The lost foam process in pilot castings plattes

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Recieved 26.02.2009; accepted in revised form: 30.03.2009

Abstract
The paper discusses the process of thermal evaporation of a foundry pattern. At several research-development centres, studies have been carried out to examine the physico-chemical phenomena that take place in foundry mould filled with polystyrene pattern when it is poured with molten metal. In the technique of evaporative patterns, the process of mould filling with molten metal (the said mould holding inside a polystyrene pattern) is interrelated with the process of thermal decomposition of this pattern. The process of polystyrene pattern evaporation in foundry mould under the effect of molten metal is of a very complex nature and depends on many different factors, still not fully investigated. The technology of evaporative patterns was used in manufacture of pilot castings of the high abrasion resistance plates. The material and the properties of the resultant castings were determined by the customer (patent protection). At the beginning of the studies, the properties of the pattern material were determined, patterns were assembled, the properties of the ceramic layer were determined as well as the technique of its preparation and application. The technique of molten metal feeding to the mould cavity was examined along with the parameters of the gating and feeding system, and casting cooling and solidification conditions (large contraction, shrinkage cavities and depressions).

Keywords: Lost foam platetes, Pattern, Polystyrene, Temperature.

1. Introduction
The technology of foamed polystyrene patterns thermally evaporated during manufacture of castings from ferrous alloys still finds numerous obstacles on the way to its full practical use. The degree of difficulty depends not only on the properties of the process itself, but also on the degree of pattern intricacy, mould properties, and quality requirements imposed on castings. One of the main parameters which decide about the correct run of the evaporative pattern process is the kinetics of the thermal decomposition of the foamed polystyrene pattern as well as the volume and pressure of gases which are evolving from this pattern. Casting using the lost foam method is used when small quantities of abrasion-resistant castings must be rapidly produced at low cost. This method was suggested as a feasible alternative for classical methods involving moulding sands. These elements must be characterized by high hardness (above 60 HRC) and high abrasion resistance.
This article presents the results of the Lost Foam process in pilot castings plattes.

2. Preparation of the mould, permeability
The moulds were prepared according to common praxis applied in the Foundry research Institute, i.e. a ceramic layer of proper thickness was deposited onto the foamed polystyrene - copolymer model (fig. 1). The model assembly with ceramic layer was moulded in dry unbounded quartz sand of defined granularity (fig. 2 - 3), [10, 14 -17]. The ceramic layer was made using ceramic coating materials:
- Kerntop L87 – manufactured by Ashland, solid phase 74-77\%, density 2.26-2.38 g/cm\textsuperscript{3}, viscosity 6.8-10.0 Pa·s;
- TroFlex WK-LF, solid phase 83-84\%, viscosity 30.0 Pa·s; density 2.6 g/cm\textsuperscript{3} – produced by Ashland.
The number of ceramic layers – 1, its thickness does not exceed 0.7 mm (fig. 2).
The self-supporting mould made of ceramic layers the technology and materials used were developed in The Enterprise of Foundry Innovation, Ltd:
Ceramic layers were prepared according to technology usually applied in lost-wax process, with four ceramic layers. Drying and/or baking of ceramically-covered sets of models were carried out according to procedures developed in Foundry Research Institute.

For preparation of moulds the mould cavity for lost foam process has been used. This mould cavity comprises of special moulding flasks, stand for preparation of model sets (formation of ceramic coatings, consolidation, preparation for mould pouring).

Assumptions:
- the number of model sets in the moulding flask,
- mould material – coarse quartz sand from Jaworzno,
- sand pouring into the moulding flask,
- positioning of the model sets and pouring with sand,
- vibrational consolidation.

The moulds were subjected to thorough inspection and directed to the pouring stand.

The technological details of mould preparation, melting parameters and pouring procedure were developed in the Foundry Research Institute.

Test plates of highly alloyed iron alloys were prepared during realization of the research project. For further investigations were chosen plates of assumed chemical composition.

Mould technology, parameters of melting and pouring were developed in the Foundry Research Institute, [1-4, 6, 7, 10 -17]. The chemical composition of alloys was developed by the authors of this presentation within their research activities at Department of Metal Sciences and Powder Metallurgy (AGH University of Science and Technology) and Department of Ferrous Alloys (Foundry Research Institute). Three different sorts of alloys were selected for experimental works. The charge material contained iron alloys, alloy additives, pure elements, and carbonizing additives of predefined granularity.

The melting process was conducted in medium frequency inductive furnace of 60 kg capacity.

The superheating and casting temperatures of the molten metallic materials were determined. It contained within 1550°C – 1600°C (fig. 4, 6).
4. Summary

In the course of experimental investigation numerous test casting were fabricated. Thus developed technology was verified during the progress of the project. The pouring protocol and technological parameters have been modified. Cast plates of satisfactory shape representation and good hardness were obtained (fig. 5 - 7).

Some of the test castings were subjected detailed structural investigations and thermal processing.

Acknowledgments

The article came into being in support about results of investigations led At Foundry Research Institut. The thanks the executors of described project

References


