Additive Manufacturing Safety Considerations

May 2019

3-D Printing (3DP) is an additive manufacturing technology that is experiencing widespread growth across numerous industries in recent years. School corporations are incorporating this new technology into STEM curriculum and other learning activities.

Research in the October, 2018 "Additive Manufacturing" publication, indicated that 3DP is being used in the educational system in six main ways: (1) to teach students about 3DP; (2) to teach educators about 3DP; (3) as a support technology during teaching; (4) to produce artefacts that aid learning; (5) to create assistive technologies; and (6) to support outreach activities.[1]

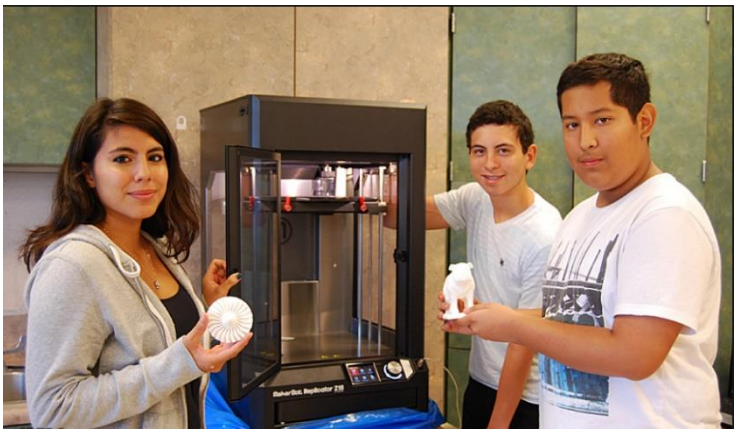
You may have already interacted with additive manufacturing technology. Eventually you may be instructing students on using a 3DP; assisting with the purchase of a new unit; or be responsible for maintaining equipment.

Emissions Considerations

Are there potential health hazards when working with a three-dimensional printer? What are those potential health hazards and what considerations should be taken when purchasing a new unit?

Exposure limits for 3D printer emissions have yet to be established. Potential inhalation hazards involve exposure to emissions from heated filaments, polymers or powders.

In a 2013 study, the Illinois Institute of Technology (IIT) noted that 3D printers can emit ultrafine particles that may cause adverse health effects. Styrene, a solvent that comes from ABS filament, is considered a "possible carcinogen" by the International Agency for Research on Cancer. The study also identified TPE filaments as a potential irritant to the eyes and respiratory tract.



2018 NIOSH research found that particle emission levels of some filaments were lower than those identified by IIT and other past studies. Chemical and particulate emissions are easily manageable with proper design. NIOSH did recommend additional research to identify low-emitting filaments. Research on ultrafine particulate and gas emissions from 3D printers continues.

[1] Ford, Simon & Minshall, Tim. (2017). 3D printing in teaching and education: A review of where and how it is used.

Safety Considerations

Filament selection: Selecting or switching to a low-emitting filament is the easiest thing to do. The properties of the low-emitting filament would have to be considered to ensure it can still effectively print the product.

Printer design: A 2016 NIOSH study noted different printer covers are better at limiting emitted particles. They also recommended printers with automated nozzle heater shutoffs that are interlocked with printer covers to reduce emissions when covers are removed for jams or maintenance.

Other safety considerations include printers with limited open slots to reduce exposure to sharp edges and internal points of operation. Locks are also recommended to reduced unauthorized use.

Ventilation

Local exhaust ventilation is the preferred method of emissions control. For multiple printers, enclosed ventilated racks that filter emissions outdoors is a cost-effective option. Allowing parts to cool before removal also helps to reduce off-gassing, while extending wait times also reduces the potential for users to come in contact with hot surfaces.

The least preferred method for controlling user exposure to emissions from 3D printers is providing users with respirators.

Future Developments

The International Organization for Standardization and ASTM International began developing voluntary safety standards in 2016 for additive manufacturing. Topics include appropriate terminology, general principles and standardized safety design criteria.

Industry forecasts for all additive manufacturing products and services in 2020 is $15.8 billion. Expected forecasts climb to $23.9 billion in 2022 and $35.6 billion in 2024. We will see continued growth in 3D printing.

Organizations are quickly realizing they can't simply buy a printer, plug it in and consider the operation ready. Training staff, performing a hazard assessment and ensuring that potential hazards are addressed is critical in creating a safe and sustainable 3D printing environment.