SAND CASTING POSTER PRESENTATION

ME323 MANUFACTURING PROCESS

HOUSE BEARING WAX CASTING

THE HOUSE BEARING CASTING PROCESS WAS INVESTIGATED BY EMPLOYING THE SAND CASTING TECHNIQUE, UTILIZING WAX FOR THE PRODUCT MATERIAL FOR CREATING THE DESIRED SHAPE AND ENSURING THE ACCURACY OF THE FINAL PRODUCT.

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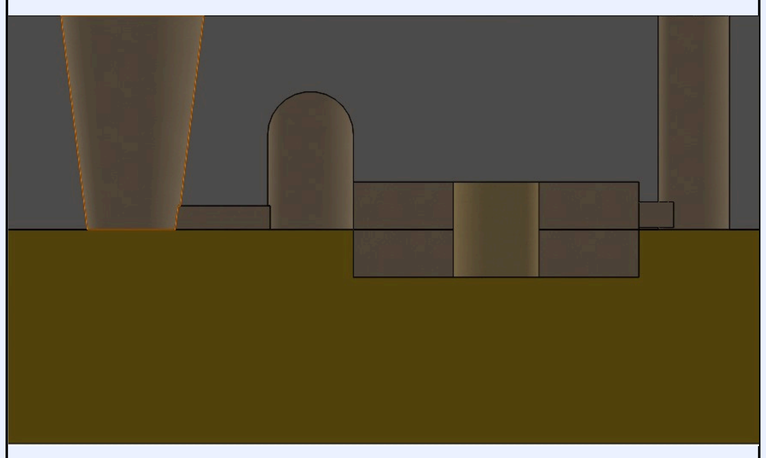
INTRODUCTION

This report examines a sand casting application. Materials were selected to optimize casting quality, focusing on sand's thermal resistance, grain size, purity, reusability, and cost. Wax replaced traditional metals for simplicity, and a shape highlighting key casting stages was chosen. The mold, split into two halves, along with components like the blind riser, sprue, container, and cores, were 3D-printed. Additional tools included a ruler for smoothing sand, bakery paper to prevent molten wax from seeping into gaps or pores between sand particles—ensuring the wax maintains its shape and mold integrity—and sticks to release trapped gases.

METHODOLOGY

Gating System

To ensure proper casting, a gating system design was initially created, and the components were selected based on appropriate criteria. A suitable parting line was chosen to allow easy removal of the mold, and draft angles were selected to ensure the mold could be lifted smoothly. Appropriate cores for the cylindrical cavities in the mold were extracted from the 3D design. The components were also properly extracted.



Selection of The Sprue

During the sprue design, attention was paid to ensuring that the sprue is tapered. The tapered design prevented the wax from experiencing turbulence and also wax have contacted with sprue during the casting process. The Reynolds number was used to check whether turbulence occurred at the base of the sprue. Additionally, the velocity at the base of the sprue was calculated using the Bernoulli equation and checked that whether turbulance occured or not.

Bernoulli Equation

$$h_1 + \frac{p_1}{\rho g} + \frac{{v_1}^2}{2g} = h_2 + \frac{p_2}{\rho g} + \frac{{v_2}^2}{2g} + f$$

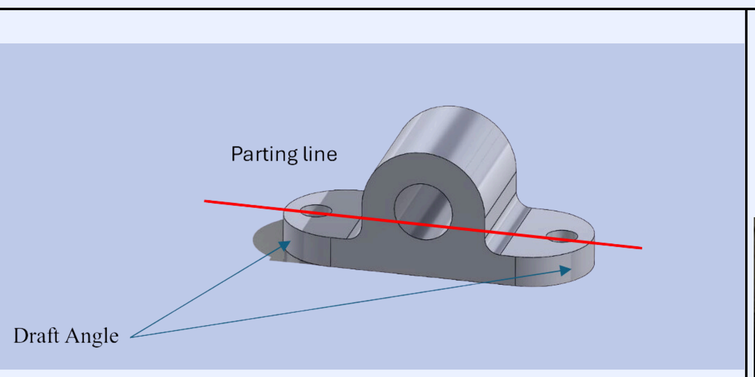
Calculation of Reynold Number

$$Re_{bottom\ of\ the\ sprue} = \frac{\rho v D}{\mu} = \frac{vD}{\vartheta}$$

The kinematic viscosity of paraffin wax was determined from a reference table, and the approximate value $8.8\ mm^2/s$ of was taken at 60 degree celcius. The diameter was given as, resulting in a Re = 2840.

Selection of The Parting Line, Draft Angle

The one of the most critical selection is parting line according to the geometry of the part. The parting line was positioned along the longitudinal symmetry axis of the part to minimize turbulence during flow. To ensure smooth removal of the part from the mold, the fillets of the part provides the function of the draft angle.



Casting Process

·Placing the Sand to the Cope
·Placing the Other Half and Preparing the Gating System
·Bakery Paper Placement and Core Placement
·Final Assembly – ready to cast
·Pouring melted wax into the pouring basin
·Solidification of wax
·Obtained the wax house bearing
·Post processing for the surface of the product

3RD ATTEMPT

4TH ATTEMPT

FINAL PRODUCT

RESULTS / DISCUSSION

During the casting process, many problems were faced. Different solutions were tried and found for these issues. Below are the problems and their solutions.

1. Problem: Wax Mixing with Sand

Reason: The dense properties and viscosity of wax decreased as it approached the boiling point, causing it to mix with the casting sand.

Solution Attempt 1: A fine powder layer was applied between the casting sand and the mold.

Result: Unsuccessful. The wax continued to seep into the sand before solidification occurred.

Solution Attempt 2: By saturating the casting sand with water to reach its maximum moisture content, it was aimed to prevent the wax from seeping between the sand particles.

Result: Unsuccessful. The molds used to form the cavities could not be removed because the sand was too wet and the casting process could not be completed because the cavities could not be formed correctly.

Solution Attempt 3: The bakery paper is placed in the between of cavities.

Result: Successful. The baking paper acted as a barrier, preventing the wax from seeping into the sand. Additionally, it provided the easy removal of the wax from the mold during the final process and prevented the sand from sticking to the wax surface. However, despite these advantages, surface roughness occurred on the part due to the texture of the baking paper.

Considering both its advantages and disadvantages, the use of baking paper was demonstrated appropriate, resulting in a successful casting process.

2. Problem: Gas Entrapment (O_2 and CO_2)

Reason: Insufficient air vents caused gases to become trapped in the casting, resulting in voids.

Solution Attempt 1: Vent was added to allow gases to escape.

Result: Unsuccesful. Since the number of vents was not enough, air voids formed in the part.

Solution Attempt 2: The number of vents was increased, and an open riser was added.

Result: Successful. Increasemet of number of vents and the addition of an open riser to prevent shrinkage, gas escape was achieved more effectively. However, minor voids still formed, which can be considered negligible.

3. Problem: Shrinkage and Symmetry

Reason: Shrinkage occurs due to the rapid solidification of the wax. This issue causes symmetry problems.

Solution Attempt 1: Open riser and blind riser was added.

Result: Successful. With the use of an open riser and a blind riser, the casting was properly fed, and symmetry errors were mostly eliminated despite shrinkage.

With the use of bakery paper, vents, open riser, and blind riser, most of the desired tolerance values were successfully achieved.

Dimension	Target Size (mm)	Actual Size (mm)	Deviation
Length	100	100.4	**+%0.4**
Width	40	40.1	**+%0.25**
Height	42	41.2	**-%1.9**
Circle 1	19	19	**%0**
Circle 2	10	11.2	**+%12**
Circle 3	10	9.2	**-%8**
Height 2	10	10.25	**+%2.5**
Height 3	11.5	9	**-%21.74**
Length 2	11.5	11.1	**-%3.48**

CONCLUSION

The casting process started with drawing part and the materials to be used in casting in a technical drawing program. Then these were printed on the 3D printer. After the gating system was created with these parts, the gaps of the system were filled with sand. Wax was chosen as the casting material. After the heating process, the melting wax was filled into the cavity from the sprue part of the system. The wax that solidificated here took the shape of mold. The wax structure was obtained when the containers were separated from each other.The following errors were encountered in the implementation of this process: the sand absorbed the wax, the sand got too wet and the mold could not be removed from the cavity, the trapped air in the cavity could not find a place to escape. As a solution to these problems, more vents were opened and the cavity was lined with bakery paper. As a result, this project provided an understanding of the casting process, the mistakes that can be experienced in this process and the solutions that can be produced for these mistakes.

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