Reducing Workers’ Exposures to Chemicals and Dust in Nail Salons Using Local Exhaust Ventilation Systems

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## Introduction

Approximately 155,000 people work as manicurists and pedicurists in the United States. Low entry requirements, limited English language skills, and flexible work schedules brought many Vietnamese women to this profession. These professionals provide nail treatments including filing, polishing, applying artificial nails, manicures and pedicures. The workers in nail salons are exposed to a wide variety of potentially hazardous chemicals such as volatile organic compounds (VOCs), resins, and plasticizers. Overexposure to some chemicals is associated with a number of health risks including eye and skin irritation, headache, dizziness, nausea, occupational asthma and respiratory problems. The proximity of the technicians’ breathing zone to the chemicals and dust during the nail treatments is a reason for concern. Various types of engineering controls, mainly local exhaust ventilation systems (LEV), can be applied to reduce the workers exposures in nail salons. LEV systems are designed to remove contaminants before entering the breathing zone.

**Objective:** The goal of this study was to evaluate four local exhaust ventilation (LEV) systems to determine their effectiveness at eliminating acetone vapor and dust from the breathing zone of nail salon technicians and their clients.

## Methods

- Four commercially available LEV systems were investigated
- Evaluated dust and solvent (acetone) capture efficiency in lab setting
- Dust generated by grinding acrylic nails using standard salon procedures
- Acetone generated by simulating acrylic nail and polish removal processes
- Acrylic nail and polish removal processes replicated by placing an acetone bowl on the table and wiping nails with an acetone-saturated cotton ball
- Measured dust (Thermo pDR-1500) and acetone (MiniRAE 2000) exposures in real-time
- Experiments done with and without LEV systems

## Results

### Dust Capture Efficiency

Dust capture efficiency was evaluated by comparing the average dust level between control and no control conditions. The efficiency data is listed in table 1.

Figure 3 compares the systems with "no control" condition based on the dust exposures. Between systems' comparison is represented in figure 4.

<table>
<thead>
<tr>
<th>System</th>
<th>Dust Capture Efficiency at Breathing Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93</td>
</tr>
<tr>
<td>B</td>
<td>83</td>
</tr>
<tr>
<td>C</td>
<td>77</td>
</tr>
</tbody>
</table>

### VOC Capture Efficiency

Similarly, VOC capture efficiency was evaluated by comparison of acetone exposure between control and "no control" scenarios for both nail wiping and the acetone container experiment (table 1).

<table>
<thead>
<tr>
<th>System</th>
<th>VOC Capture Efficiency</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>97</td>
</tr>
<tr>
<td>B</td>
<td>98</td>
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<tr>
<td>C</td>
<td>98</td>
</tr>
<tr>
<td>D</td>
<td>92</td>
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</tbody>
</table>

## Discussion

### Dust

- Statistical analysis of dust exposures exhibited significant temporal variation for each system (p-value<0.001).
- Overall, the systems performed well in removing dust from the technician’s breathing zone when comparing to the "no control" scenario.
- The different systems had dust capture efficiencies between 67-90%.

### VOC

- Statistical analysis of acetone exposures showed significant temporal variation for each system (p-value<0.001).
- Comparing the LEV systems with the "no control" scenario, the systems’ mean acetone levels were significantly lower for both experimental conditions (p-values<0.001).
- The systems had capture efficiencies between 77-93% for nail wiping and 92-98% for the acetone bowl experiment (table 1).

## Conclusions

The LEV systems can significantly minimize the workers’ and most likely their clients’ exposures to particles and organic vapors in nail salons. The ability of the systems to reduce technician’s exposures during real use will depend on the systems’ usability and capacity.

This study was limited to the application and removal of acrylic nails in generating particles and VOCs to evaluate the capture efficiency of the systems in the lab setting. However, further research will be needed to investigate the exposure levels and capture efficiencies in realistic conditions (i.e. nail salons) and/or the efficiency associated with other nail treatments (e.g. application of gel nails). Also, additional studies should be conducted to provide information on filter capacity and longevity of LEV systems.

## References


## Acknowledgements

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## Table 1: Dust and VOC Capture Efficiency

<table>
<thead>
<tr>
<th>Unit</th>
<th>Dust Capture Efficiency at Breathing Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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<td>D</td>
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</table>

## Figure 3: Comparison of Systems with NC

## Figure 4: Comparison of Systems Excluding NC

## Figure 5: Acetone Exposure for Systems and NC

## Figure 6: Comparison of LEV Systems

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