INTRODUCTION TO THE SHELL MOULDING PROCESS

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Shell moulding is a process for producing simple or complex near net shape castings, maintaining tight tolerances and a high degree of dimensional stability. Shell moulding is a method for making high quality castings. These qualities of precision can be obtained in a wider range of alloys and with greater flexibility in design than die-casting and at a lower cost than investment casting. The process was developed and patented by Croning in Germany during World War II and is sometimes referred to as the Croning shell process.

EXPERIMENTAL DETAILS

Raw Materials, Equipments

- Resin coated sand.
- Chromel Alumel Thermocouple, digital panel meter.
- Muffle Furnace.
- 2 Kg Aluminium Silicon Alloy (LM6) scrap.
- Clay Graphite crucible.
- Fireclay.
- Asbestos Gloves, Tongs, safety goggles.

THE PROCESS DETAILS

- The process was optimized to get a better shell by varying the temperature of the metal pattern, holding time of sand – resin mixture and final curing time of shell and pattern.

A metal pattern having the desired shape of the casting is heated to 180 – 250° C. The pattern is sprayed with a solution of a lubricating agent or a release agent containing silicone to prevent the shell from sticking to the pattern. The sand is
put in the dumpbox in sufficient quantity. The pattern is then turned down with its heated face inside the dumpbox. The dumpbox is now inverted so that the sand resin mixture falls on the heated metal pattern face. The sand mixture gets heated up and it softens the resin forming a shell on the pattern. Initially the resin becomes sticky. Further additional heat cures it. The dump box is again turned to its original position. The excess sand falls in the dump box leaving a shell on the pattern.

The pattern along with the shell is again kept in the heating oven. This cures the resin in the sand and shell acquires rigidity. On the pattern ejector pins are provided to strip off the shell. After the shells get cooled the two parts are joined properly to form a mould. Fireclay is applied along the edges of the mould to avoid leakage of the molten metal. Shell mould D was used as it had better thickness and had no breakage.

A 2 kg scrap of Aluminium Silicon alloy (LM6) was charged in a muffle furnace in a clay graphite crucible. The dross floating on the molten alloy was removed by a thin graphite plate. The molten aluminium silicon alloy was poured in the cavity of the shell mould.
Later on the shell mould was broken to remove the casting. The use of safety goggles, gloves, shoes is a must to avoid any accident.

<table>
<thead>
<tr>
<th>Shell No.</th>
<th>Temperature of the heated pattern measured by Chromel Alumel thermocouple (°C)</th>
<th>Holding time</th>
<th>Final Curing time</th>
<th>Thickness of the shell. (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12.5 mv</td>
<td>325</td>
<td>40 sec</td>
<td>60 sec</td>
</tr>
<tr>
<td>B</td>
<td>10.5 mv</td>
<td>260</td>
<td>60 sec</td>
<td>60 sec</td>
</tr>
<tr>
<td>C</td>
<td>10.7 mv</td>
<td>264</td>
<td>90 sec</td>
<td>90 sec</td>
</tr>
<tr>
<td>D</td>
<td>11 mv</td>
<td>270</td>
<td>120 sec</td>
<td>120 sec</td>
</tr>
</tbody>
</table>
Shell Moulding Pattern

Shells formed on the heated metal pattern
Shells removed from the heated pattern

Shells matched to form a mould. (Mould preheated to avoid moisture)
Aluminium Silicon alloy (LM6) being poured in the mould from the graphite crucible.
Aluminium Silicon alloy casting ring broken from the mould after room temperature cooling.

Advantages

- Better surface finish
- Better dimensional tolerances.
- Reduced Machining.
- Less foundry space required.
- Semi skilled operators can handle the process.
- The process can be mechanized.

Disadvantages

- The raw materials are relatively expensive.
- The process generates noxious fumes which must be removed.
- The size and weight range of castings is limited.

Comparison of Shells
(B) Less Holding time and curing time
(A) Over heated pattern, less holding and curing time
(D) Shell with better thickness
(C) Shell with good thickness

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Applications

- Crankshaft fabrication
- Steel casting parts, fittings
- Moulded tubing fabrication
- Hydraulic control housing fabrication
- Automotive castings (cylinder head and ribbed cylinder fabrication).

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