

Smoothing 3D Printed Models

Posted by Marco CM - 2013/03/11 13:40

All 3d printing technology is similar in one aspect, they are all forms of layered or additive manufacturing. Naturally many forms of 3d printing leave more or less visible lines, grain , or striations on the surface of the object. There are a handful of methods to reduce or remove the layered surface appearance from 3d printed items and to produce highly smooth objects. Below I provide links to and short explanations of these various smoothing techniques develop for the additive manufacturing industry.

1. Tumble your parts!

One of the best methods for smoothing the surfacing finish of 3d printed models is with a bead tumbler. You can home make a tumbler or purchase a variety of sizes. For most 3d printed items something small like a hobby rock polisher will do. The basic concept is a drum or barrel partially filled with some type of smoothing substrate. The part to be smoothed is placed inside the drum and the drum rotates or spun for a period of time. This cause the substrate to repeatedly wash over the part's surface evenly wearing down the surface texture.

What type of filler you use depends on the material the part is made of. Plastic, Nylon, Acrylic, and Polymer based 3d prints can be smoothed using plastic beads, and pumice. Metal parts can be tumbled with steel ball bbs, sand, or pumice. Below are photographs of an industrial tumbler, a homemade tumbler and a Nylon 3d print that has been tumbled to become smooth.

<http://kraftwurx.com/images/fbfiles/images/tumbler.JPG>

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Homemade part tumbler:

http://kraftwurx.com/images/fbfiles/images/diy_parts_tumbler.jpg

<http://hackaday.com/2012/07/03/easy-to-build-parts-tumbler-you-can-add-to-your-shop/>

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Posted by Marco CM - 2013/03/11 13:42

Tumbled smooth Nylon 3d printed parts:

http://kraftwurx.com/images/fbfiles/images/wsf_polishcompare.jpg

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Posted by Marco CM - 2013/03/11 14:26

2. Acetone Dip/Vapor Deposit

ABS Plastic is one of the most common 3d print materials readily available. Unfortunately even the highest quality ABS 3d printers leave visible "stacking" of layers or build lines in the models they produce. The build lines make the final surface of the model bumpy and somewhat undesirable for consumer grade products. This is because ABS plastics have a limit to how viscous or "thin" they can become when heated and extruded from a nozzle in a 3d printer.

Although ABS is very durable and used in many consumer products and toys, 3d printed forms of ABS plastic cannot be held-up to the exact same standards for durability, strength and surface quality. Therefore the additive manufacturing industry has developed a method of chemically treating 3d printed models with Acetone in order to achieve smoothing effects on the surface.

The first method is a basic dipping process. ****Attention**** This is not a proper step-by-step instruction on how to process 3d printed parts with Acetone. The proper procedure may or may not included further precautions regarding use of Acetone. Always wear eye protection respiratory protection when working with Acetone and other chemicals.

ABS Plastic parts can be fully submerged in Acetone for a few seconds to smooth the surface. Typically small parts under 10" in diameter are placed in a bath of Acetone for under 10 seconds. The parts are then quickly removed and rinsed with distilled water to remove the Acetone and stop the chemical effects. The dipping method is tricky and not advised for parts with complex geometries or shapes. Acetone is very strong acting on ABS plastics and works by dissolving the surface. The risk is that Acetone may become trapped in the part's shape for longer than 10 seconds causing severe surface warping or softening. It is possibly to completely melt a 3D printed ABS part in Acetone.

When done properly the Acetone dip can produce extremely smooth and strong parts. The extra strength is added when the surface is fused together further by the melting/softening of the plastic. Normally layered printed parts are weak along the layer. After dipping in Acetone, the part becomes further solidified.

Vapor deposit is a less tricky and more controllable method of Acetone smoothing 3d prints. The basic concept is to deposit not liquid but low-heat Acetone vapor onto the surface of the model. Slowly smoothing the model over a period of time. This method is more time consuming and cannot easily provide the added strength of a Acetone dip but is ideal for complex model shapes and configurations.

Typically the ABS Plastic part is placed inside a small container such as a glass jar or metal can. A few mm (3-5mm) of Acetone is added to the jar or can. The amount used depends on the size of model you plan to treat. Typically this 3-5mm is good for small models under 10" in height. The part is then placed into the container with the Acetone and the entire container is heated to roughly 90C (about 200F). This can be done under safe precautions in an oven or on the heated build bed of a MakerBot. After about 10-15 minutes The vapors of the Acetone have filled the jar and soaked into the surface of the model. The longer the parts spend in the jar with the vapor the smoother they become. The parts should now be smooth and possibly semi-glossy. Repeat process if necessary.

Eventually the Acetone will become completely absorbed by the model but the trick is to watch and remove the model as just the right time. Be careful removing the parts from the hot surface or oven and provide plenty of time for your part to cool down. Usually parts will require little washing with water to remove any excess Acetone from the surface.

Here is a video link of Neil Underwood using this vapor deposit method on his homemade ABS Plastic 3d prints along with a photo of the results.

<http://www.youtube.com/watch?v=Xj53P2YzYGM>

http://kraftwurx.com/images/fbfiles/images/Smooth_3Dprints.jpg

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