSH REL
Toluene (personal)[2]	14	0.07	0.01	0.08	0.09	200 ppm 100 ppm	OSHA PEL NIOSH REL
EMA (personal)[2]	14	0.08	<0.04	<0.05	0.49	0.3 ppm	EPA
Formaldehyde (personal)[2]	3	0.028	0.0036	0.0054	0.16	0.75ppm 0.016ppm	OSHA PEL NIOSH REL

Key: colorimetric tube[1] passive diffusion badge[2]

Thank you to our collaborators:

VIET AID

BOSTON PUBLIC HEALTH COMMISSION

Healthy Cosmetology Committee

Results

Figure 3: Comparison of acetone levels in personal and area samples

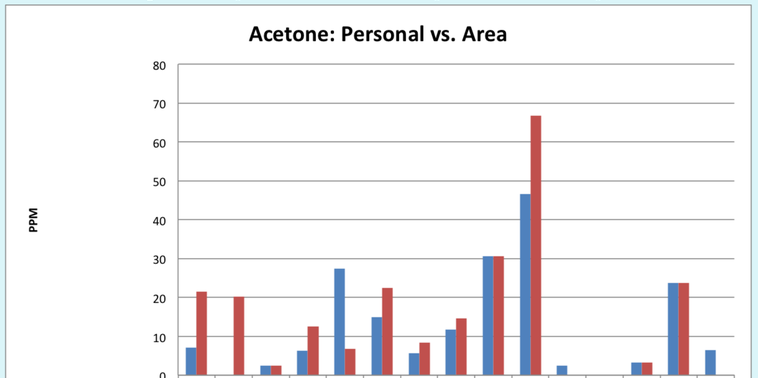
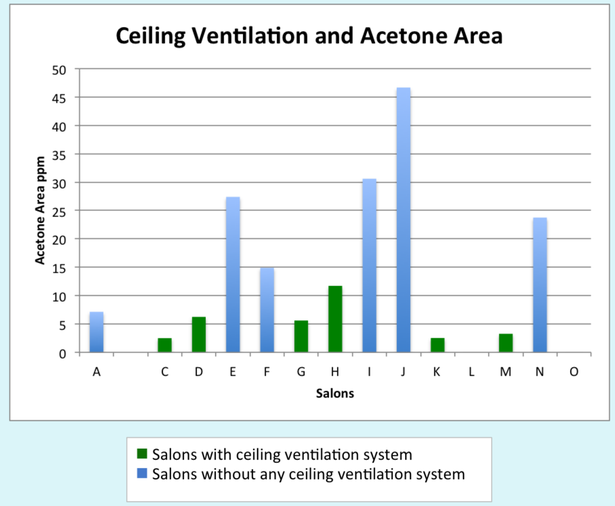


Figure 4: Acetone concentrations in salons with and without mechanical ventilation



Conclusions

- Some salons had levels of CO_2 that indicated they did not meet the ASHRAE ventilation standard CO_2 of 800ppm (Fig. 1).
- Our findings showed high levels of formaldehyde in the air of some salons (Fig. 2).
- Our data show high acetone concentrations in the personal breathing zones of the workers (Fig. 3).
- Our data show a strong correlation between low acetone concentrations and mechanical ventilation (Fig. 4).
- Toluene was detected at minimal levels (Table 1).
- EMA was detected in only one salon. In that salon, the EMA concentration exceeded EPA's health-based guideline for EMA (Table 1).

Recommendations

- Install proper mechanical ventilation, if not already installed
- Opt for safer products (where possible) rather than enforcing personal protective equipment for workers
- Research nail products to provide accurate knowledge of their contents to users and regulators
- Educate nail salon workers, clients, and owners on safer practices
- Research short-term worker exposure to specific chemicals (with task-based monitoring)