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(54) **A method for producing composite zones in castings**

(57) A method for producing composite zones in castings, characterised in that on the walls and / or on the bottom of a foundry mould or die, shaped inserts are placed, comprising the reactants of synthesis of the selected type of carbide undergoing the SHS reaction, wherein the group of carbides comprises carbides of niobium, titanium, molybdenum, tantalum, vanadium, tungsten and zirconium, and wherein the mutual atomic ratio of components necessary for the reaction of the formation of a given carbide is corresponding to the stoichiometry of this carbide, and wherein the shaped inserts comprising a metal - graphite mixture are prepared by the known methods of powder metallurgy, and when placed in the mould cavity or die cavity are poured with the previously prepared iron-based cast alloy.

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Description

[0001] The present invention relates to a process of manufacturing composite zones in iron alloy-based castings, designed for structural components resistant to abrasive wear.

[0002] Iron alloys with increased hardness represent the largest group of materials used in the manufacture of structural components resistant to abrasive wear. Among these materials, the most commonly used are cast steels: mainly martensitic, and austenitic with manganese and chromium, and to a lesser extent cast irons: white martensitic cast iron, as well as chromium cast irons. Among the materials resistant to abrasive wear, a separate group form composite materials reinforced with hard ceramic phases such as nitrides, carbides, borides or oxides. One of the methods to obtain hard ceramic phases is the SHS method (*self-propagating high-temperature synthesis*) disclosed, inter alia, in the publication by A.G. Merzhanov, Journal of Materials Processing Technology, Vol. 56, year of edition 1996, pages 222-241, which enables a synthesis of these phases from reactants of the atomic ratio corresponding to the stoichiometry of a given compound. An example of the use of this method for the fabrication of cast in situ composites is the technology of SHSB (*self-propagating high-temperature synthesis in bath*), in which the initiation of the reaction occurs at the instant of placing the packets with reactants in a crucible of the furnace holding liquid alloy. At that instant, the ceramic particles are formed as a result of violent exothermic reaction initiated by heat collected from the liquid metal. Next, as a result of the effect of eddy currents raised by the induction furnace, a vigorous stirring of the said ceramic particles occurs. As a result of this process, the ceramic particles are dispersed in the entire volume of the liquid alloy. This method has been disclosed, inter alia, in the Polish patent specification No. 190 605.

[0003] Polish patent specification No. 167 197 discloses a method for manufacturing by the casting route a layered material, wherein the said method consists in this that on the bottom of the mould cavity, or on a "scaffold" in the mould cavity, a ceramic component in the form of granular electrocorundum layer is introduced, said ceramic component being next poured with cast aluminium alloy.

[0004] Moreover, patent application CN 1868635 discloses a method for obtaining a composite material based on steel, locally reinforced with TiC particles, which are synthesized from the compacted mixture of powders of Al, C, and Ti- Fe at high temperature in a foundry mould.

[0005] A method for producing composite zones in castings according to the present invention consists in this that on the walls and / or on the bottom of a foundry mould or die, shaped inserts are placed, comprising the reactants of synthesis of the selected type of carbide undergoing the SHS reaction, wherein the group of carbides comprises carbides of niobium, titanium, tantalum, molybdenum, vanadium, tungsten and zirconium. The mutual atomic ratio of components necessary for the reaction of the formation of a given carbide is corresponding to the stoichiometry of this carbide. The shaped inserts comprising a metal - graphite mixture are prepared by the known methods of powder metallurgy, and when placed in the mould cavity or die cavity are poured with the previously prepared iron-based cast alloy.

[0006] Hard and abrasive wear-resistant ceramic phases of the MeC type (where Me - Ti, Nb, Mo, Zr, W, V, Ta) are formed in situ by reaction that takes place between the, placed on the walls and / or on the bottom of a mould or die, reactants and liquid alloy poured into the said mould or die. The introduced components are undergoing the reaction of SHS (self propagating high-temperature synthesis), as a result of which, in the liquid alloy, carbides are locally generated, to form, after the casting crystallisation process, a composite zone. The method guarantees the creation of areas reinforced with ceramic phases in strictly determined places of the casting. The process of the creation of an area resistant to abrasive wear occurs simultaneously with the process conferring to the cast detail its ultimate, final shape.

[0007] An important advantage of the method according to the present invention is the possibility of transforming the selected area of casting into a composite, wherein the reinforcement is accomplished by *in situ* synthesis of a high-melting point, hard ceramic phase of the MeC type. Within the area of the foundry mould cavity or die cavity, where the shaped inserts are arranged, after the process of crystallisation and solidification of the casting, a composite containing carbides is produced, the matrix of the locally produced composite being an iron-based cast alloy, while the reinforcing phase is composed of carbides.

[0008] Example. A mixture of reactants for the TiC carbide synthesis was prepared by mixing titanium powder having a purity of 99.98% and a particle size of ~ 40 μm and graphite powder having a purity of 99.99% and a particle size of ~ 40 μm. The powders were combined together while maintaining the atomic ratio of 1: 1 and were stirred for 6 h in the absence of oxygen. Thus prepared mixture was divided into batches and subjected to compaction in a die under a pressure of 500 MPa. Compacted shaped inserts of dimensions 5 × 10 × 45 mm were obtained, and then the shaped inserts were glued to the walls of a mould made of bentonite sand mixture. Then the cast alloy corresponding with its composition to the composition of a ferritic nodular graphite cast iron grade according to EN- GJS- 350- 22- LT (PN- EN- 1563) was prepared, and was next poured into a mould. The surface of the shaped insert contacting the hot liquid metal initiates the exothermic reaction of synthesis (SHS) of the reinforcing phase, as a result of which a composite area reinforced with TiC carbides is formed in the casting.

Claims

1. A method for producing composite zones in castings, **characterised in that** on the walls and / or on the bottom of a foundry mould or die, shaped inserts are placed, comprising the reactants of synthesis of the selected type of carbide undergoing the SHS reaction, wherein the group of carbides comprises carbides of niobium, titanium, molybdenum, tantalum, vanadium, tungsten and zirconium, and wherein the mutual atomic ratio of components necessary for the reaction of the formation of a given carbide is corresponding to the stoichiometry of this carbide, and wherein the shaped inserts comprising a metal - graphite mixture are prepared by the known methods of powder metallurgy, and when placed in the mould cavity or die cavity are poured with the previously prepared iron-based cast alloy.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- PL 190605 **[0002]**
- PL 167197 **[0003]**
- CN 1868635 **[0004]**

Non-patent literature cited in the description

- **A.G. MERZHANOV.** Journal of Materials Processing Technology. 1996, vol. 56, 222-241 **[0002]**