УДК 338.45

АДДИТИВНОЕ ИЗГОТОВЛЕНИЕ КАК ИННОВАЦИОННЫЙ МЕТОД ПРОМЫШЛЕННОГО ПРОИЗВОДСТВА

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Additive manufacturing, or 3D printing, is a process of making an entire three-dimensional object of almost any geometric shape from a digital model.

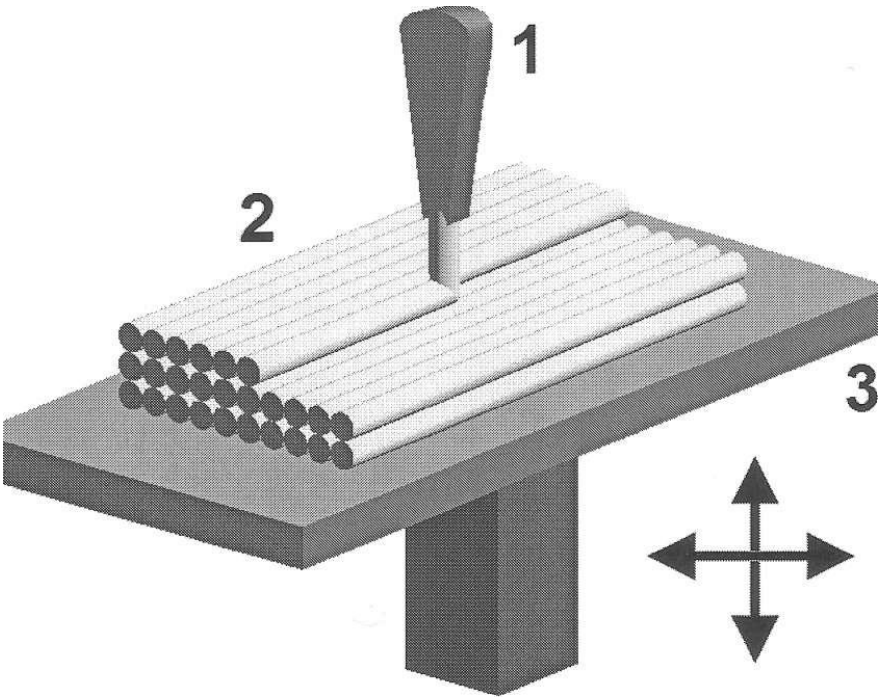
A 3D printer is a program-controlled machine which performs construction of an object through an additive printing process.

Though 3D printing technology was developed in the 80's of the 20th century, it got wide commercial distribution only at the beginning of the 2010's. The first able to function 3D printer was created in 1986 by Charles Hall.

The main principle of making 3D models is 3D scanning. 3D scanning is a process of collecting and analyzing digital data of a real object on its shape, colour and other characteristics. The data then can be used to produce a digital three-dimensional model. The system starts by applying a thin layer of the powder material to the building platform. A powerful laser beam then fuses the powder at exactly the points defined by the computer-generated component design data. The platform is then lowered and another layer of powder is applied. Once again the material is fused so as to bond with the layer below at the predefined points. Depending on the material used, components can be manufactured using stereo lithography, laser sintering or 3D printing. Additive manufacturing technology based on laser sintering has been in existence for over 20 years. Recently, many IT companies like Microsoft and Google enabled their hardware to perform 3D scanning, a great example is Microsoft's Kinect. This is a clear sign that future hand-held devices like smartphones will have integrated 3D scanners. Digitizing real objects into 3D models will become as easy as taking a picture.

Not all 3D printers use the same technology. There are several ways to print and all those available are additive, differing mainly in the way layers are build to create the final object. Some methods use melting or softening material to produce the layers. Selective laser sintering (SLS) and fused deposition modeling (FDM) are the most common technologies using this way of printing. Another method of printing is when we talk about curing a photo-reactive resin with a UV laser or another similar power source one layer at a time. The most common technology using this method is called stereo lithography (SLA).

To be more precise, since 2010, the American Society for Testing and Materials (ASTM) group "ASTM F42 - Additive Manufacturing", developed a set of standards that classify the additive manufacturing processes into 6categories according to ‹Standard Terminology for Additive Manufacturing Technologies'. These six processes are: extrusive method, powder method, polymerization, wire method, inkjet method and lamination.



Pic. 1 Extrusive method of rapid prototyping 1 – nozzle ejecting molten material (plastic); 2 – deposited material (modeled part); 3 – controlled movable table

3D engineers are starting to explore how to use additive manufacturing with a wider range of metal alloys, including some materials specifically designed for 3D printing. 3D aviation, for one, is looking to use titanium, aluminum, and nickel-chromium alloys. A single part could be made of multiple alloys, letting designers tailor its material characteristics in a way that is not possible with casting. A blade for an engine or turbine, for example, could be made with different materials so that one end is optimized for strength and the other for heat resistance.

The choice of the method in additive manufacturing depends on the type of an enterprise or plant. Such methods as extrusive, powder and polymerisation are the most popular.

3D printing is used in architecture and building, automobile industry, aero- and space industry, military industry, medicine industry, food industry, clothes and shoes, jewelry and many other spheres.

At the beginning of the 21st century there was a significant rise in sales, which dramatically decreased the price of 3D printers.

In industry 3D printing is used because of its economic benefits, which include the following: low price of 3D printers, low price of materials, low consumption of time and resources, high quality.

Additive manufacturing is now being used increasingly in series production. The technology has especially been applied in conjunction with rapid pro-

totyping - the construction of illustrative and functional prototypes. It gives original equipment manufacturers in the most varied sectors of industry the opportunity to create a distinctive profile for themselves based on new customer benefits, cost-saving potential and the ability to meet sustainability goals.

The strengths of additive manufacturing lie in those areas where conventional manufacturing reaches its limitations. The technology is of interest where a new approach to design and manufacturing is required so as to come upwith solutions. It enables a design-driven manufacturing process – where design determines production and not the other way around. What is more, additive manufacturing allows for highly complex structures still be extremely light and stable. It provides a high degree of design freedom, the optimization and integration of functional features, the manufacture of small batch sizes at reasonable unit costs and a high degree of product customization even in serial production.

Breaking with traditional manufacturing techniques, such as casting and machining material, gives 3D product designers far greater flexibility. Additive manufacturing machines work directly from a computer model, so people can devise completely new shapes without regard for existing manufacturing limitations.

Personal 3D printing or domestic 3D printing is mainly intended for hobbyists and enthusiasts and really started growing in 2011. Because of rapid development within this new market printers are getting cheaper and cheaper, with prices typically in the range of 500–2,500 $. This puts 3D printers into more and more hands.

The RepRap open source project really ignited this hobbyist market. For about a thousand dollars people could buy the RepRap kit and assemble their own desktop 3D printer. Everybody working on the RepRap shares their knowledge so other people can use it and improve it again.

It is predicted by some additive manufacturing advocates that this technological development will change the nature of commerce, because end users will be able to do much of their own manufacturing rather than engaging in trade to buy products from other people and corporations.

3D printers capable of outputting in colour and multiple materials already exist and will continue to improve to a point where functional products will be able to be output. With effects on energy use, waste reduction, customization, product availability, medicine, art, construction and sciences, 3D printing will change the manufacturing world as we know it.

3D printing is becoming more and more popular, widespread, accessible, efficient and qualitative, which means, that in the nearest future this technology will totally change our ideas about making things and goods, from producing pens to constructing houses.