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(54) **Control of the temperature distribution of a mould and of cast or moulded parts produced thereby.**

(57) In order to control the temperature distribution of a permanent mould (and optionally of the casting or moulding itself), one or more optical pyrometers scan the surface areas of the mould and, if necessary, also the surface of a casting or moulding after its removal from the mould, and operate a blowing system that will cool or heat those areas so that desired temperatures are obtained according to the temperature readings at each area.

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Beschreibung

Control of the Temperature Distribution of a Mould and of Cast or Moulded Parts produced thereby

This invention relates to permanent moulds, such as die casting moulds and ignition moulds, and to a process for controlling the temperature distribution in such a mould (and in the parts cast or moulded thereby) when it is used repetitively.

The life of a chill die mould (permanent die casting mould) and as well as the microstructure and the dimensional stability of a part cast or injected into it are dependent on the temperature distribution of the different points of the casting and mould.

The present invention provides as process as defined in claim 1.

The invention provides, in particular, a process for cooling and/or controlling the temperature distribution of a mould, e.g. a chill die mould or a permanent die casting mould, and of a cast or injected part in it, using optical pyrometry in combination with the localized blowing of one or more cooling fluids under adjustable flows, so that the process may be optimized.

According to the invention, an optical pyrometer or a plurality of optical pyrometers scan, at a convenient distance, the different parts of a pemanent mould immediately after the removal of the casing or moulding and measure the temperature of each area thereof and, if necessary, also the temperature of each point of the casting or moulding, e.g. a cluster of cast parts.

The measurements of the optical pyrometer(s) are converted into one or more electrical signals which are fed to an information processing system that treats them according to a predetermined program. Depending on the temperature readings and according to the said program, one or more blowing systems are operated so that a controlled flow rate or rates of air or of another cooling or heating fluid are impinged against the area or the areas, the temperatures of which are being read or have just been read by the pyrometer or pyrometers.

In this way, the temperatures of said areas are controlled.

The present invention provides a system which improves the life of a permanent die casting mould as it avoids its overheating or its excessively heterogeneous heating. On the other hand, this process adjusts the temperature of each area of the permanent die casting mould so that a subsequent casting or injection run may be made and undue heterogeneity, warpings and/or any other faults of the casing caused by the solidification may be avoided. At least, the process according to this invention can also be used whenever the produced castings or the injected parts have to be homogeneously cooled, for instance when the direct austempering of cast iron after the casing is intended. The inventive process will control effectively the cooling of the cast parts.

The process according to this invention can be used together with the classical systems of temperature control of permanent moulds, including those having channels for the circulation of cooling (or heating and cooling) fluids, in order to reduce deviations in relation to the previewed or desired local temperatures. But the process can also be used alone, replacing the traditional cooling systems.

It has the advantage of being simple and also the advantage that it acts locally in dependence on the temperature and the real conditions existing at each point and at each time.

The process here disclosed also has the advantage that it can be used not only with metallic moulds, but also in the cooling of ceramic permanent moulds, and moulds made of any porous and/or low thermal conducting materials, eliminating the excess of heat by the side of the permanent moulds that is directly heated during the pouring or the injection casting.

With this system the opening of cooling channels in the interior of the permanent moulds is no longer necessary and the risks of cracking of the dies and of leakage of cooling liquids are avoided.

It has still the advantage that it can be also used to cool, in a controlled way, the cast pieces, namely when they are poured in dies or made by injection casting.

With the present process, it is possible to homogenize and control the temperature and the cooling of the parts, in order to avoid warping, guarantee predetermined structures, prepare the cast pieces for subsequent heat treatments, or even to accomplish the heat treatments by using an adequately strong cooling rate when the temperatures are convenient for that.

The fluid used may be air, but one can also use any other fluid, including mixtures with lubricants, antiadherents, thermal insulating materials, and so on. Those additives or mixtures, besides cooling the permanent moulds, may prepare them for the next pouring or injecting casting operation, being deposited on the area at which the stream of fluid is directed.

If a more severe cooling is necessary, the used cooling fluid can be a liquid which is volatile in the actual working conditions.

This process of temperature control can be used in the die casting of cast irons, in the die and injection casting of aluminium and other alloys, and in the injection moulding of polymers and of other materials.

Although conceived, in principle, to cool permanent moulds or to cool the pieces poured in dies or injected in permanent moulds, the same process can also be used to heat the permanent moulds (and, in some cases even the pieces poured or injected) when the blowing fluids are conveniently heated.

It is a process that is quite simple, can be automatized, and has a very wide application.

For controlling the temperatures of a permanent die casting mould and cast or injected parts, by optical pyrometry in combination with the local blowing of a fluid in dependence on the temperature measured in each area, one or a plurality of optical pyrometers scan (at a certain distance) the surfaces of a die casting permanent mould, made of a metallic, ceramic composite, coated material, or any others, with or without cores, and, if necessary, scan also the cast or injected part and, depending on the temperatures read in each area, open or close more or less one or more valves of a blowing system, blowing one or more heat carrier fluids (air or other gaseous or liquid fluid), in controlled amounts, towards the areas that need to be cooled or heated, so that their temperatures become the desired ones, in order to improve the life of the permanent die casting mould, including eventually a core, and in order also to guarantee good conditions for the subsequent casting or injection operation of the next pieces in the same die, or in order also to reach the convenient temperatures in the die-cast or injection-moulded parts, for a subsequent heat treatment (austempering or any other), in order to avoid warping, and also in order to achieve desired microstructures.

Claims

1. A process for controlling the temperature of a permanent mould, comprising scanning areas of the mould by means of at least one optical pyrometer in order to measure the temperatures of those areas, comparing the measured values of the said temperatures with desired values, and directing heat carrier fluid streams at the said areas in order to reduce any difference between the measured and desired values.

2. A process as claimed in claim 1, in which the said areas are scanned immediately after removal of a casting or moulding from the mould.

3. A process as claimed in claim 1 or 2, further comprising scanning areas of a casting or moulding by means of at least one optical pyrometer in order to measure the temperatures of those areas immediately after removal from the mould, comparing the measured values of those temperatures with desired values, and directing heat carrier fluid streams at those areas in order to reduce any difference.

4. A process as claimed in any of claims 1 to 3, in which the heat carrier fluid is air.

5. A process as claimed in any of claims 1 to 3, in which the heat carrier fluid is a liquid.

6. A process as claimed in any of claims 1 to 3, in which the heat carrier fluid contains an additive, e.g. a lubricant or anti-adherent, which is deposited on the area at which the stream is directed.

7. A process as claimed in any preceding claim, in which signals from the optical pyrometer(s) are fed to a processing system which controls one or more blowing systems for directing the heat carrier fluid streams at the said areas.

8. A process as claimed in claim 7, in which the blowing systems comprise valves which are closed or opened more or less, as a function of the signals.