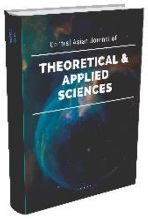

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Improvements in Obtaining Thin-Walled Casting Details Through Liquid Glass Mixtures

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Abstract: *The article presents the defects that may occur in the production of thin-walled cast parts from gray cast iron using liquid glass mixtures, some shortcomings and modern technologies of casting thin-walled cast products using resource and energy – efficient innovative casting technologies.*

Keywords: *cast iron, gray cast iron, liquid glass mixtures, liquefaction, foundry, model, sand – clay, mold, cementite, alloys, thin – walled casting.*

Introduction

Molds made from fast – hardening plastic mixtures on liquid glass are used to obtain large castings from cast iron, steel, and non – ferrous alloys weighing more than 5 tons with wall thicknesses up to 200 – 300 mm under single and serial production conditions. In this case, the liquid-glass mixture is used as a facing mixture, applying it to the model with a layer 50 – 70 mm thick and filling the rest of the flask volume with a filling sand-clay mixture. Thick-walled shell molds and rods are also made from liquid glass mixtures, assembled in a metal jacket with backfill, for example, from sand, coarse steel or cast iron shot, fireclay chips. The liquid – glass form after the model is removed is chemically cured by purging with carbon dioxide.

The resulting silicic acid gel binds the sand grains during curing. The curing time, depending on the intensity of the CO_2 purge and the dimensions of the mold, averages 6 – 7 minutes [1,2].

Main part

Currently, liquid glass is used in many foundries as the most convenient and inexpensive binder. However, its use is constrained due to its poor knockout from castings and low regenerability, which significantly affects the expansion of its scope for producing castings from ferrous and non-ferrous metals and alloys. Curing of liquid glass mixtures is possible in various ways. One of the breakthrough directions in the introduction of liquid-glass mixtures is the development of the most appropriate curing process that provides the required physical and mechanical and technological properties, as well as the quality of manufactured castings from ferrous and non – ferrous metals and alloys [3].

The DSP – 05 electric arc furnace was chosen for casting experimental samples in the “Casting Mechanics” workshop of O‘zmetkombinat JSC. Gray cast iron of the SCH24 (GOST 1412 – 85) brand and ferrosilicon FSi75 (GOST 1415 – 93), ferromanganese FMn88, FMn90 (GOST 4755 – 91), copper phosphide CuP_2 – 9, CuP_2 – 10 (GOST – 4515) were used.

The following solid (SCH24), secondary cast iron alloys were used to liquefy the samples of this experiment. Particular attention was paid to the fact that the content of phosphorus and sulfur, which are harmful elements in the mixture, does not exceed 0.01 – 0.04%. The temperature of liquefaction during casting of the researched samples was from 1400 to 1470 ^oC. Before pouring the liquefied alloy into the furnace, slag cleaning was performed. The temperature of pouring the liquefied alloy into a sand-clay mold was 1400 to 1460 ^oC.

SCH 24 – 44 gray cast iron GOST 1412 – 85, which is used in the casting of lifting window parts at the O‘zmetkombinat enterprise, and in the samples with the proposed new composition, the amount of elements is given in table 1 below.

Table 1

Cast iron mark	**C**	**Si**	**Mn**	**P**	**S**	Cr	Cu	**Ni**
СЧ24 – 44	2,9 – 3,2	1,2 – 1,6	0,8 – 1,2	0.7 – 1.0	0.1 – 0.2	0.2 – 0,3	0.1 – 0.5	0,03 – 0.04

During the molding process, a 3D-printed model of acrylonitrile butadiene styrene (ABS) was used in laboratory conditions. The accuracy of the dimensions of the 3D-printed models, the smoothness of their surfaces, and the possibility of casting bevels on the walls ensured that the casting details were flawless (Pic 1).

Picture 1. Models made on a 3D printer

The 3D printer models presented in Figure 1 have been coated with 0.1 - 0.2 mm gray graphite on their surfaces in order to prevent defects from being observed in the mold as a result of good separation from the mold [4 – 8].

Research methods. Produce loading from 20 to 30 kg of coke in portions from 2 to 3 kg. After melting the mixture, the bath is thoroughly mixed with a special spoon, a sample is taken and sent to an express laboratory to determine the mass fraction of carbon and other elements. The end of the melting period is considered to be the complete melting of the charge, with a melt temperature not exceeding 1450 °C. Quartz sand is introduced to form slag. After downloading the slag, ferrosilicon, ferromanganese are introduced in full and aged for 10-15 minutes. During the melting process, a sample is periodically taken to determine the mass fraction of carbon and other elements. The sample is taken from three places of the metal mirror. The temperature of the melt is measured. The release of the melt is carried out at a metal temperature of 1420 to 1430 °C. By the time the melt is released, the ladle lining must be cleaned of metal and slag residues. The temperature of the pouring ladle lining should be from 800 to 850 °C. When released into a jet or into a ladle, copper phosphorous is added with a mass of 2.5 to 3.5 kg per 1 ton of melt. A glass sample is taken and sent to the Center Laboratory Kombinat to determine the full chemical composition.

Currently, several research works have been carried out under the cooperation of researchers of the Uzbek-Japanese Youth Innovation Center at the Tashkent State Technical University and JSC "Uzmetkombinat" the thin-walled lifting roof used in the rolling shop was cast from SCH 24-44 cast iron using a model made on a 3D printer using a liquid glass mixture in the "Casting – Mechanics" workshop of "Uzmetkombinat" JSC. The composition of the mold mixture used in the molding process is shown in Table 2 below.

Table 2

Quartz sand, %	Liquid glass, %	Hardener
99 – 100	4 – 6	CO_2

Molding facing mixtures for the preparation of casting molds are prepared according to the factory technological instructions. Preparation of the casting mold is carried out by a pneumatic rammer in paired flasks. The packing density of the casting mold should be from 35 to 40 kgf/cm^2.

Drying of the surface of the casting halves is carried out by gas burners with an open flame for 5-10 minutes. The assembled casting mold is loaded. The minimum weight of the weights must be three times the total weight of the castings. The load is placed symmetrically (Pic.2).

Picture 2. The process of casting a molded thin-walled lifting roof detail using a liquid glass mixture.

Conclusion.

In the course of this study, a new technological innovation process of model preparation and casting for thin-walled lifting window detail used for rolling production was described. In the course of the research, it became known that the molds made with the help of liquid glass have many conveniences and advantages in the casting of heavy-walled complex structural details. Because the resource is efficient and accuracy in the casting process showed high efficiency.

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