**Mouse pulmonary response following solid surface composite dust inhalation_dataset**

**Project Overview**

**Introduction:**

Solid surface composites (SSCs) are a widely used construction material that can generate dust and volatile organic chemicals (VOCs) during fabrication. Exposure to SSC dust has been linked to pulmonary health effects, including pulmonary fibrosis and lung inflammation. Previous studies have investigated the toxicity of SSC particles using in vitro and in vivo models, but these studies have limitations. For example, they often relied on pre-generated particles that may not accurately represent the size distribution and characteristics of aerosols encountered in real-world settings. Additionally, these models did not capture the co-exposure to VOCs that can occur during SSC fabrication.

To address these limitations, we developed a novel apparatus capable of real-time generation of SSC sawing particles and their simultaneous delivery to rodents via whole-body inhalation. This approach allows for a more accurate assessment of SSC toxicity under conditions that better reflect workplace exposure scenarios. The present study utilizes this system to characterize the acute pulmonary response in mice following a 4-day inhalation exposure to real-time generated SSC aerosols, with evaluations at 1, 6, 27, and 56 days post-exposure.

**Methods:**

- **Inhalation Exposure System Design:** A system was designed to automatically control airflow, particle concentration, and exposure duration in an inhalation exposure chamber. The system monitored chamber temperature, relative humidity, and CO2 levels. During exposures, airflow was held constant at 30 L/min. HEPA-filtered air or air drawn through an airtight chamber housing an automated saw assembly could enter the exposure chamber. A cyclone removed particles larger than 6 μm from the air stream. The target concentration of countertop cutting particles inside the chamber was 20 mg/m3 over 4-hour exposures. A gravimetric method was used to calibrate and verify the Data RAM readings during each exposure run. An automated software program determined when to start and stop sawing based on chamber concentration readings. Dilution air flow was used to reduce chamber concentration at the end of the exposure. A slight negative pressure (-2.5 inch-H2O to ambient) was maintained inside the chamber to pull air from the saw assembly housing chamber.
- **Automated Countertop Cutting Assembly:** A 3D rendering of the automated cutting assembly is shown in Figure 1. Two linear actuators with stepper motors were used to move the countertop and the circular saw. A circular saw with a 7.25-inch diameter, 60-tooth blade was used to cut the countertop. The saw assembly was housed in a custom airtight stainless steel chamber. Sound deadening material was affixed to the outside of the chamber to reduce noise. Air entered the saw assembly housing chamber through a HEPA filter on the far-left side. Air exited the chamber from a port on top, approximately 1 foot from the cutting blade.
- **Inhalation Exposure Chamber:** The exposure chamber was made of stainless steel with a clear polycarbonate door and measured 22 x 22 x 20 inches (L x W x H), It held a stainless-steel cage

rack that could hold up to 36 mice in individual cages. Air entered from the top center of the chamber through a dispersion nozzle to aid aerosol mixing. The flow rate of air entering the chamber was 30 L/min.

- **Particle Characterization:** The size distribution of particles generated by countertop cutting was measured using several instruments. Samples were collected inside the chamber a few inches above the animal cages.
- **Animals:** Male C57BL/6J mice (4 weeks old, 20-25 g) were purchased from The Jackson Laboratory. Mice were housed two per cage with a 12-hour light/dark cycle. The study protocol was reviewed and approved by the CDC-Morgantown Institutional Animal Care and Use Committee.
- **Study Design**: The study used two separate exposures to investigate the effects of countertop cutting emissions on mice.
    - In the first exposure, mice (n=6) were exposed to either filtered air or 20 mg/m3 of countertop cutting emissions for 4 hours. They were then euthanized immediately or 24 hours after exposure. The lungs were then analyzed for Aluminum content to determine particle deposition.
    - In the second exposure, mice (n=18) were randomly divided into two groups (n=9 per group) and exposed to either filtered air or 20 mg/m3 of countertop cutting emissions for 4 hours a day for 4 consecutive days. They were then euthanized at 1, 6, 27, and 56 days after the last exposure. Blood and lung tissue samples were collected from the mice for further analysis.
- **Lung Tissue Aluminum Analysis (ICP-AES Al analysis):** Inductively coupled plasma atomic emission spectrometry (ICP-AES) was used to quantify aluminum concentration in lung tissue samples, potentially indicating aluminum accumulation from inhaled countertop particles.
- **Bronchoalveolar Lavage (BAL) Analysis:** Bronchoalveolar lavage (BAL) retrieved lung fluid and cells for analysis:
- **Total Protein and Lactate Dehydrogenase (LDH) Activity:** BAL fluid levels of total protein and LDH activity were measured. Increased protein may suggest lung inflammation or damage, while LDH, an enzyme associated with cell death, can indicate cellular injury.
- **Cell Differential Analysis:** BAL fluid cells were isolated, stained, and examined microscopically to determine white blood cell types. Shifts in these cell populations can signal different immune responses in the lungs.
- **Histopathological Examination:** Lung and nasal cavity tissues were processed, sectioned, and stained for microscopic evaluation by a veterinary pathologist to identify any abnormalities such as inflammation, scarring, or cell death.
- **Blood Cell Analysis:** Whole blood samples underwent complete blood count (CBC) analysis to assess various red and white blood cell parameters, including counts, size, and maturity. Deviations from normal values can indicate potential health issues.

- **Bronchoalveolar Lavage Fluid (BALF) Cytokine Levels:** A V-PLEX Pro-inflammatory Mouse panel measured the levels of pro- and anti-inflammatory cytokines in the BAL fluid to assess the inflammatory response in the lungs of mice exposed to countertop emissions.
- **Tissue Oxidative Stress Marker Analysis:** Lung tissue homogenates were analyzed for markers of oxidative stress, including superoxide dismutase (SOD) activity and total antioxidant capacity. These analyses assessed the potential for oxidative damage caused by exposure to countertop emissions.

**References:**

Mandler, W. Kyle, Walter G. McKinney, Mark Jackson, Alycia K. Knepp, Sarah L. Keeley, Sherri A. Friend, Lori A. Battelli, and Yong Qian. 2025. Mouse pulmonary response following solid surface composite dust inhalation. *Inhalation Toxicology* 37 (1):18-30

**Acknowledgements:**

When a publication makes use of this data set, acknowledgement of the development of the data set should be attributed to National Institute for Occupational Safety and Health (NIOSH), Health Effects Laboratory Division (HELD). This project was funded by NIOSH intramural NORA funding of the project, "Toxicological Assessment of the Airborne Contaminants released from Solid-surface Composite," CAN 93909NF

W. Kyle Mandler – oex1@cdc.gov

Walter G. McKinney - wdm9@cdc.gov

Mark Jackson - moj8@cdc.gov

Alycia K. Knepp - ydt0@cdc.gov

Sarah L. Keeley - uqz0@cdc.gov

Sherri A. Friend - shf8@cdc.gov

Lori A. Battelli - lob0@cdc.gov

Yong Qian - yaq2@cdc.gov

Contact:

For further information contact:

Pathology and Physiology Branch, Health Effects Laboratory Division, National Institute for Occupational Safety and Health, 1095 Willowdale Road, Morgantown, WV 26505 USA.