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Adding Chemical Resistance to PolyJet Prototypes

By Stratasys

The environment that 3D printed prototypes operate within are varied and affect their durability and longevity. The ability to protect them from harsh chemicals and other environmental conditions help preserve their longevity and functionality, similar to the production parts they represent. This white paper discusses those conditions that 3D printed parts are exposed to and a way to increase their chemical resistance.

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Figure 1. Applying chemical resistance spray on assembled parts.

OVERVIEW

Prototype parts are used in many different applications and their ability to resist deterioration from chemical exposure and other environmental conditions depends on a variety of factors.

Rapid prototype (RP) models designed to evaluate functional use within a chemical environment are subjected to various conditions, such as temperature, reagent combinations and concentrations, and exposure time, all of which affect chemical resistance. Due to the wide range of variables that affect the shape of RP models, there is a need to more accurately establish parameters, such as usage, combination of chemicals and their resultant reactions and the geometry of the RP models, including surface finish, wall thickness and resin.

Typically, there is a correlation between the temperature of a chemical reagent and its reactivity. The higher the temperature, the greater the chemical reactivity and the more aggressive the chemical is to the RP model. Correspondingly, most chemical-resistant coatings lose their chemical resistance as temperature increases. Many chemicals, such as biocides, can affect the color, gloss, texture and performance of a chemical-resistant coating as well as the printed RP model itself.

Figure 2. Coating the inner surface of the bottle.

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Figure 3. After 72 hours the bottle is chemical resistant.

APPLICATIONS

Today, chemical-resistant applications of RP models are growing in importance. The choice of suitable applications with adapted material properties, like chemical resistance, ensures that the application requirements are met.

For durable parts and patterns, or test parts for aggressive functional testing, a post-process provides an excellent answer. Chemical resistance to corrosive agents, such as oil, gasoline and acids offers a viable solution for functional prototypes that can withstand robust performance demands.

The high chemical resistance provided by the post process also extends to the use of aerospace, automotive and medical prototypes. These industries are among the first users to exploit this solution. The aerospace industry and the automobile manufacturers take advantage of its petroleum resistance and its ability to function when in contact with different chemicals.

The use of a chemical-resistant coating on RP models that withstands the presence of aggressive materials, such as acid, bases, water, salt water and fuel, expands their range of applications. Such a coating may serve the automotive, industrial, appliance, consumer goods and other related industries that apply abrasion, chemical, corrosion, oil resistant and water repellent coatings to their products.

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INCREASING CHEMICAL RESISTANCE

Increasing the chemical resistance of 3D printed parts can be achieved with the use of a product such as Fine-L-Kote™ SR. It is a transparent, durable coating that offers chemical resistance and is recommended for harsh environments. It is UL recognized, offering excellent resistance to moisture and fungus. The coating's flexibility allows for vibration, movement and rapid changes in temperature. The aerosol coating is applied in a thin layer that won't hide part details, and then cured for 72 hours before exposure to chemicals. The result is a smooth coating that is easily applied to complex surface shapes.

The levels of chemical resistance provided by this type of coating are as follows:

- Excellent resistance (no deterioration) to diluted and concentrated acids, alcohols, bases and esters
- Good resistance (minor deterioration) to aldehydes, ketones and oils
- Limited resistance (moderate deterioration suitable for short-term use only) to aliphatic and aromatic hydrocarbons, mineral oils, and oxidizing agents

Regardless of which product you choose, the application of a protective coating can positively impact the durability and longevity of PolyJet parts. If you are unsure about whether your parts require some form of protection, a good strategy is to print a small test piece and subject it to the chemical or environment where the final model or part will be used. If no adverse effects are noted, no protection is necessary. Other types of coatings similar to Fine-L-Kote are available that offer protection for PolyJet parts from chemicals and other substances.

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