T. Ruda, Junior specialist student
N. Barbelko, PhD in Pedagogy, research and language advisor,
Berdychiv College of Industry, Economics and Law

INNOVATIVE PROCESSES IN FOUNDRY PRODUCTION

The number of innovative processes increases every year in the foundry industry. This article deals with new methods for refining metal and production of porous metallic materials.

A new method for refining metal has been developed lately. The essence of this method is that the metal and salt are melted separately. The molten salt, the specific gravity of which is less than the specific weight of the metal in 1.5-10.5 times, is subjected to vibration and molten metal is poured into it. By the way, the less specific gravity of salt and metal, and the less the contact surface of salt and metal, the more intense the vibration of the molten salt is carried.

Such combination of new features with known ones makes it possible to reduce the laboriousness of the metal refining process, to obtain a more pure metal, to improve the quality of metal, to reduce energy costs and the cost of metal cleaning [3].

The method is carried out as follows. The salt, for example, the barium salt, is melted, and the metal, for example, aluminum or an aluminum alloy, is melted separately. Moreover, the molten salt should have a specific gravity less than the specific weight of the metal, which corresponds to the use of barium salt and aluminum. Molten salt is subjected to vibration and molten metal is poured into it. Molten salt, having a smaller specific weight than the metal, passes through the metal melt, cleaning the metal from nonmetallic inclusions. Vibration of molten salt increases the efficiency of metal cleaning from non-metallic inclusions. After passing through the metal, the salt melt accumulates on the surface of the metal, the melt vibration is stopped, the salt is drained from the metal, and the purified liquid metal is used for casting. This process can be repeated, which leads to a complete purification of the metal from nonmetallic inclusions. After that, the salt is cooled, dissolved in water and the nonmetallic materials transferred from the metal are removed from the solution, the water is evaporated, the purified salt is dried, and then it is melted and reused for the above process. The amount, shape and composition of nonmetallic inclusions removed from the metal are determined from the non-metallic materials extracted from the solution.

The choice of the vibration intensity of the molten salt depends on the difference in the specific gravities of the salt melt and the metal to be cleaned, as well as on the contact surface of the molten salt with the molten metal, the required degree of metal purification from nonmetallic inclusions. The smaller difference in the specific gravities of salt and metal, and the less contact surface of salt and metal are, the more pure metal is required, the greater vibration intensity of the molten salt is needed. The specific gravity of the salt melt should be in 1.5-10.5 times less than the molten metal poured into the molten salt.

In practice this method is carried out as follows. The water-soluble barium salt is melted in a crucible furnace and aluminum is melted separately in another crucible furnace. The volume of the molten material is the same; the capacity of the crucibles is greater than the double volume of salt and metal. The temperature of the molten materials is raised to 800 ° C., then a vibrator attached to the crucible with the molten salt is added and the molten aluminum poured into the molten salt. After passage of the salt through the metal and the accumulation of molten salt on the surface of the metal, the vibrator is turned off and the molten salt is poured along with the molten metal into the crucible in which the aluminum is melted. Then, the molten salt is drained from the molten metal, and the metal is used to fill the castings. After cooling, the salt is dissolved in water, nonmetallic materials are removed from the solution, analyzed them, the water is evaporated, the salt obtained from the solution is dried, melted again, and used for the purification of aluminum from nonmetallic inclusions [4].

With the help of this method, the amount of nonmetallic inclusions in the metal is in 2-3 times less, the duration of the metal refining process is in 3.5-5 times less, the electric power consumption for the process is in 1.5-2.6 times less, the tensile strength of the purified metal is in 1.2-1.5 times higher than when the metal is refined with the help of other methods.

The proposed method can be used not only for refining aluminum alloys, but also alloys containing copper, iron, tin, lead, nickel, chromium, silver, gold, platinum and other components [2].

A new method for the production of porous metallic materials and products has been developed lately. The technical result of the proposed method is simplification, reduction of labor input, obtaining porous castings with heat-insulating properties, due to the use of inexpensive, non-deficient gas-producing substances.

The technical result in a method for producing a porous casting comprising material melting, adding to the form of a gassing substance, and casting a melt into a mold, an organic substance is achieved by using a gassing agent, which is added to the mold prior to the formation of the melt crust, which is poured into the mold with overheating in 50-150 degrees. In this case, according to the invention, black soil, humus, peat, silt, rosin, crushed paper, wood, plant residues, powdered hydrocarbons, carbonates is used as a gassing organic substance.

Porous castings, containing voids in the form of gas shells and channels of various shapes, can be obtained from various metallic and nonmetallic materials (cast iron, steel, copper, aluminum alloys, silica, high-alumina, glass compounds, and plastics). The shape, dimensions, weight of hollow castings can be as required. The quantity and composition of the gassing substances added to the mold are determined on the basis of the requirements of the degree of emptying of the material to be filled into the mold, the composition of the molten material, the temperature and viscosity of it when it enters the mold, the cooling rate of the cast material in the mold [5].

Application of inexpensive, non-deficient gas-producing substances such as: black soil, humus, peat, silt, rosin, crushed paper, wood, plant residues, powdered hydrocarbons, carbonates makes the proposed method economical and allows using waste or low-value materials for the process [1]. The choice of the temperature of the molten material, at which the melt enters the mold, is made taking into account the fact that the amount of heat of the melt entering the mold should be sufficient to decompose the gassing substances and form the necessary quantity of gases. Before the formation of the crust of the material that solidifies in the form of a material, the temperature of the melt entering the mold should be 50-150 degrees higher than for the conditions for obtaining a dense cast of the same material. Under the influence of the heat of the melt entering the mold, the decomposing gassing substances form gases and vapors that pass through the solidifying material and form pores and voids in the casting. The amount of evolved gases must be such that not all gases leave the casting, and some remain in the form of bubbles in the casting and form numerous gas shells and voids of the required dimensions and in the right places in the solidified material. Depending on the thickness of the walls of the casting, the mass, temperature, viscosity of the melt, the amount of heat required for the decomposition of the gas-melt material, the composition of the gassing substance, the quantity and its placement in the mold is selected. The gaseous substances can be added to the molding mixture, making it a lining of the mold, which is destroyed when the casting or a permanent mold (metal, refractory) is knocked out.

The porous castings, having a large number of voids, acquire heat-insulating properties and have high strength (at a lower mass, less specific weight compared to the same dense castings). These cast products can be used instead of dense, heavy, expensive refractory molds in heat exchangers, recuperators, regenerators. They can protect from the cold the buildings and structures, so it is possible to use them to make the walls of industrial facilities, the details of energy devices [4].

This method is applicable for the production of porous castings of steel, copper, aluminum, lead alloys, molten cupola slag, glass, and plastic. The composition and amount of gassing substances can be varied within wide limits depending on the technical requirements for the porosity of the castings.

REFERENCES

1. Малых С.В. Рыночная оценка инновационного процесса в литейном производстве : Моногр. / С.В. Малых. – О. : Тес, 2004. – 110 с.

2. Молдован О. О. Структурна трансформація чорної металургії як чинник економічної безпеки України : автореф. дис. .. канд. екон. наук : 21.04.01 / Молдован Олексій Олександрович ; Нац. ін-т стратег. дослідж. – К., 2012. – 20 с.

3. Теоретичні засади регіональної промислової політики : монографія / К.І. Ткач ; наук. ред. Б.В. Буркинський. – Одеса : Астропринт, 2008. – 280 с.

4. Черный А. А. Инновационные процессы в литейном производстве / А.А. Черный, А.В. Ковалева, С.И. Соломонидина // Труды Международного симпозиума «Надежность и качество». – Том 2. – 2008. – С. 73-75

5. Черный А.А. Компьютерные программы математического моделирования и расчетов по математическим моделям : учеб. пособие. – Пенза : Изд-во Пенз. гос. ун-та, 2006. – 197 с.