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INVESTIGATION OF MODERN ADDITIVE TECHNOLOGIES OF FOUNDRY EQUIPMENT MANUFACTURING

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ДОСЛІДЖЕННЯ СУЧАСНИХ АДИТИВНИХ ТЕХНОЛОГІЙ ВИГОТОВЛЕННЯ ЛИВАРНОГО ОСНАЩЕННЯ

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For the manufacture of parts casting methods require designing special forming pattern equipment. However, the cost of such equipment created using traditional technologies, as a rule, is many times higher than the cost of products manufactured with it. In order to reduce the cost and automate the manufacturing process, additive technologies - 3D printing technologies are applied. Their use is particularly effective in pilot production, when it is necessary to often make changes to the design of parts and, accordingly, to constantly adjust such equipment for prototyping.

A variety of types of additive technologies are known, which differ in the peculiarities of the processes of building 3D products, as well as features of the design and operation of technological equipment (3D printers). The studies we spent allowed to single out the following modern additive technologies for manufacture the forming pattern equipment (Fig. 1):

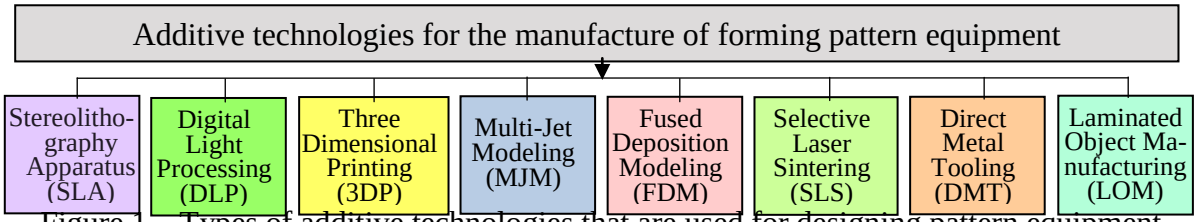

Figure 1 – Types of additive technologies that are used for designing pattern equipment

SLA - the process is that the layers of the liquid photocurable resin are sequentially applied on each other each newly applied layer selectively indurates under the action of the beam of the ultraviolet laser. DLP - the process is similar to SLA, the difference is that the photocurable resin solidifies under the action of the stream of ultraviolet rays, formed by the projector. 3DP - the powder of the building material is applied by layers on the platform, on each layer using a jet head selectively the binder is applied by drops, which glues the powder particles between themselves and the previous layers. MJM - the liquid photocurable resin or the wax heated to the semi-liquid state is applied by drops through the multi-jet print head directly to the place of part building, where the building material indurates under the action of ultraviolet rays or as a result of cooling. FDM - the fiber from the thermoplastic polymer, heated to a semi-liquid state, is applied to layers directly to the place of part building, where the applied layers are connected to each other and harden as a result of cooling. SLS - the

powder of the building material is applied by layers on the platform, each newly applied layer is selectively sintered under the action of the laser beam. DMT - metal powder is applied directly to the place of part building by laser layer-by-layer cladding. LOM - laser contour cutoffs from sheet material are packaged and joined together with an adhesive.

In the foundry production, additive technologies are used to create casting patterns, including master-patterns and removed (investment or consumable) patterns, on the basis of which casting molds are obtained by traditional technologies, as well as for the direct design of casting molds. Master-patterns are made from SLA-technology photopolymers, as well as thermoplastic polymers of type ABS, PLA by FDM technology and from photopolymers or foundry wax by MJM technology. Such master-patterns are used primarily for the subsequent creation of silicone patterns, which, in turn, used to cast the plastics, in particular, to design the investment patterns. In addition, with the help of such master-patterns, sand and plaster molds for casting metals are obtained. The investment patterns are made from cast wax with photopolymer compositions by MJM-technologies, consumable patterns - from photopolymers by means of SLA technology, from polystyrene - by SLS technology. In practice, it is of particular interest to apply additive technologies for the direct manufacturing of foundry patterns without using any specially created equipment, which in general leads to simplified cast parts manufacturing and to decreased labor content and cost [1]. Thus, the casting molds are directly manufactured by SLS technologies from foundry (silicate or zirconium) sand plated by a binder polymer, as well as by means of INK-JET technology, when the binder is applied by drops on sand or plaster layers. Such molds are used to obtain cast products from aluminum and magnesium alloys, steel.

A number of foreign companies offers 3D printing of sand molds and cores without any forming equipment directly from the printer. In addition, on the same printer we can make sand casting molds by replacing materials and programs. Forming materials are not much different from traditional sandy mixes. Fig. 2 shows the stages of the technological process: from the image part on the computer monitor to the printed sand mold and finished casting [2].

a)  b)  c) 

Figure 2 – Technological route: part's file on the computer monitor (a); printed sand mold (b); finished casting (c)

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