TECHNICAL BRIEF

Chemical Insights
An Institute of Underwriters Laboratories Inc.

A Strategic Research Initiative on the Dosimetric and Toxicological Analysis of 3D Printer Emitted Particles

Introduction

With the development of affordable, compact and user-friendly three-dimensional (3D) printers, consumer use is booming, particularly in nonindustrial environments including schools, offices, and homes. 3D printers have become a valuable tool in K-12 classrooms and higher education institutions because they inspire creativity and problem-solving by bringing students' ideas and designs to life. In homes and offices, they enrich the ability for creativity and productivity. But with any new technology, there are also unintended safety consequences to consider.

Teachers and students reviewing operating procedures for safely using the 3D printer technology. (iStock)

Extensive research conducted by Chemical Insights, a non-profit Institute of Underwriters Laboratories, and its research partners, have found that heating and extrusion of thermoplastics using fused filament fabrication (FFF) 3D printers result in the release of high levels of ultrafine particles and volatile organic compound (VOC) emissions into the air, presenting human health risks. These findings have resulted in the publication of UL/ANSI/CAN 2904, "Standard Method for Testing and Assessing Particle and Chemical Emissions from 3D Printers," that provides a standardized testing and assessment protocols for evaluating emissions.

This extended research will further assess the toxicological properties of 3D printer particle emissions by determining respiratory dose potentials and measuring toxicological profiles using cellular based assays.

Study Objectives

- Determine the level of particle deposition in adolescents and adults based on specific lung and breathing characteristics.
- Using epithelial cells, measure cellular responses to printer particle emissions with various feedstock materials.

Science Outcomes

This research will provide an assessment of printer emission inhalation opportunities and their impact on respiratory health with the following key outcomes.

- Develop dose response methodologies using Multiple Path Particle Dosimetry Computational Models.
- Evaluate cellular bioassays for cytotoxicity, epithelial cell responses, metabolic biomarkers, and oxidant responses.
- Statistical analysis for all cellular outcomes and differences among exposure groups.

Research Partners

- Georgia State University
- Georgia Institute of Technology

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