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Objet PolyJet – NEW RAPID PROTOTYPING TECHNOLOGY

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ABSTRACT

For two centuries we have assisted to the continuous perfection of the Rapid Prototyping Technologies (RPT) regarding the quality of the obtained model, but also the implied costs. Thus the combination of the advantages of all RP methods took place, with the elimination of their deficiencies. This happens through the *PolyJet* method, developed by the high-tech Objet Geometries Ltd. from Israel. The method combines the using of the excellent stereolithography (SLA) materials with the *3D Printing* method, in the sense that the photosensitive polymer is directly deposited from the printing head. There can be used more types of materials simultaneously, which will assure the making of some complex models of many materials, without the subsequent assembling from different materials, thus reducing essentially the making time and assuring a higher precision. The material used for the making of supports is water soluble, making possible their elimination without mechanical intervention.

1. INTRODUCTION

Two decades ago the great dream of the designers came true, that is to see the result of their activity materialized as soon as possible. This was achieved through the appearance of the Rapid Prototyping Technologies (RPT).

These technologies are based on the making of the piece, which is the RP model, through depositing the material in the right place in the necessary quantity, without using any tool, at least in the classic meaning of the word. The making of the model is done *layer by layer*.

At the beginning these models were used only at the visualization of the product, due to the quality obtained at that time. But in time this quality became better and better, today being very good, thus allowing the making of functional models, which can be even tools. This is due to the continuous dreaming of people regarding the obtaining of high quality RP models in a short time and with low costs.

This could be done by adopting new working strategies, implicitly the apparition of new methods, the developing and improving of the used materials, respectively their combination.

2. THE *Object PolyJet* PROCEDURE

2.1. GENERALITIES

The Objet PolyJet method was developed by the high-tech Objet Geometries Ltd. from Israel.

The great achievement of this new method is that it combines the advantages of all RP methods known so far, once with the elimination of their deficiencies. This is done by combining the *3D Printing* method with materials used at SLA, which are photopolymers.

2.2. THE WORKING PRINCIPLE

The *Objet PolyJet* procedure is actually a special three-dimensional method different from the classic *3D Printing* from MIT - USA, because in this case through the printing head of jet type, the material of the pattern is directly deposited. This material is a photopolymer, whose solidification is provided by an UV light source, in comparison with laser at *SLA*.

The basic principle of this procedure is presented in the figure 2.1.

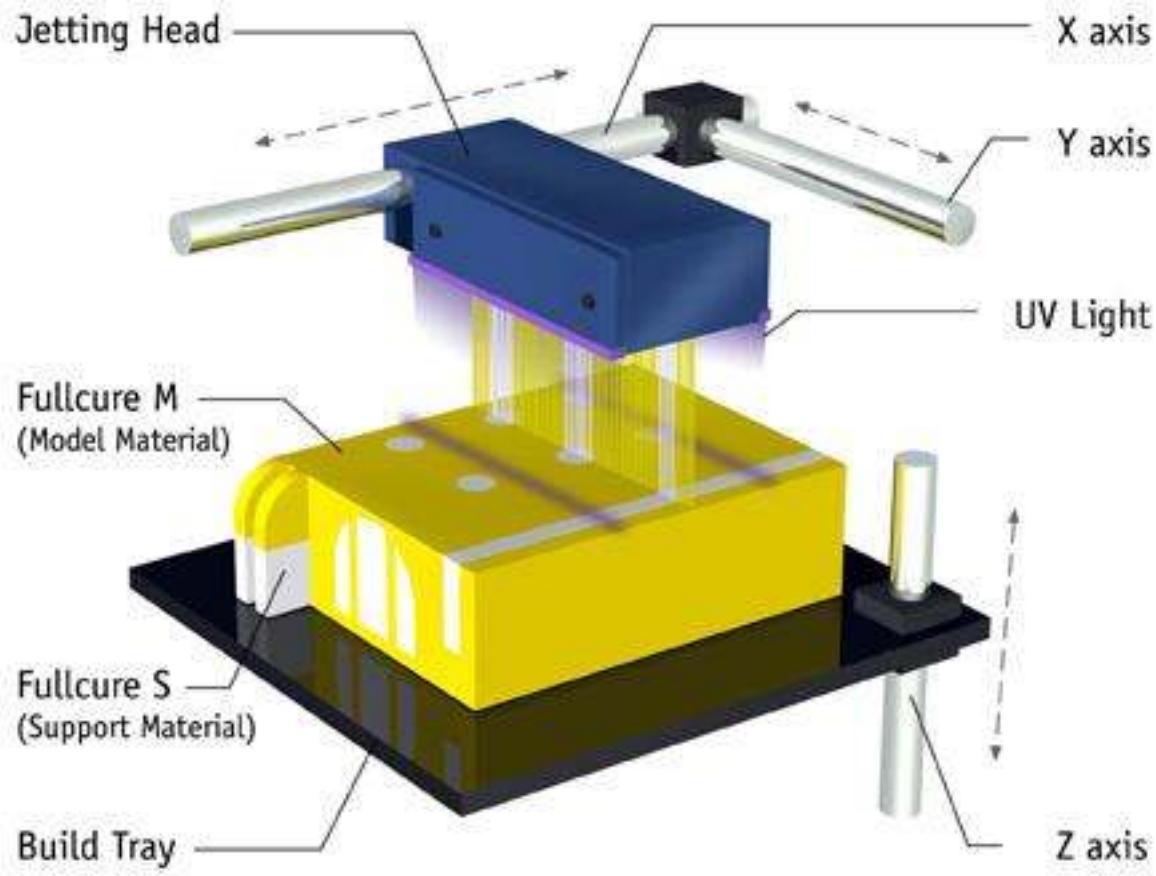


Fig. 2.1. The Objet PolyJet Process [3]

As we can notice in figure 2.1, the model makes the vertical construction movement on the OZ axis, and the "work head", the covering movement in the horizontal plan is made on the OX and OY axes. We can also notice that for the undercut areas there have to be used the so-called supports. The material of these supports is deposited once with the basic material, which provides a shorter making time. In the case of this method the generating of the supports is also made automatically.

Thus the solution adopted for this method is more efficient and cheaper than the one from *3D Printing* and *SLA*, being obtained high quality models, regarding the precision and the roughness, respectively mechanical properties.

2.3. USED MATERIALS

As mentioned before, the used materials are photopolymers, which are polymeric materials sensitive to light, meaning they are solidified under the action of light. The materials used by this method are solidified under the action of UV light.

As results from the basic principle of the process, two categories of materials are used: a main one, from which the model is effectively made, and a secondary one, used for the making of supports.

The material for supports is water soluble, which makes very simple the removing of the supports, just by keeping them in water. Thus the removal in mechanical ways is not necessary anymore, which can affect the quality of the pattern and it's time consumer.

The main material for the model can be made from more materials, which are deposited simultaneously from the printing head. Besides, these materials can also be combined through the printing head, thus facilitating the making of a "digital" material blade. This is another revolutionary aspect of the method, which facilitates the making of multi-material models. This way we remove the necessity for the parts which must be made from different materials to be made separately, perhaps through different methods, and finally be assembled. Besides the productivity, this method also provides a higher precision.

2.4 USED EQUIPMENT

The *Objet PolyJet* RP procedure is executed on the machines from series Connex and Eden of the company Objet Geometries Ltd. In figure 2.2 is presented the Connex500™ machine, and in figure 2.3 is presented the Eden500V™ machine. Both machine have 500×400×200mm work space and they accept **.stl* and **.slc* as entrance file format. The operating program is Objet Studio™.

Fig. 2.3. The Connex500™ Machine

Fig. 2.3. The Eden500V™ Machine

2.5. PERFORMANCES

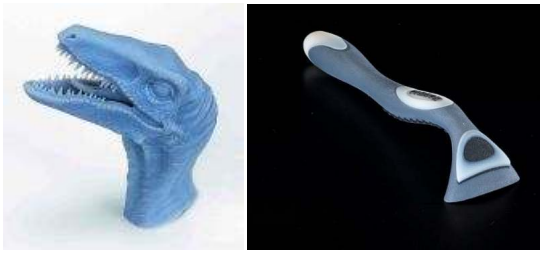
Maybe the most important feature of this method is the very small thickness, of 16 μm (0.016mm) of the deposited layer, 10 times smaller than for the other RP methods which also use plastic materials. This is very important when fine details have to be made and/or thickness for small walls.

The work precision is 0.05 mm, which provides the possibility of making some vertical walls with a thickness of only 0.6 mm.

The models obtained through this method are framed between IT12 and IT15 precision classes, with a general rugosity of Ra=(1.6/12.5) μm.

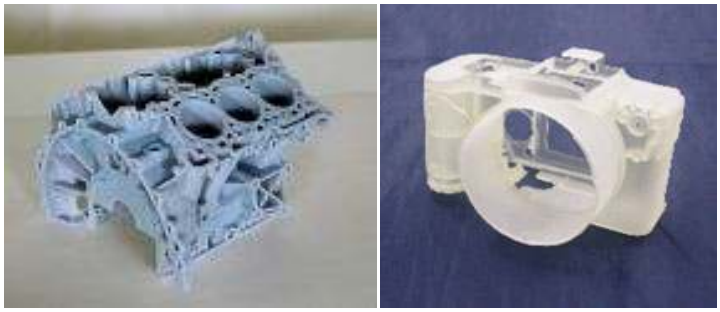
2.6 APPLICATIONS

Having in view the previously presented performances, this method has many applications, starting with the making of some models by using more materials for visualization and control (see figures 2.4.a and 2.4.b), continuing through industrial applications of making functional models or models for study (see figures 2.5.a and 2.5.b), up to medical applications of implants making (see figures 2.6.a and 2.6.b).



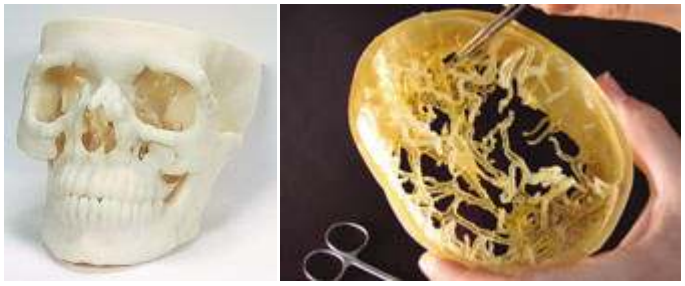
a) *b)*

Fig. 2.4. Visualization and Control with Objet PolyJet Models



a) *b)*

Fig. 2.5. Industrial Applications of Objet PolyJet Models



a) *b)*

Fig. 2.6. Medical Applications of Objet PolyJet Models

5. CONCLUSIONS

As results from this paperwork, today the RP technologies already present remarkable performances, both qualitatively and financially. This way the necessary conditions for the further developing of these technologies regarding the performances and implicitly the applications are provided.

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