TIP No. 017-1023

Waste Management from Dental Three-Dimensional Printing Processes

The following guidance is based on federal requirements. Host nation, state, local, or Service-specific requirements may be more stringent.

BACKGROUND

Healthcare three-dimensional (3D) printing has become a widely used technology in many applications ranging from making prosthetics to replicate models of internal body structures derived from computerized tomography scans in preparation for surgery. Dental 3D printing is used to create crown and bridge models, dental guards, retainers, dentures, surgical guides, and more. Some Defense Health Agency (DHA) healthcare facilities print dental surgical guides for implant surgery.

WHAT IS 3D PRINTING?

Simply stated, 3D printing is a manufacturing process in which material is laid down, layer-by-layer, to form a 3D object. Several types of printer technologies are used in dental care, all of which vary in cost, speed, and accuracy (Hoffman 2020):

- **Stereolithography.** Works by exposing a layer of photosensitive liquid resin to a UV-laser beam. The resin then hardens in the desired form.
- **Digital light projector.** Exposes a liquid polymer to light from a digital light processing projector. This hardens the polymer layer-by-layer until the object is built.
- **Multi-jet modeling.** Consists of an inkjet-like 3D printing system that sprays a colored, glue-like binder onto successive layers of powder where the object is to be formed.

MATERIALS USED

Dental 3D printing uses polymer resins. Depending on the purpose of the printed object, some resins contain wax for casting and pressing crowns; come in various colors such as for dentures; may be clear for dental guards; and others contain ceramic for creating crowns and veneers.

Solvents, such as isopropyl alcohol and Tripropylene glycol monomethyl ether (TPM), are used to wash and cure the printed objects.

POTENTIAL HAZARDS

Hazards associated with 3D printing vary depending on the type of printer and materials used. Consult the manufacturer's safety data sheets for specific guidance. It is important to understand the specific hazards associated with different types of 3D printing and post processing of printed materials. Installation health and safety professionals must be involved in hazard analysis and selecting controls.

Some common hazards include:

- Breathing in harmful materials: 3D printing can release particulates, ultra fine particulates, and other harmful chemicals into the air.
- Skin contact with harmful materials: users can become sensitized to the resins and solvents, and can damage skin on contact. Thermal concerns include fire and explosion: Solvents and other materials may be flammable or combustible. High temperatures from printers can cause burns (CDC 2019).
- Ultraviolet light, laser, or radiation exposure.
- Noise.
- Other hazards from specific technologies and use environments.

HAZARD CONTROLS

To control exposures to 3D printing hazards, workplaces should ensure that installation health and safety professionals have been involved in selecting controls (Kelly 2023). Processes may need specific engineering controls (exhaust ventilation), personal protective equipment (lab coats, gloves, safety glasses, etc.), and training. These controls may need to be disposed of as hazardous waste.

WASTE MANAGEMENT

A hazardous waste determination must be made for waste resins and solvents (PL 94-580). Turn in all waste resins and solvents to the installation environmental office for proper disposal. Fully cured waste product models may be recycled as regular plastic waste; check with the recycling company or discard them as general waste.

ASSISTANCE

For questions, contact the DCPH-A Environmental Health Sciences Division at 410-436-3651 or DSN 584-3651.

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Appendix A

References

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