

Development of technology for manufacturing molding and core mixtures for obtaining synthetic cast iron

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Abstract. The article presents the technology for manufacturing molding and core sands for producing synthetic cast iron and also describes the scheme of the molding-pouring line. The composition and properties of core mixtures are reflected. Shows the process of preparing the molding sand using a mixing runner. The relevance of the topic lies in the fact that the increase in cargo transportation in the world places increased demands on cast iron used to manufacture railway parts and sets new challenges in the field of metallurgy, while reliability and durability are the most important of them. The fulfillment of these requirements determines the competitiveness of products in the corresponding segment of the railway transport market.

1 Introduction

The smelting of synthetic cast iron is the main means of lifting the iron foundry to a qualitatively new stage since they can be attributed to structural materials that differ significantly from the used cast iron not only in strength properties but also in the nature and technology of production.

The process of smelting synthetic cast iron consists in the metallurgical enrichment of liquid iron with carbon and silicon in arbitrary proportions, as well as in the use of high-temperature processing, which makes it possible to obtain alloys with predetermined chemical composition and properties. To form high properties of cast iron in castings, it is necessary to destroy the imperfect structure of the initial charge materials. The use of induction furnaces for smelting synthetic cast iron allows for deep thermal processing, refining, modification, and alloying of liquid metal.

The raw materials for the production of synthetic cast iron are steel scrap, sheet metal, shavings, and other cheap, low-grade metal waste. Currently, the metal utilization rate in mechanical engineering is 0.7, i.e., 30% of the metal goes to waste, most of which has

Materials for molding and core mixtures must be checked at the entrance control by the technical control department (TCD 100%) following Russian State Standard GOST 24297-2013 with an appropriate mark in accounting accompanying documents.

Quartz sand is dry and air-dry with humidity not higher:

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-for molding mixtures up to 3%;

-for core mixtures up to 2%;

The spent molding mixture should be separated, sifted through a sieve with a cell of no more than 5x5 mm, dry, ground molding clay, sifted through a sieve with a cell of 2x2 mm, sulfite bard should be stored in a closed container with a lid. Garbage is not allowed to enter. Serve to runners in buckets; silver graphite should be stored in bags in a closed room [4,5].

The preparation of mixtures based on the NOVANOL 165 binder should be carried out according to TI No. 39.002.2014. Preparation of mixtures based on liquid glass in a mixer mod. ICM-050-02 to produce according to TI No. 39.003.2014. Use quartz sand instead of chromite sand. The composition and properties of the core mixtures are shown in Table 1.

Table 1 - Composition and properties of rod mixtures

The mixture composition, %				The mixture properties
Quartz sand	Novanol 165	Glass liquid	Technical water	Tensile strength of solid samples, MPa (kgf/cm ²)
100	4.5-6.0	-	-	0.15-0.2 (1.5-2.0)
100		10,0-12,0	2,0	Not less than 0.2 (not less than 2.0)

2 Methods

The method of sampling and preparation of a sample for testing according to Russian State Standard GOST 23408-78; general requirements for test methods according to Russian State Standard GOST 23409.0-78; the method for determining moisture content is made according to Russian State Standard GOST 23409.5-78, the method for determining gas permeability is made according to Russian State Standard GOST 23409.6-78, the method for determining the strength is made according to Russian State Standard GOST 23409.7-78.

Note: Molding and core mixtures should be selected to determine the moisture content, gas permeability, and strength at least 1 time per shift.

When manually manufacturing rods in one-piece boxes, perform the following operations:

- clean the inner surface of the box from dust and apply a separating compound to its walls;

- pour a portion of the core mixture into a box (slightly more than half the height), install the frame, and seal the mixture with a wooden rammer;

- pour the mixture slightly above the side of the box (by 6 - 8 mm) and seal again;

- clean off the excess mixture from the surface of the drawer with a ruler and prick the ventilation ducts with a shower head so that the end of the shower head does not reach the bottom of the drawer by 5-10 mm;

- dry the rods with carbon dioxide; blow small rods with carbon dioxide in batches under an umbrella (sealed box). To do this, carbon dioxide is fed under the umbrella 2 times for 20-30 seconds with a break of 2-3 minutes;

- medium rods should be blown into the body through a metal tube for from 1 minute directly in the rod boxes, thereby eliminating the possibility of their deformation;

- the purge pressure should be 1 atmosphere, and the optimum temperature of the mixture when it is purged is 18 ... 22 ° C.;

- after drying, tap the box (push the rod) with a wooden hammer;

- carefully remove the rod box from the rod;

- if necessary, repair the rod;
- it is not allowed to idle chemically hardened rods for more than 12 hours.

Preparation of the molding mixture using a mixing runner (Roller mixer) of the 114M brand with a capacity of 20 m³ / hour. Preparation for 2000kg of kneading, the sequence of operations:

- turn on the runners by pressing the "Start" button on the control panel;
- load the spent mix 1820 kg into the runners;
- load dry quartz sand 150 kg into runners;
- pour bentonite 30 kg into runners;
- stir the mixture for 2-3 minutes;
- pour 20 kg of sulfite-yeast brew into the runners;
- stir the mixture for 2 minutes;
- turn off the runners by pressing the "stop" button on the remote control;
- to control the properties, it is selected for 0.5 liters of the molding mixture capacity of three places and sent to the laboratory (50% OTC control);
- when a satisfactory result is obtained, release the batch into the conveyor belt.

Note:

- a. If the humidity is higher than normal (Table 2), add dry bentonite.
- b. If there is insufficient humidity, add sulfite-yeast brew.
- c. Loading is carried out using a telfer Q = 5 tons. The container with sand is loaded onto the runner's bowl. The composition and properties of the molding mixtures are shown in Table 2.

Table 2. Composition and properties of molding mixtures

The mixture composition, %				The mixture properties		
Waste mixture	Quartz sand	Bentonite	Sulfite-yeast mash (KBJ)	Gas permeability, unit	Compressive strength of raw samples, 105 Pa (kgf/cm ²)	Humidity, %
90-92	6.5-8.0	1.0-1.5	0.5-1.0	80-100	0.3-0.5	3.4-4.5

3 Results and Discussions

The preparation of molding mixtures on vortex mixers is carried out according to the instructions of TI No. 39.004.2014.

The finished mixture is sent to the automatic molding line (AFL).

Figure 1 shows the scheme of the molding-filling line.

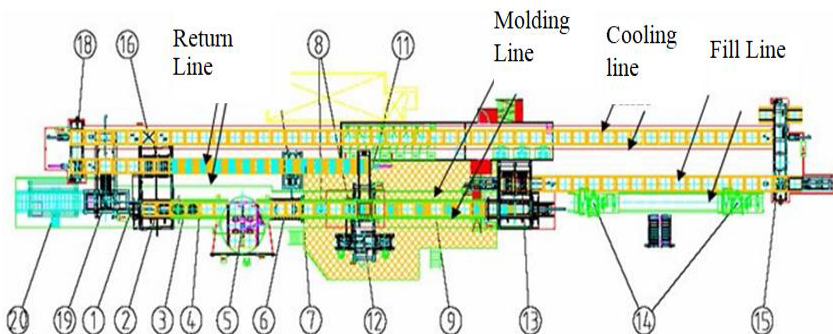


Fig 1. The scheme of the molding-filling line

The line operation procedure. After the knocking-out process, empty pairs of flasks are permanently fixed on the return line and transported to the beginning of the molding section using a device for moving and steaming empty flasks (2). Then, with the help of a transport cylinder (1), they are shifted along the molding section. Then the inner surfaces of the flasks are cleaned using a cleaner device (3) from the adhering sand residues. And with the help of a contour cleaning and control device (4), the flasks are cleaned from the outside, and the contours are checked for solid metal residues.

In the double molding machine EFA-ZFA-SD 5 (5), the top and bottom half-forms are made simultaneously. The holder of model plates in the machine with sand-filled flasks and a filling frame on it rises from the turntable using the lifting table of the molding machine to the working position under the frame of the sealing device. At this time, the seal occurs. The sealing process begins by opening a special patented SEIATSU valve with the passage of air flow through the molding mixture. In contrast, the required amount of air is determined by adjusting the opening time of the valve. By the subsequent pressing force from above, the compaction process is completed. By lowering, the manufactured molds are removed on the roller of the molding line and separated from the model. After moving the flasks along the molding line, the molding machine is ready to produce the following semi-molds. In the flask tilter (6), all half-forms rotate 180°, fret up. While moving along the molding line, the counterplate of all half-forms is cleaned with a knife to cut off excess mixture (7) flush with the edge of the flask. Then, in the half-shape of the top, with the help of automatic drilling devices (8), gating funnels and ventilation holes are produced. On the roller of the molding line (9) between the two tilters, the semi-molds can be sorted, controlled, equipped with rods, and blown. The pallets remaining on the return line in the trolley cleaner (10) are freed from the stuck mixture with the help of scrapers and brushes and cleaned. The transfer trolley (11) moves the cleaned pallets to the molding line. Then they are lifted utilizing a lifting table to the semi-forms of the bottom located at the top. The rods are inserted into the lower half-forms using an automatic device for positioning the rods (12). The rods are alternately transported by two trolleys to the rod stacker. From this moment on, the pallets are moved side by side along the molding line.

At the end of the molding line, by inverting the half-forms of the top and bottom with the pallet using the removal and pairing device (13), they are removed to the filling line, paired, and then fastened with staples. The finished molds in the assembly are then moved along the filling line using a transport cylinder. Next, the paired molds are filled with two filling machines (14). At the end of the filling section, the filled molds are taken by a transfer trolley (15) and transported to cooling line 1. A lifting device (16) on cooling line 1 moves the flasks to the refrigerator. There are, respectively, at the ends of the cooling lines (2, 3, 4, and 5), lifting stations (17) with transport cylinders that ensure the passage of the flasks through the refrigerator. At the end of the cooling phase, the flasks are received by the transfer trolley (18) and transferred to the return line. In the device (19), a lump of the mixture is squeezed out from the bottom of the flasks using an extrusion plate, and by removing the lump is delivered to the chute for separating castings from sand (20). At the sand separation chute from the castings, the sand falls through the grating system onto the conveyor belt and is brought back to the mixing system.

4 Conclusion

The use of cheap metal waste for smelting synthetic cast iron reduces its cost by 25...30% compared to conventional cast irons of secondary remelting.

The efficiency of technologies for smelting synthetic cast iron in an induction furnace with a different proportion of steel scrap in the composition of the metal charge is investigated. It is shown that with an increase in steel scrap in the metal charge, the melting

time increases, the specific consumption of electricity, the consumption of coke, the hardness of the block, and the yield of the usable decreases.

Synthetic cast iron is used to produce a variety of castings for responsible purposes: carriage and locomotive pads, friction wedges, pistons D100, cylinder liners D100, crankshafts, cylinder blocks and heads of internal combustion engines, wear-resistant castings, machine casting, etc.

Expected gross income in production:

1. Carriage and locomotive pads - 3.815 billion soums/year
2. Friction wedges - 1,931 billion soums/year

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