Manufacturing processes

Lecture six

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Types of casting process

Shell Molding Casting

Casting process in which the mold is a thin shell of sand held together by thermosetting resin binder.

Steps in shell-molding:

(1) a match-plate or cope-and-drag **metal pattern is heated** and placed over a box containing sand mixed with thermosetting resin.

(2) box **is inverted** so that **sand and resin fall onto the hot pattern**, causing a layer of the mixture to partially cure on the surface to form a hard shell;

(3) box **is repositioned** so that loose uncured particles drop away;

(4) sand shell **is heated** in oven for several minutes to complete curing;

(5) shell mold **is stripped** from the pattern;

(6) two halves of the shell mold **are assembled**, supported by sand or metal shot in a box, and ***pouring is accomplished***;

(7) the finished casting with sprue ***removed***.

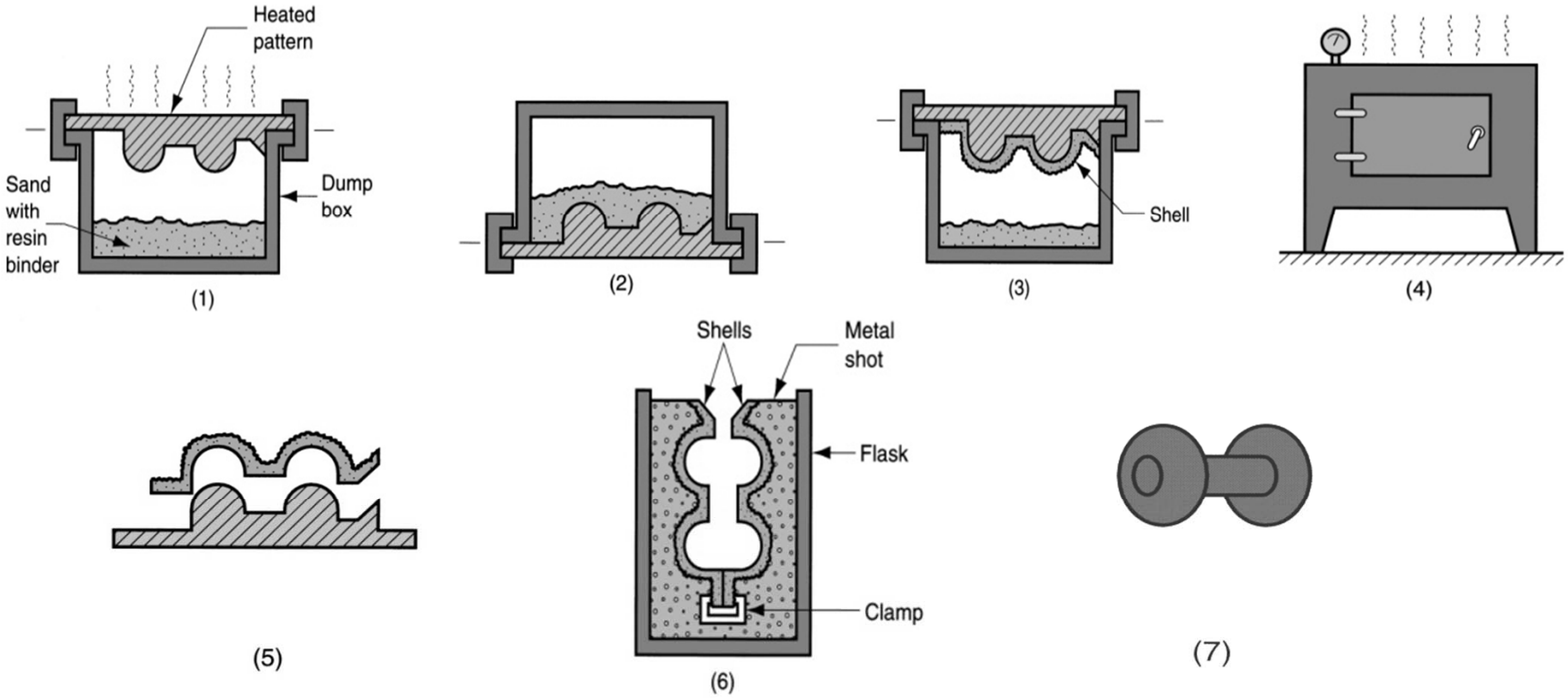

Figure 1.17 Steps of shell molding casting process

Advantages of shell molding:

- Smoother cavity surface permits easier flow of molten metal and better surface finish
- Good dimensional accuracy - machining often not required
- Less cracks in casting

Disadvantages:

- metal pattern costly -design must include gate/runner
- large amount of expensive binding resin required
- Part size limited

Expanded Polystyrene Process (Lost-Foam Process)

Uses a mold of sand packed around a polystyrene foam pattern which vaporizes when molten metal is poured into mold. Polystyrene foam pattern includes sprue, risers, gating system, and internal cores (if needed)

Steps in Expanded polystyrene casting process:

1. pattern of polystyrene (Styrofoam) is coated with refractory compound;
2. foam pattern is placed in mold box, and sand is compacted around the pattern;
3. molten metal is poured into the portion of the pattern that forms the pouring cup and sprue. As the metal enters the mold, the polystyrene foam is vaporized ahead of the advancing liquid, thus the resulting mold cavity is filled.

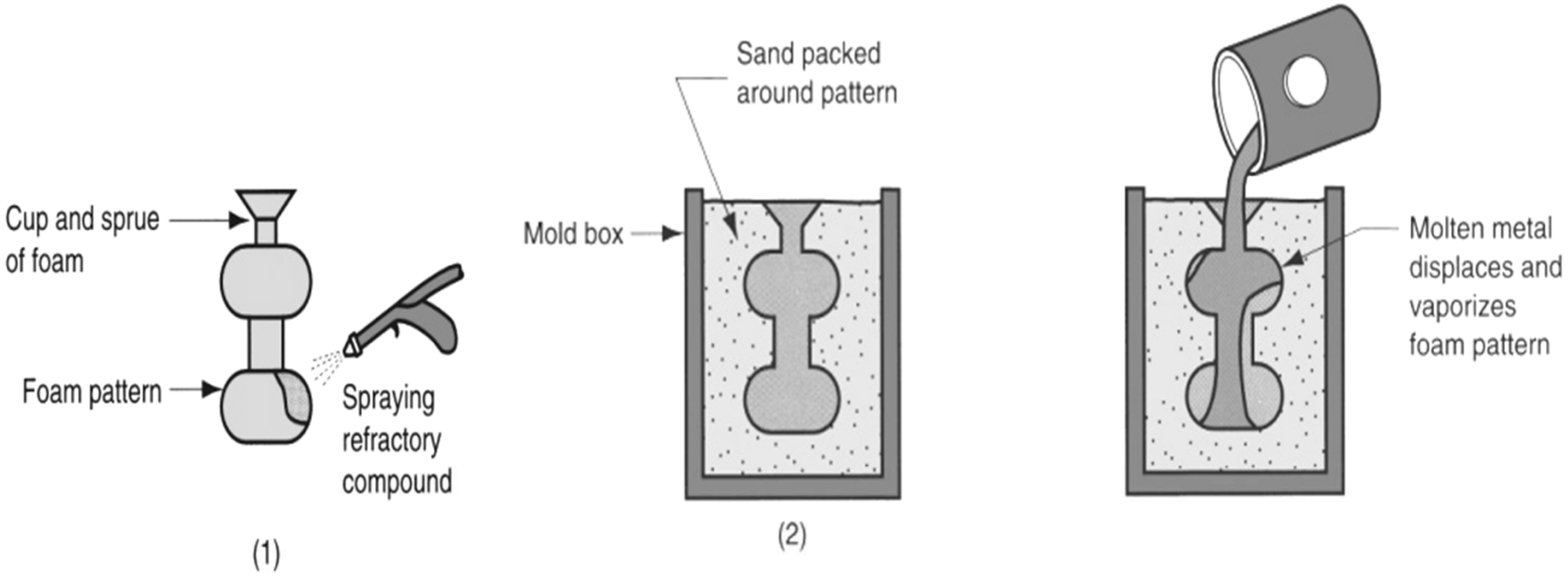

Figure 1.18 Steps of Expanded polystyrene casting process

Advantages and Disadvantages

Advantages of expanded polystyrene process:

- Pattern need not be removed from the mold
- Faster: two mold halves are not required

Disadvantages:

- A new pattern is needed for every casting
- Cost is highly dependent on cost of producing patterns

Investment Casting (Lost Wax Process)

This process uses wax patterns assembled in tree forms on a runner. The completed assembly is coated with ceramic slurry, allowed to dry and then heated to melt out the wax leaving a ceramic mould into which the molten alloy is poured. It is a precision casting process - capable of producing castings of high accuracy and intricate detail

Steps in investment casting:

(1) wax patterns are produced,

(2) several patterns are attached to a sprue to form a pattern tree

(3) the pattern tree is coated with a thin layer of refractory material,

(4) the full mold is formed by covering the coated tree with sufficient refractory material to make it rigid

(5) the mold is held in an inverted position and heated to melt the wax and permit it to drip out of the cavity,

(6) the mold is preheated to a high temperature, the molten metal is poured, and it solidifies

(7) the mold is broken away from the finished casting and the parts are separated from the sprue

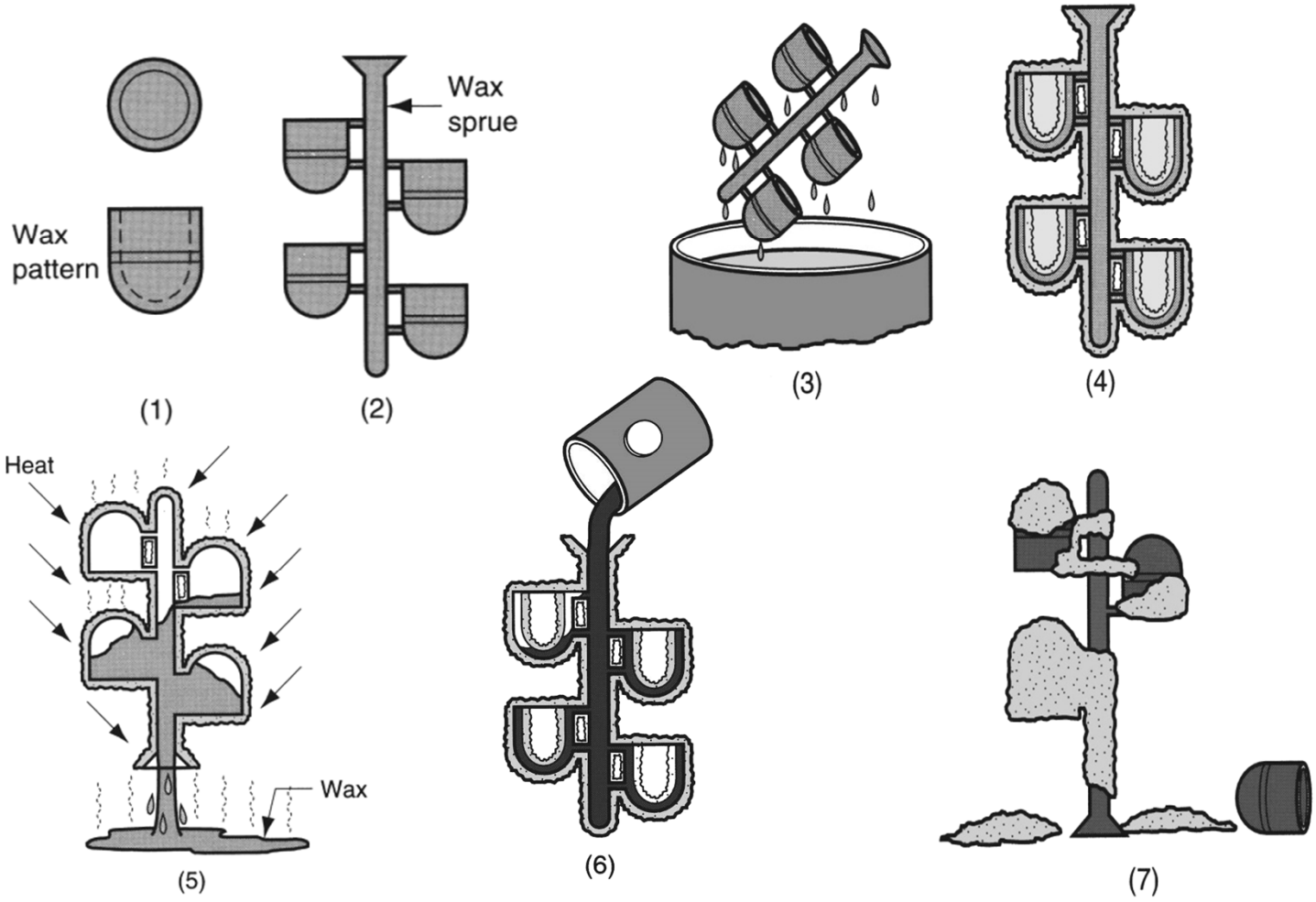

Figure1.19 Steps of investment casting casting process

Advantages and Disadvantages of investment casting

Advantages

- Parts of great complexity and intricacy can be cast
- Close dimensional control and good surface finish
- Wax can usually be recovered for reuse
- Additional machining is not normally required - this is a net shape process
- Suitable for most ferrous / non-ferrous metals.
- Useful for casting alloys that are difficult to machine

Disadvantages

- Many processing steps are required
- Relatively expensive process
- *Patterns and molds are expendable*
- Limitations on size of casting.