>> Join us in exploring the transformation of a 3D printing manufacturing company. This enterprise evolved from a humble startup in a rental space with a garage into a global leader with facilities in the United States, Vietnam, and Japan, all while prioritizing employee safety. In 2016, the Nanotechnology Research Center received a call from a burgeoning startup in California to check to make sure their workers were safe. Occupying a rental space with an adjoining garage, this innovative company was delving into next-generation 3D printing technology that used fused filament fabrication, a process that makes objects by stacking layers of melted plastic. Their aim? To revolutionize 3D printing using these filaments by incorporating carbon nanotubes and carbon nanofibers, making the material both stronger and lighter. This cutting-edge material needed higher processing temperatures, raising concerns about workplace exposures. The company also sought to create a robotic printing system for greater design flexibility.

>> Our team assessed the site and discovered low levels of volatile organic compounds and free nanomaterials, both which are potential hazards. This provided specific ideas to improve how the work is done and to help make the workplace safer for everyone. Based on these findings, our team suggested better cleaning routines, written safety rules, and separating the work and office spaces.

>> In January 2017, the company moved to a bigger facility and changed some of the materials they used. They asked the Center to check again to make sure their workers were safe in the new setup.

>> They had already followed our 2016 recommendations by moving the 3D printing machines away from the office, using personal protective equipment like safety glasses, and continuing to consider health and safety while working on robots for printing. Our team set up a portable isolation chamber to measure the emissions each printer gave off, to better understand the risks.

>> Based on the findings, our team recommended that the company better contain the 3D printers and use local exhaust ventilation to minimize the printer emission release into the work area. Our team had also suggested isolating the robotic mechanisms when turned on to keep workers from being injured during operation.

>> In 2019, the company moved into an even larger facility and asked the Center to return for another check. The company had created new materials and machines that used lasers and robotic equipment for advanced 3D printing.

>> They had also followed our team’s 2017 advice in this new setup. The printing unit was sealed and vented outside, and it had a strong safety interlock to prevent opening the chamber if the laser and robot system was powered on, or until after the emissions from the printing activities had been vented. Our tests showed that this new system was extremely effective. In fact, the air in the production area outside the enclosed printers had 94% fewer particles than the enclosed areas.

>> While the printer emissions were the focus of our team’s assessment, we saw other opportunities to improve worker health and safety in the machine shop. This included a recommendation to improve housekeeping and to avoid dry sweeping, which decreases the chance of particles getting into the air. Another suggestion dealt with reducing the noise at the worksite.

>> This collaboration is an example of how voluntary participation with the NIOSH Nanotechnology Research Center can lead to successfully supporting company growth and technology development while also protecting worker health and safety.