Casting Process: Shell Mould Casting

In Shell Mould Casting, molten metal is poured into a thin-walled, expendable, sand-based mould created by applying a sand-resin mixture around a pattern. The pattern, a metal piece in the shape of the desired part, is reused to form multiple shell moulds. A reusable pattern allows for higher production rates, while the disposable moulds enable complex geometries to be cast. Compared to sand casting, this process has better dimensional accuracy, a higher productivity rate, and lower labour requirements. It is often used for small to medium parts that require high precision.

This process data sheet describes the basic steps involved in the shell mould casting process as well as the benefits and limitations of the process:

1. A two-piece pattern is created in the shape of the desired part.
2. Each pattern half is heated to 175-370°C (350-700°F), coated with a lubricant to facilitate removal, then clamped to a dump box containing a mixture of fine silica sand and a thermosetting phenolic resin binder.
3. The dump box is inverted, allowing the sand-resin mixture to coat the pattern. The heat partially cures the mixture forming a shell around the pattern. The thickness of the shell is 10 to 20mm depending on exposure time and temperature. Once cured to completion in an oven it achieves a tensile strength of 350 to 450 psi (2.4 to 3.1 MPa), and then the shell is ejected from the pattern.
4. The two shell halves are joined together and securely clamped to form the complete shell mould. If any cores are required, they are inserted prior to closing the mould.
5. The shell mould is then placed into a flask and supported by a backing material.
6. Molten metal is poured from a ladle into the gating system to fill the mould cavity.
7. When cool, the mould can be broken and the casting removed. Trimming and cleaning processes are required to remove any excess metal from the feed system and any sand remaining from the mould.

Shell Mould Casting

Why use NovaCast Shell Mould Casting?
Shell mould casting delivers many benefits including:

- It can be completely automated which lowers labour costs and facilitates mass production
- Good and consistent surface finishes result in lower machining costs.
- As no moisture is present in the shell, very few gases are produced and those that are escape through the thin permeable shell walls easily.
- Surface burning of the shell's resin binder makes removal from the cast component easy.
- Scrap metal and sand-resin mix can be recycled.
- A wide variety of metal alloys can be cast.
- Tolerances can be just 0.005 mm/mm and cast surface is 0.3–4.0 micrometers (50–150 µin).
- The process allows complex shapes in a large range of sizes to be cast.

Limitations of the process
There are some disadvantages including:

- The gating system must be part of the pattern which can be expensive.
- Phenolic resin is expensive. Equipment costs can be high, labour costs are high if not automated.
- Shrinkage can be a problem.
- Poor material strength is achieved compared to other casting processes
- High porosity can be a problem

About NovaCast
NovaCast has over 40 years of ferrous and non-ferrous metal casting experience extending into markets as diverse as transport, utilities, offshore and general engineering. Our non-ferrous foundry, in Melksham, England, is supported by a fully risk-managed supply chain that expends out to the Far East allowing us to provide a single source solution for precision cast and machined components.

To find out more, get a quote or just to discuss your project, give us a call on +44 (0)1225 707466 or email sales@novacast.co.uk