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Foresight

SPECIAL EDITION

Research into the Human Health Impact of 3D Printing Emissions

Advancing Chemical Insights Research Institute's (CIRI's) Research into Unraveling the Human Health Impact of 3D Printing Emissions

Three-dimensional printing (3DP) is an exciting innovation that has transformed research, manufacturing, and student experiences, particularly in STEM curricula throughout secondary and post-secondary education. As with many emerging technologies, there are unintended safety and health considerations that must be thoroughly studied, understood, and managed.



In 2015, CIRI, Georgia Institute of Technology, and Emory University began a <u>multi-year study</u> on 3D printing emissions and potential impacts on indoor air quality and human health. In 2017, CIRI and its collaborators were the first to publish a journal article that characterized particle emissions from consumer fused deposition modeling 3D printers.





In 2018, CIRI and collaborators applied a lognormal moment model to study the aerosol dynamic processes of particles emitted from a fused deposition modeling 3D printer, which had never been done before. Details of this study are published in the journal article, "Investigating Particle Emissions and Aerosol Dynamics from a Consumer Fused Deposition Modeling 3D Printer with a Lognormal Moment Aerosol Model."

In 2019, the <u>ANSI/CAN/UL 2904</u>, "Standard Method for Testing and Assessing Particle and Chemical Emissions from 3D Printers," was published. This allows for reproducible quantification of 3D printer emissions. Additionally, CIRI and collaborators published the journal articles, "<u>Characterization of</u> <u>Volatile Organic Compound Emissions from</u> <u>Consumer Level Material Extrusion 3D</u> <u>Printers</u>" and "<u>Chemical Composition and</u> <u>Toxicity of Particles Emitted from a Consumer-Level 3D Printer Using Various Materials,"</u> which examined volatile organic compound (VOC) emissions and particle toxicity, respectively.





In 2020, CIRI published, the Summary Report, "<u>3D Printer Emission Research</u>," describing that more than 200 different VOCs, including known and suspected carcinogens and irritants, are released during 3D printer operation. Additionally, extrusion temperature, printer brand and filament color, brand, and

material impacted emission levels.

In 2021, CIRI released the Summary Report, "<u>The Effect of Filtration on Particle and</u> <u>Chemical Emissions from a 3D Printer</u>." This report shares findings that local filtration reduced the particle concentration during 3D printer operation and that research is ongoing to further understand VOC emission findings.



Today, CIRI's ongoing research further assesses toxicity, evaluates options for reducing emission exposures through filtration of the emissions, and analyzes emissions in new 3D print technologies and real-world environments.

PLEASE VISIT CIRI'S 3D PRINTING PAGE FOR A FULL LIST OF PUBLICATIONS

New Research Released on the Toxicological Properties of 3D Printer Emissions



After extensive research with our research partner, <u>Georgia State University School of Public</u> <u>Health</u>, CIRI's newly released report, "<u>Dosimetric and Toxicological Analysis of 3D Printer</u> <u>Emitted Particles</u>," shows that exposure to certain 3D printing emissions may lead to cellular injury, inflammation, and oxidative damage to important biomolecules such as DNA and phospholipids that serve critical roles in the health of living human cells. Attention to key safety protocols including selection and purchase of low emitting 3D printers, providing good ventilation and particle filtration, and distancing observers from operating printers should be considered.

Create, Innovate, Stay Safe — Actionable Mitigation Strategies

CIRI's research to date has shown that 3D printing with plastic filaments can release high levels of harmful fine particles and chemicals into the air that people breathe. Find actionable insights to promote indoor air quality (IAQ) safety while using 3D printers.

TOOLKIT & HANDOUTS

- 3D Printer Safety Toolkit: A Guide for Supporting Indoor Air Quality & Human Health
- Mitigation Strategy Checklist
- 10 Ways to Promote Healthy Indoor Air Quality While Using a 3D Printer

E-LEARNING

• 3D Printers and Indoor Air Quality

WEBINAR & VIDEOS

- <u>Keeping Your Buildings Healthy: Managing 3D Printer Emissions for Occupant Safety</u> and Health
- 3D Printer Basics
- Behind the Scenes: 3D Printing

Recent Publications and Events

RECENT PUBLICATIONS

• Final report, "Dosimetric and Toxicological Analysis of 3D Printer Emitted Particles"

UPCOMING EVENTS

- <u>AAAR 40th Annual Conference</u>, October 3-7, 2022, "Impacts of 3D Printing and Mitigation Strategies on Particle Exposures in School Environments"
- <u>2022 CSHEMA Fall Symposium</u>, October 11-12, 2022, "From Research to Impact Storytelling Science for a Safer World"
- IFMA Environmental Stewardship Utilities, and Sustainability Communities Webinar, October 19, 2022, "Chemistry 101 for Building Managers"
- <u>Greenbuild International Conference + Expo</u>, November 1-3, "Wildfires + Resilience: Whole Building Approach from Design to Occupancy"
- <u>ASID Virginia Chapter</u>, November 10, 2022, "Specifying Residential Upholstered Furniture to Safeguard Human Health"



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