

# Indoor Air Chemistry and Health Implications

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September 28, 2006



**Air Resources Board**  
**California Environmental Protection Agency**

# Indoor Air Chemistry: Cleaning Agents, Ozone and Toxic Air Contaminants

- Objectives:
  - 1) Identify and measure emissions of TACs from cleaning products & air fresheners
  - 2) Identify and measure reaction products when cleaning agents with reactive compounds are exposed to ozone
- UC Berkeley, William W. Nazaroff, PhD.

# Published Work Resulting from This Study

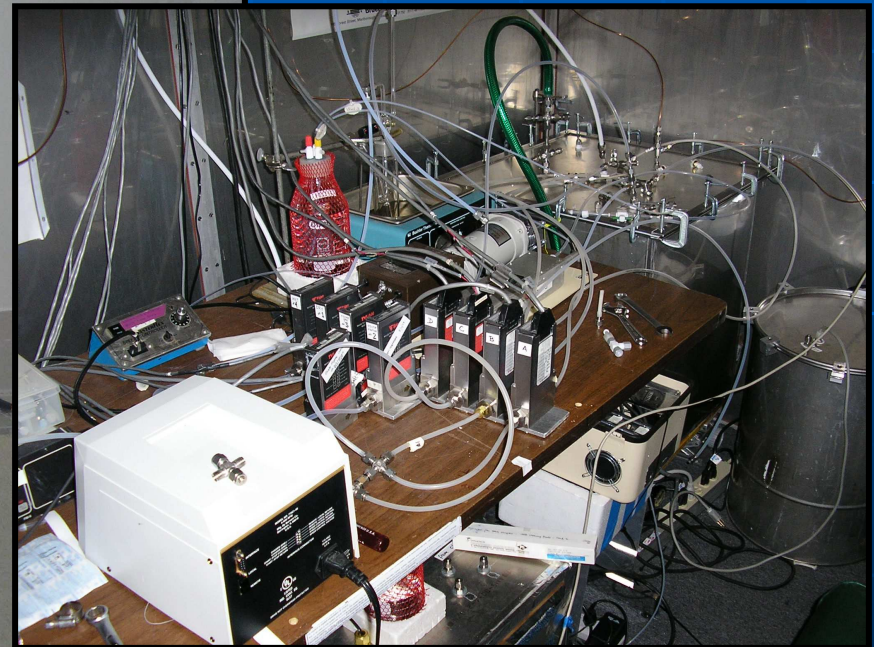
- WW Nazaroff and CJ Weschler, Cleaning products and air fresheners: exposure to primary and secondary air pollutants. *Atmos. Environ.* 2004, 38, 2841-2865.
- ➔ ■ BC Singer *et al.*, Cleaning products and air fresheners: emissions and resulting concentrations of glycol ethers and terpenoids. *Indoor Air* 2006, 16, 179-191
- ➔ ■ H Destailats *et al.*, Indoor secondary pollutants from household product emissions in the presence of ozone: a bench-scale chamber study. *Environ. Sci. Technol.* 2006, 40, 4421-4428.
- ➔ ■ BC Singer *et al.*, Indoor secondary pollutants from cleaning product and air freshener use in the presence of ozone. *Atmos. Environ.* in press.

# Methods

- Task 1 – screened 21 products for chemical components
- Task 2 – measured emissions of 6 products in room-sized chamber
- Task 3 – studied 3 products with ozone in small and large chambers for secondary emissions
  - Large chamber tests: 120 ppb ozone introduced; 60 ppb available for reaction

# How many scientists does it take to mop a floor?

6



# Results – Primary Emissions

- 3 TACs were released during cleaning
  - 2-butoxyethanol
  - 2-hexyloxyethanol
  - *m*- and *p*-xylene
- 2-Butoxyethanol levels were below OEHHA acute reference exposure level of 14 mg/m<sup>3</sup>
- Direct emissions of TACs do not appear to pose a risk
- 12 products contained ozone-reactive compounds (terpenes) up to 26%

# What are Terpenes?

- A class of VOCs from plant oils
  - Pine –  $\alpha$ -pinene
  - Citrus –  $d$ -limonene
- Pleasant odors
- Favorable solvent properties
- Generally recognized as safe (GRAS)
- Oxidants (e.g. ozone) react with terpenes to produce more irritating and toxic compounds

# Results – Secondary Emissions

- **Formaldehyde**
  - Increased 9 – 16 ppb for 4 hours post cleaning
  - Exceeded OEHHA's chronic reference exposure level of 2.4 ppb
  - Exceeded Prop 65 no significant risk level for cancer of 1.6 ppb
- **Particles**
  - Emitted as ultrafines
  - Increased the estimated mean PM<sub>2.5</sub> mass by 30 – 90  $\mu\text{g}/\text{m}^3$  for 12-hour period
  - National 24-hour standard of 35  $\mu\text{g}/\text{m}^3$  (new)
- **Modeled exposure scenarios showed user exposure may exceed health benchmarks**



# Implications

- Primary emissions of TACs generally below health benchmarks
- Secondary emissions may pose a previously unrecognized exposure and health risk
- Continue to recommend further research on secondary indoor emissions
- Support further reductions of outdoor ozone levels and indoor ozone emissions

**Thank You**

# How many scientists does it take to mop a floor?

