Tech Article

Smoothing it Out: The Best Finishing Fluids for Plastic 3D Printed Parts

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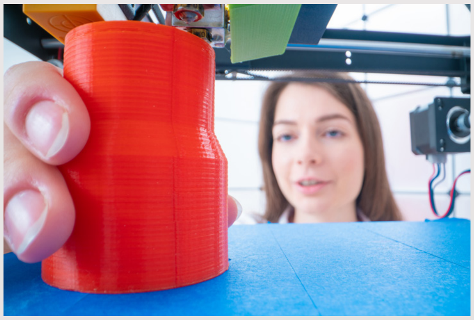

3D printing produces complex and intricate parts.

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Medical device manufacturing using 3D printing, a subset of additive manufacturing, is gaining widespread acceptance. Initially 3D printing was considered too slow and too expensive by some manufacturers to use on a large scale. It was often limited to parts prototyping and low production runs. However, recent advancements in software and hardware technologies are lowering the costs and speeding up the building process. This make 3D printing a viable method for complex medical device manufacturing.

In the past more traditional manufacturing methods limited the design of devices that were too intricate or too small. But now, 3D printing makes design possibilities nearly limitless. It is providing a practical way to make detailed, precise and patient-specific parts matched to their unique anatomies. This includes dental aligners, hearing aids, dental crowns, contact lenses, prosthetic devices and dentures. Biomedical devices can all now be 3D printed and custom made for each individual patient.

Plastic 3D Printed Parts

Historically, plastics were used to make the majority of 3D printed medical devices. That trend continues. Today over 80% of 3D printed parts are still made using thermoplastic or thermoset polymers. Metals, ceramics and other composite materials comprise the other 20%. 3D printed polymer parts are manufactured using any variety of 3D printing methods. This includes FFF, SLS, SLA, DLP or material jetting processes. Common to all these methods is that the parts are made in layers. They are constructed in progressive layers. The layers of polymers are deposited or extruded one level at a time, until the parts reach their final shape.

However, building the parts is just the beginning of the 3D printing process. Choosing the correct smoothing and cleaning fluid also plays a key role in the successful construction of 3D printing components. Since 3D parts are built layer-by-layer, the process sometimes leaves the parts with a stepped or terraced surface. That requires smoothing out the terraces to get a finished part.

Smoothing It Out

Traditional methods of smoothing out the terraces include grinding, buffing or sandblasting. However, they are extremely manual, time-consuming and often leave particles behind. Today, specialty fluids are available for use in a vapor degreaser that smooth the parts to their finished state. Immersing the unfinished parts in a fast-evaporating fluid vapor inside the degreaser smooths the parts. The fluid slightly melts the surface of the plastic parts. This levels out any irregularities and removes the terraces. It leaves a smooth finish without any leftover particles or damage to the finished part. The quality of the finished product is comparable in quality to parts using more traditional injection molding processes.

In order for the smoothing to work without damaging the parts, it is necessary to understand the composition of the polymer parts. For instance, acrylic, ABS, polycarbonate and highly basic materials with a pH 10 or above need to be approached carefully due to potential softening and swelling of the materials. Finding the best smoothing fluid can often be a delicate balance between selecting one with a high enough solvency to effectively level out the parts, but not so strong that it damages them or compromises their structural integrity.

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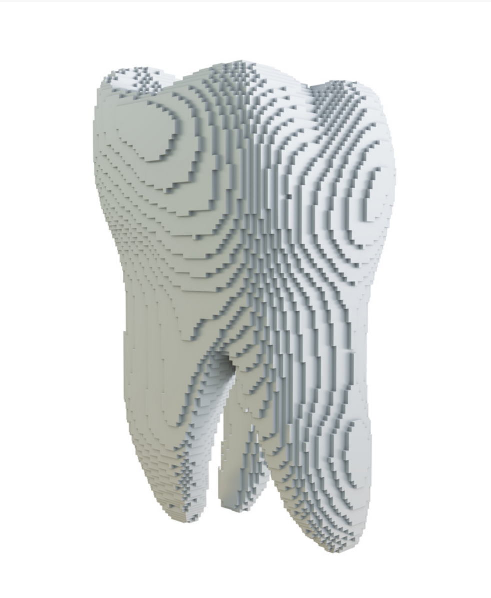


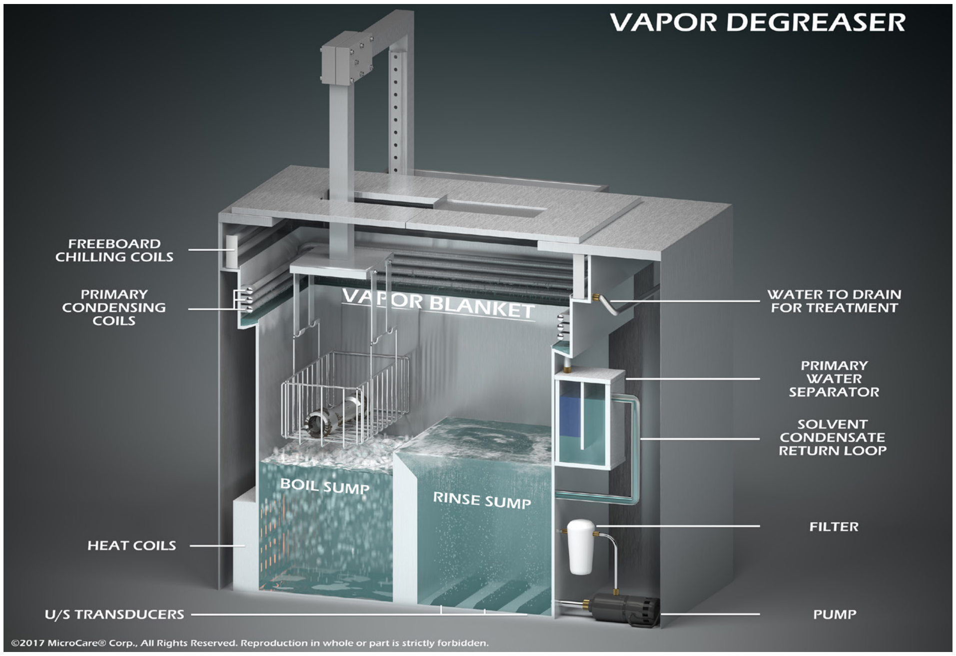
3D printed plastic parts sometimes have a stepped or terraced surface that needs smoothing.

Removing Soils

In addition to smoothing the parts, the fluid must also be effective at removing soils or particulate left behind from any additional processes. The fluid, when used in a modern vapor degreaser can be used to dissolve and clean a variety of oils, greases and waxes. Any stray particulate like dust or shavings are typically non-soluble and will not dissolve in the cleaning fluid. Therefore, the particulate must be removed using displacement cleaning where the cleaning fluid gets under the particulate, dissipates any static charge and lifts it off the surface. The key to effective displacement cleaning is to use a dense, heavy fluid that floats the particles of dust and dirt off the substrate surfaces. Today's modern fluids are typically 20% heavier than water and 50% heavier than alcohol. This makes them an ideal choice for displacement cleaning of 3D printed polymer devices.

Other Advantages

An added advantage of using a chemical-based fluid for smoothing and cleaning 3D printed medical devices is that it creates a nonpyrogenic environment and can significantly reduce the risk of bioburden. Modern day cleaning fluids dry very quickly and completely therefore leaving no residues on parts after they exit the vapor degreaser. This process offers an easy way for engineers to validate bioburden issues out of the 3D printing process.



Cleaning fluid inside a modern vapor degreaser dissolves and clean a variety of oils, greases and waxes.

Lastly, the modern-day 3D printing post-processing fluids are nonflammable and safe for use in heated machines, cold operations or in ambient temperatures. They have been formulated without the use of n-propyl bromide, methyl pyrrolidone, polyethylene glycol, heptane, or trichloroethane, which all carry health and or environmental baggage, making them better for workers and the environment.

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Today, the medical device manufacturing industry is in a constant state of flux with new, unique and state-of-the-art designs being developed daily. Yet one thing will always stay the same: even state-of-the-art designs and 3D printing manufacturing methods can benefit from unique chemistries that make some of these advancements possible. Post-processing using specialty fluids can help to make plastic 3D printing a viable option within the medical device making industry. It is essential to work with a partner that has particular experience and expertise in specialty cleaning fluids for 3D printed polymers and vapor degreasing technologies. They can guide part designers through the post-processing steps and recommend the fluids and methods that will work best.

About the Author:
Venesia Hurtubise is a Technical Chemist at MicroCare which offers precision cleaning solutions. She has been in the industry more than 6 years and holds a MS in Green Chemistry from Imperial College. Hurtubise researches, develops and tests cleaning-related products that are used on a daily basis in precision cleaning and medical applications. For more information, visit www.microcare.com.

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