Technical Brief

A Strategic Research Initiative for Extended Research on 3D Printing School Studies

The Impact of 3D Printing on Indoor Air Quality in Schools and Pollutant Exposure

Introduction

The use of 3D printers in educational settings has become widely adopted as a learning practice. They are commonly used in STEAM programs for K-12 schools, and they are often used for designing and prototyping in universities. 3D printer advocates are offering educational resources and grants, making it easier for educators to acquire a 3D printer. Fused filament fabrication (FFF) is popular among primary and secondary schools, however other additive manufacturing technologies using metal powder, resins, and lasers can also be found in universities.

An extensive research project conducted by Chemical Safety and Human Health of Underwriters Laboratories Inc. with Georgia Institute of Technology found that heating and extrusion of thermoplastics using FFF 3D printers results in ultrafine particle and volatile organic compound (VOC) emissions. Ultrafine particles are small enough to penetrate deep in the respiratory system and even penetrate the human bloodstream. This health hazard can contribute to respiratory and cardiovascular stress that is more pronounced in children. This new health hazard and control mechanisms have not been addressed for educational environments.

Study Objectives

1. Evaluate how 3D printers are typically used in schools relative to type, location, length of operation, and safety engineering controls.
2. Measure the chemical and particle emissions from operating printers and how they impact indoor air quality and personal exposure of young people.
3. Compare field study data with laboratory exposure studies to see if predictive approaches work.
4. Develop exposure mitigation recommendations for the use of 3D printers in schools to maintain healthy environments.

Science Outcomes

Maintaining good indoor air quality is a key factor in ensuring healthy and productive teaching and learning environments. This research provides the knowledge to assist in building the positive contribution of 3D printing and ensuring acceptable indoor air quality. Specific research outcomes will include:

1. Obtaining comprehensive assessment/comparison of particle and VOC characterizations in school classrooms with and without 3D printers.
2. Measuring the impact of 3D printing on indoor air contamination in classrooms, non-occupational settings where little data has been obtained.
3. Defining the relationship between 3D printer emissions and spatial exposure concentrations using a numerical model.
4. Evaluating health consequences from exposure to 3D print emissions in school environments.
5. Developing guidelines for the safe use of 3D printers in schools.

Research Partners

- Georgia State University
- Georgia Institute of Technology
- Kennesaw State University
- Duke University
- Metro Atlanta School District

Additional partners may include:
- The Center for Green Schools
- ASHRAE
- EPA

Chemical Safety & Human Health, Underwriters Laboratories Inc.
2211 Newmarket Parkway, Suite 106, Marietta, Georgia 30067
W: ulchemicalsafety.org | E: ChemicalSafety@ul.org