Секція: **Механічна інженерія**

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Oji Joshua Chukwuemeka - st. gr. IMP-42
Ternopil Ivan Puluj National Technical University
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WAYS OF INCREASING THE EFFICIENCY OF FOUNDRY PROCESSES IN SMALL-SCALE PRODUCTION

Supervisor: Ph.D., Assoc. Prof. L.M. Danylchenko

Оджі Джошуа Чуквуемека
Тернопільський національний технічний університет імені Івана Пулюя

ШЛЯХИ ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ ЛИВАРНИХ ПРОЦЕСІВ В УМОВАХ ДРІБНО-СЕРІЙНОГО ВИРОБНИЦТВА

Науковий керівник: к.т.н., доцент Данильченко Л.М.

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Foundry, as the main procurement base of mechanical engineering, has a huge range of technologies and casting equipment, which can be used to perform specific production tasks with varying efficiency. It is known, that the same casting can be obtained in many ways using various technological methods. However, the economic efficiency of its production in different cases will differ significantly [1]. Modern mechanical engineering poses new tasks for foundry, the solution of which will improve the accuracy of castings; optimal adjustment and refinement of its design. With any option of casting method, the process from setting the problem to obtaining the casting can be represented as a series of successive stages (Fig. 1).

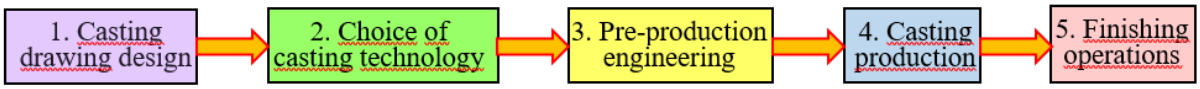


Figure 1. The main stages of new castings' manufacturing

Taking into account that the 1st-3rd stages are practically independent of production volumes, and the costs of the 4th and 5th stages are directly related to production volume of castings, then with the growth of series production the share of the 4th and 5th stages in the total cost of manufacturing one casting increases, and the share of the 1st-3rd is reduced. Thus, it is advisable to use different approaches to the preparation of the production of castings in the conditions of individual, serial and mass scales of production.

Based on the presented analysis, it is possible to formulate a number of principles for ensuring the maximum efficiency of small-scale and single foundry production: the maximum reduction in the time and cost of pre-engineering; choice of technology for the manufacturing of castings with the possibility of flexible regulation of the time and sequence of execution of individual technological operations; the versatility of the technological processes, materials and equipment used, which should make it possible to obtain castings from different alloys in a wide range of sizes, application of additive technologies. The use of additive technologies in modern foundry makes it possible to "grow" both pattern equipment and casting molds directly with minimal labor costs and a significant reduction in manufacturing time [2].

When prototyping, manufacturing pilot cast products and adjusting their design, great advantages are provided by the use of modern CAD/CAM/CAE systems, 3D printers for direct printing of casting molds and cores, which makes it possible to completely exclude the

stage of manufacturing model castings from the traditional chain of obtaining casting tooling (Fig. 2). Taking into account that in the development of new castings and development of their production, the process of adjusting the design is often repeated many times, the exclusion of the stage of design and manufacture of pattern equipment can significantly reduce costs and increase the competitiveness of production.

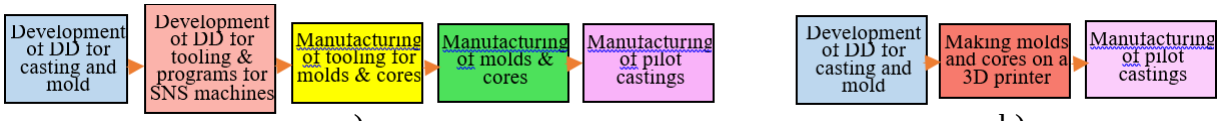
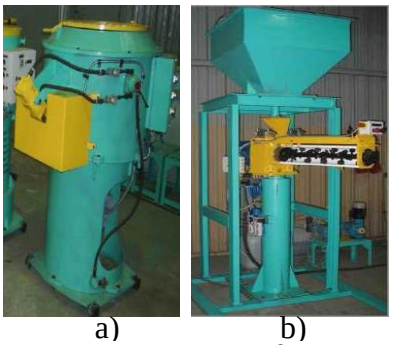


Figure 2. Schemes of pre-production engineering for new castings: traditional (a); using additive technologies for the manufacturing of molds and cores (b)

The specifics of single and small-scale production, in addition to the requirement to constantly a a new range of castings, lies in the need to manufacture casting molds of different sizes and metal consumption, prepare various alloys, and apply different approaches to organizing finishing operations. If in mass production end-to-end constantly functioning technological flows are organized with parallel execution of technological operations, then in single and small-scale production it is often necessary to use a mixed system of labor organization, with a number of operations performed sequentially with their placement in time. In such conditions, the most rational is the use of No-Bake technologies and modern cold-hardening sand-resin mixtures using batch and continuous operation. Batch mixtures, as a rule, are small-sized blade units (Fig. 3, a), which are quite simple to operate, do not require large areas and foundations for placement, and can work with most of the currently used organic binder compositions.

To organize small-scale production of molds and cores from such mixtures with acid hardeners, it is preferable to use continuous screw mixers, which make it possible to mechanize and minimize the time of mixing, transporting and filling technological equipment with mixtures (Fig. 3, b). Modern screw mixers, as a rule, are equipped with multi-circuit systems for supplying and dosing liquid binders, as well as systems for controlling temperature and heating the filler, which makes them suitable for preparing most types of sand-resin mixtures used in the modern foundry industry.

The widespread use of modern technologies and specially selected equipment with rational technological tooling allow the most efficient organization of single and small-scale production of castings, ensuring their consistently high accuracy and quality.



a) b)

Figure 3. Mixers for the preparation of cold-hardening sand-resin mixtures [3]: blade-type batch operation of various capacities (a); screw continuous operation (b)

References:

1. Vasylkiv V., Danylchenko L., Radyk D. Technological methods of workpieces manufacturing. Metal Casting: Manual / V. Vasylkiv, L. Danylchenko, D. Radyk. Edited by L. Dzhydzhora. – Ternopil: Osadtsa U.V., 2021. – 203 p.

2. Данильченко Л.М., Радик Д.Л. Особливості запровадження адитивних технологій в процесах виробництва заготовок // Збірник тез доповідей Міжнародної науково-технічної конференції присвяченої пам'яті професора Гевка Б.М. „Проблеми теорії проектування та виготовлення транспортно-технологічних машин", 23-24 вересня 2021. — Т.: ФОП Паляниця В. А., 2021. — С. 26–27.

3. Seven Steps to Energy Efficiency for Foundries / [Електронний ресурс]. Режим доступу: https://www.foundrymag.com/melt-pour/article/21928478/seven-steps-to-energy-efficiency-for-foundries.