



White Paper

Expanding Applications and Opportunities with PolyJet™ Rapid Prototyping Technology

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ABSTRACT

PolyJet™ 3-dimensional rapid prototyping technology, first introduced to the market in 2000, has been proved to address the needs of a wide range of industries and applications.

With installations at leading manufacturers around the world, Objet has accumulated a great deal of experience in applying PolyJet™ technology in a wide range of industries, including footwear, toys, automotives, consumer goods, industrial manufacturing, and many more. Hundreds of companies, amongst them many of the world's largest in their fields, are using PolyJet™ -based RP systems in their design and manufacturing processes. By handling all RP in-house they can ensure confidentiality throughout the design process, reduce the risk and cost of error, promote team creativity and reduce time to market.

Through hands-on customer experience, Objet found that new applications for rapid prototyping could be realized by enabling accurate models that closely resemble the end product "look and feel" as well as its functionality.

By combining proven technology with a wide range of materials, it is possible to bring the advantages of rapid prototyping to a broader range of industries and also vastly expand the applications within those industries. This is particularly true for the manufacturing of plastic goods. For example, in shoe manufacturing, the ability to genuinely feel the flexibility of the end product by bending the model of the sole would enable design adjustments early in the design

cycle, avoiding time-consuming changes later in the process.

PolyJet™ technology jets ultra-thin 16-micron layers of Objet's FullCure® photopolymer materials, delivering exceptional accuracy and allowing any geometry, including thin walls, overhangs and even moveable parts. Currently, Objet is investing significant resources in developing new materials and extending the applicability of PolyJet™ technology.

Key words: Rapid Prototyping, Photopolymer, Jetting, Inkjet, Resins

INTRODUCTION

The manufacturing world is increasingly turning to 3D printing in an effort to meet the requirements for rapid time to market in today's competitive market place. By solving engineering problems as early as possible in the development process companies can save costs and progress more swiftly from concept to finished product.

Objet's advanced PolyJet™ technology, featuring ultra-thin build layers and the Objet family of FullCure® materials, enables more industries to embrace the technology and expand applications within each industry.

POLYJET TECHNOLOGY

PolyJet™ 3-dimensional rapid prototyping technology, first introduced to the market in

2000, has been proved to address the needs of a wide range of industries and applications.

With installations at leading manufacturers around the world, Objet has accumulated a great deal of experience in applying PolyJet™ technology in a wide range of industries, including footwear, toys, automotives, consumer goods, industrial manufacturing, and many more. Hundreds of companies, amongst them many of the world's largest in their fields, are using PolyJet™ -based RP systems in their design and manufacturing processes. By handling all RP in-house they can ensure confidentiality throughout the design process, reduce the risk and cost of error, promote team creativity and reduce time to market.

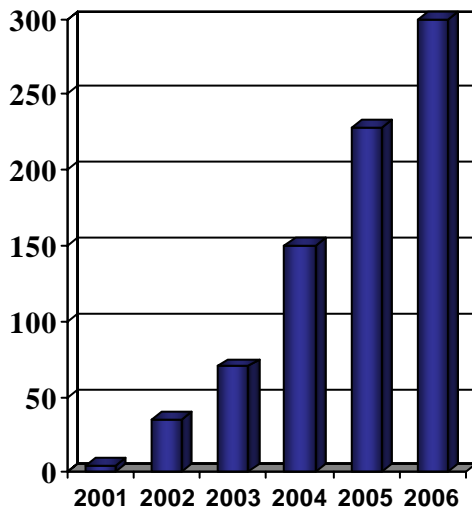


Fig. 1. Users WW adopt Objet's PolyJet™ Technology

PolyJet™ technology jets ultra-thin 16-micron layers of Objet's FullCure® photopolymer materials, delivering exceptional accuracy and reproducing any geometry, including thin walls, overhangs and even moveable parts. Each layer includes both model and support materials. The support material is necessary to enable jetting of overhangs, cavities, holes, etc. The jetting head slides back and forth along the X axis depositing a single super thin layer of photopolymer onto the build tray. Immediately after building each layer, UV bulbs alongside the jetting bridge emit UV light

and cure each layer. The internal tray moves downwards with extreme precision and the jet heads continue building until the model is complete. The finished model is fully cured and does not require any post curing. Once the support is removed, the model can immediately be used.

Today, Objet is investing significant resources in developing new materials and extending the applicability of PolyJet™ technology.

FULLCURE MATERIAL FAMILY

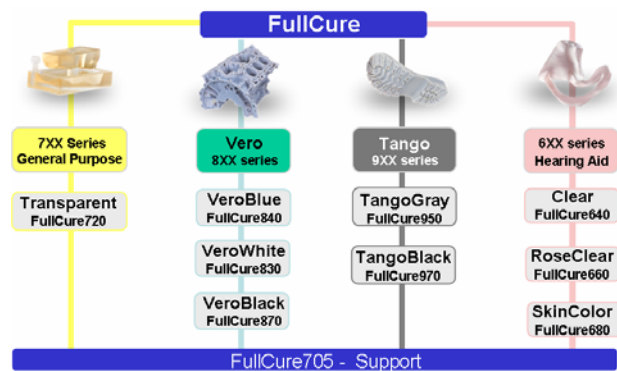


Fig. 2. Objet's FullCure Family of Materials

FullCure® is Objet's family of proprietary resins, including acrylic-based photopolymer materials. Based on Objet's PolyJet™ technology, the materials produce fully cured models. The materials are delivered in fully sealed 2kg or 3.6kg cartridges

A single Support material is used with all model materials.

The FullCure® family benefits are:

Productivity

- Instant curing ready to use models
- No lengthy post process required.

Flexibility

- Choice of materials enables a wide variety of applications
 - Transparent, colored, opaque, flexible and rigid materials
 - Specialized materials for Hearing Aids

- Ease of Use
- Same support material for all materials
 - Easily removable gel-like Support - no hard grid edges
 - Easy loading and unloading of cartridges
 - Easy switching between materials
- Environmental Safety
- Delivered in fully sealed 2kg or 3.6kg cartridges
 - No skin or eye contact
- Diversified Finishing
- Model surfaces readily absorb paint
 - Models can be machined, drilled, chrome-plated, glued or used as a mold

The FullCure® Tango series of model materials embraces new applications by providing different levels of flexibility and elasticity with Elongation at break of 47% and SHORE A of 61 and 75 for TangoBlack and TangoGray, respectively.

TangoBlack provides maximum elasticity, while TangoGray is a slightly harder, yet flexible material that provides a more controlled flexibility and elasticity. This enables the creation of models that closely resemble the “feel” of their target products, such as shoes (particularly athletic footwear), toys, and consumer electronics applications. Tango materials are also ideal for general industrial applications and rapid tooling.



Fig. 3. The Tango Series

The FullCure® Vero family of materials makes it possible to produce opaque models that closely resemble the “look” of their target products. The opaque surface enhances visualisation of details and edges. A good impact strength (40 J/m) and flexural modulus (2200 MPa), with a 20% elongation at break, enable their use in a wide range of applications. Enhanced mechanical properties offer improved humidity resistance and the ability to withstand bending. Available as VeroWhite, VeroBlue and

VeroBlack, the range of colours also enables numerous applications in different industries. For example, VeroBlack enables consumer electronics manufacturers to simulate the look of black end-products without painting.



Fig. 4. The Vero Series

The Vero family is used intensively when functional testing of engineering parts is required in prototyping, pre-production, production verification, form/fit/function testing, snap fit assemblies, RTV molding patterns and more.

The FullCure720, a transparent material, is suitable for a broad range of rigid models, particularly where visibility of liquid flow or internal details is needed. The material is also biocompatible and suitable for various medical applications.

Its main characteristics are: Tensile Strength: 60.3 MPa, Elongation at break: 15–25%, Modulus of Elasticity: 2,870 MPa, Flexural Strength – 75.8 MPa.



Fig. 5. FullCure® 720 Transparent Model

The FullCure® 6XX materials are designed especially for the unique requirements of Hearing Aids (ear molds): Clear - FullCure640; RoseClear - FullCure660; SkinTone - FullCure680. With this group of materials, Objet is taking a great step forward towards rapid manufacturing.



Fig. 6. Objet's Hearing Aid Materials

The following FullCure® materials have medical approvals:

Material	Approval
FullCure 720	Cytotoxicity
	Irritation
	Sensitization
	USP Class VI
FullCure705	Irritation
	Sensitization
VeroWhite	Irritation
Hearing Aid Materials	Cytotoxicity
	Irritation
	Sensitization
	USP Class VI

Table 1. FullCure® Family, Medical Approvals.

With the above listed materials, and PolyJet™ technology, the following medical

activities are made possible: Surgery simulation:

- Production of surgical guides over bones
- Reduction of surgical risks
- Reduction of time and hospital costs
- Production of personal prostheses
- Communication to patient
- Planning without necessity for patient presence

CONCLUSION

PolyJet™ technology has the capacity to grow with the rapidly changing requirements of the Rapid Prototyping market in the areas of material properties, resolution, speed, build size and other special feature requirements.

With the FullCure® family of materials being the perfect complement to PolyJet™ technology, more applications and solutions may be realized and shared with customers, to meet any rapid prototyping/manufacturing requirement they may have.

REFERENCES

Wholers Report 2006, Rapid Prototyping and Manufacturing, Annual Worldwide Progress Terry Wholers, Wohlers Associates Inc