

Lost Wax Process Metallurgy for Industrial Valves

HISTORY

- The Lost Wax Process Metallurgy is the widely used technology employed to make precision castings for valve, pump and other engineering industries and commercially known as 'Investment Casting'
- The process 'Investment casting' is developed from an art that dates back as early as 1766-1122 B.C, during the early Egyptians and the later Shang dynasty periods, where artisans used this technique for making metal art works.

PROCESS OF MANUFACTURE

- There are two types of Investment casting process
- Lost Wax Process
- Lost Foam Process
- The Lost Wax Process is widely used in India and elsewhere.
- In Lost Wax Process, Expandable Wax Patterns are used.
- In Lost Foam Process, foam patterns made from low density expandable polystyrene and similar materials are used.

Lost Wax Process

The steps involved in manufacturing of Lost Wax Investment Castings include :

Die

- The die contains an accurate impression of the castings. Dies are usually manufactured using aluminium alloys or steel and are machined from the solid by milling/ machining/die sinking (EDM process) and assembled in tool room.

Wax Pattern Production

- Pattern waxes of low ash content are compounded from natural and synthetic waxes and resins.
- Wax in the pasty form is injected in the die at a low pressure.
- The wax patterns need to be stored in a constant temperature until ready for investing (coating) for dimensional stability. Due to this almost all injection is done in air conditioned atmosphere.

Assembly of Wax Patterns.

- The next step is to assemble each pattern into a cluster or tree, also made out of similar wax which forms the replica of the as cast assembly. Assembly can be done using soldering iron, heated spatula or high intensity gas torch.

Investment (coating)

- The pattern assemblies or the cluster of trees are dip coated in ceramic slurry and then stucco ceramic sand in fluidized bed. The coating starts with finer stucco and ends up with coarser stucco particle. After each coat, the assembly is allowed to dry in a controlled humidity and temperature for a specific time period before the next coat, till building up of a relatively thick refractory shell over the wax assembly. The number of coats required depends upon the geometry and weight of the casting, and may vary from 5 to 15 coats.

The name investment casting is generated since the ceramic material is invested or coated over the cluster of wax tree

Dewaxing or Removal of**wax**

- Wax from the refractory mould is removed by heating the mould to a temperature slightly above the melting point of the wax. The melted wax flows out of the mould through the bottom cup.
- After dewaxing, the left out is a hollow refractory mould with very high permeability.

Firing or Sintering

- Dewaxed moulds further heated in a furnace to a temperature of approximately 1000°C and kept in this temperature for 1-2 hours. Firing brings about final dehydration, full strength of shells and also burns out the organic compound if any left out including wax and prepares the mould to casting temperature.

Melting and Casting

- The required alloys i.e. ferrous, non ferrous, alloy steel etc. is

melted in an induction furnace and the specified composition is maintained. The composition is generally verified before casting using a spectrometer in most of the quality conscious foundries.

- The casting process may be by gravity cast, pressure cast, or centrifugally cast. The gravity casting is widely used all over the world. Vacuum pouring is employed especially for making complex alloys.

Knock Out

- After the solidification and cooling of the metal inside the refractory moulds, ceramic coating is removed from the casting cluster by mechanical vibration, chemical cleaning or sand blasting.

Casting Removal / Cutting/ Fettling

- Then the individual castings from the clusters are removed by

cutting through abrasive cutoff wheels, plasma cutting, gas cutting etc depending on the alloy.

- The gates/runners left out on the castings are removed by machining, grinding.

Heat Treatment

- Depending upon the type of material and alloy composition, heat treatment is carried out wherever necessary. These are essentially required for stress relieving, refining grain structure and improve strength of the castings.

Finishing

- Finally casting are cleaned either by shot blasting or sandblasting and polished. Stainless steel castings are pickled and passivated. Machining is carried out wherever required. Accepted casting is dispatched.

ADVANTAGES

- Investment casting process is an advanced casting process with capability to produce net shaped components in any desired complex shapes.
- High degree of Dimensional accuracy
- Excellent surface finish
- Structural integrity
- Versatility of design
- Reduces machining by 75-80% compared to sand casting
- Virtually any metal /alloy can be cast

APPLICATION

- There is enormous benefits to the users of Investments castings in the form of saving in raw materials, labor cost, reduction and simplification of production processes, simplifications of part assemblies. The investment casting process therefore provides opportunity to the designers to convert their components from forging, fabrication etc. to the desired shapes and thereby achieve considerable cost saving .

- The valve industries in particular has taken advantage of this process and benefited to a great extent. For its critical and severe service conditions, casting from special alloys with complex design being cast using lost wax technology.
- The other major users of the investment castings are Defense, Pump industries, Automobiles, General Engineering Industries and Railways etc.

BUSINESS POTENTIAL FOR INDIA

There are estimated more than 60 small and medium scale investment casting industries in India producing approximately 12000 metric tons of castings per annum. Also they are contributing to India's foreign exchange revenue to a great extent. India is rapidly becoming one of the major global source of investment casting due to its consistent quality and low cost.

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(This paper was presented at International Valves' Seminar Organised by CII, Valve's Divn. at Mumbai on 6th Dec. 05.)