Core Shooter Machine

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Abstract— In this paper we have considered a project based on design, manufacturing related to the casting process. Casting finds its application among a wide range of industries. The project has been undertaken to make drastic improvement in the core making process. The setup consists of lead screw, electric motor, frame, two square box.. Project is based in Foundry section. In this project we are combining all the processes which are used for manufacturing Dies. Also increases sand quality. We are also reducing production time, Human fatigue. We are improving the uniformity of sand. Casting is the basic process in industry, so we never skip it from industry. To enhance the casting process, we must need to improve the quality of sand and sand muller improves this quality. The dry silica sand is used as a basic refractory material for pre-preparing moulds. This sand withstands for high temperature of metal poured in the mould. Bentonite, Coal dust and Water. All above mentioned additives are added in muller to prepare mould. Bentonite gives bonding to the sand, is also helps to swelling the sand to improve sand particles bonding strength. Coal dust is added to burn gases during the pouring of molten metal in mould. Water is added to make sand wet to get mould shape.

Key words: Casting, mould, sand, muller

I. INTRODUCTION

Reason to adding for such material to sand molds is to minimize sand expansion defects. Such defects, especially in non- ferrous metals. Such defects results when the interface sand , heated by radiation or conduction from the metal rising in the mould , increases in volume and shears away from dipper adjacent layers which have not been heated. Mold, washes scabs may result. Addition also made to sand to improve the surface smoothness of casting.To properly mixes up a batch of "green sand" a machine known as a muller is used. A muller mixes the ingredients, by way of a set of mixing scrappers and a set of heavy wheels to compact and press the mix.

Sand casting, also known as sand molded casting, is a metal casting process characterized by using sand as the mold material. The term "sand casting" can also refer to an object produced via the sand casting process. Sand castings are produced in specialized factories called foundries. Over 70% of all metal castings are produced via a sand casting process.

Sand casting is relatively cheap and sufficiently refractory even for steel foundry use. In addition to the sand, a suitable bonding agent (usually clay) is mixed or occurs with the sand. The mixture is moistened, typically with water, but sometimes with other substances, to develop strength and plasticity of the clay and to make the aggregate suitable for molding. The sand is typically contained in a system of frames or mold box known as a flask. The mold cavities and gate system are created by compacting the sand around models, or patterns, or carved directly into the sand.

II. CONSTRUCTION

Cope & drag (top and bottom halves of a sand mold), with cores in place on the drag:

From the design, provided by an engineer or designer, a skilled pattern maker builds a pattern of the object to be produced, using wood, metal, or a plastic such as expanded polystyrene. Sand can be ground, swept or trickled into shape. The metal to be cast will contract during solidification, and this may be non-uniform due to uneven cooling. Therefore, the pattern must be slightly larger than the finished product, a difference known as contraction allowance. Pattern-makers are able to produce suitable patterns using 'Contraction rules' (these are sometimes called "shrink allowance rulers" where the ruled markings are deliberately made to a larger spacing according to the percentage of extra length needed. Patterns also have core prints that create registers within the molds into which are placed sand cores . Such cores, sometimes reinforced by wires, are used to create undercut profiles and cavities which cannot be molded with the cope and drag, such as the interior passages of valves or cooling passages in engine blocks.

Paths for the entrance of metal into the mold cavity constitute the runner system and include the sprue , various feeders which maintain a good metal 'feed', and in-gates which attach the runner system to the casting cavity. Gas and steam generated during casting exit through the permeable sand or via risers, which are added either in the pattern itself, or as separate pieces.

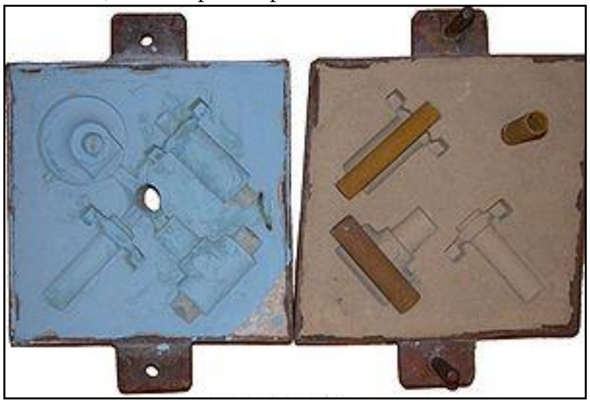

Fig. 1: Pattern Box

III. WORKING

To produce cavities within the casting—such as for liquid cooling in engines blocks and cylinder heads—negative forms are used to produce cores. Usually sand-molded, cores are inserted into the casting box after removal of the pattern. Whenever possible, designs are made that avoid the use of cores, due to the additional set-up time and thus greater cost.

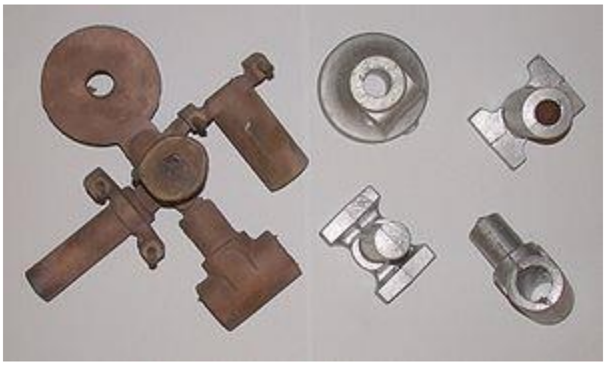

Fig. 2: Core

Two sets of castings (bronze and aluminum) from the above sand mold.

With a completed mold at the appropriate moisture content, the box containing the sand mold is then positioned for filling with molten metal—typically iron, steel, bronze, brass,, aluminum, magnesium alloys, or various pot metal, alloys, which often include lead,, tin,, and zinc.. After filling with liquid metal the box is set aside until the metal is sufficiently cool to be strong. The sand is then removed revealing a rough casting that, in the case of iron or steel, may still be glowing red. When casting with metals like iron or lead, which are significantly heavier than the casting sand, the casting flask is often covered with a heavy plate to prevent a problem known as floating the mold. Floating the mold occurs when the pressure of the metal pushes the sand above the mold cavity out of shape, causing the casting to fail.

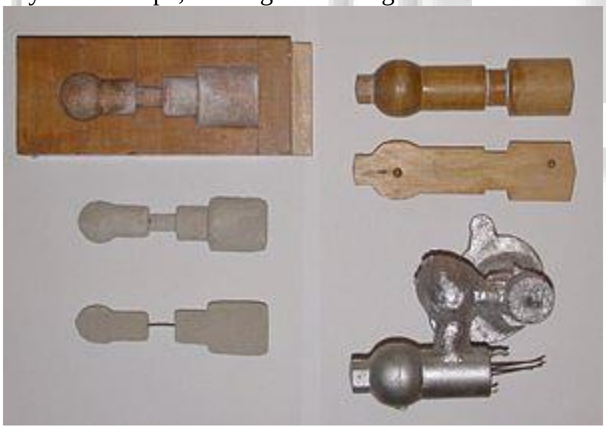

Fig. 3: Final stage

Left: Corebox, with resulting (wire reinforced) cores directly below. Right:- Pattern (used with the core) and the resulting casting below (the wires are from the remains of the core)

After casting, the cores are broken up by rods or shot and removed from the casting. The metal from the spurge and risers is cut from the rough casting. Various heat treatments may be applied to relieve stresses from the initial cooling and to add hardness—in the case of steel or iron, by quenching in water or oil. The casting may be further strengthened by surface compression treatment—like shot penning —that adds resistance to tensile cracking and smooth the rough surface.There are several types of sand used in sand casting. Each has its own advantages, disadvantages and use. There are a lot of different sands that are not mentioned here, the ones here are the more common ones used in the foundry.

IV. Design and Brought out Parts

Thus rollers get rotated with the help of square housing and it starts mixing of sand uniformly in the pan of Muller. The scrapper takes off the sand which is far away from the roller and also prevents the sticking of the sand to the rollers. When the mixing is competed the sand is taken out from the door which is provided to the cover plate.

Considering the Arm's weight = 10kg
Vertical piston weight approximately = 1 kg
Frame weight = 4 kg
Total weight = 10 + 1 + 4 = 15 kg
The required rpm at upper part is near about 20 to 30 rpm. So we selected the motor with 20rpm speed.

A. Materials

1) Mild steel

Tensile strength –1200/1420MPA
Yield strength – 750/1170 MPA

2) C30

Tensile strength – 620 MPA
Yield strength – 400 MP

3) 40C8

Tensile strength – 620 MPA
Yield strength – 400 MPA
Izod Impact Value – 55 Nm

4) **PLASTIC (NYLON)**

Tensile strength – 82 N/mm2
Compressive strength – 35 N/mm2
Yield strength – 8500 psi

5) DESIGN OF SHAFT Axle

Consider the M. S material yield = 320 N/mm^2

$$\sigma t = \frac{F}{A} = \frac{15 \times 9.81}{(\pi/4) \times d^2}$$

d = 0.765 mm
Consider F.O.S = 1.2
d = 0.765 x 1.2
= 0.918mm
d = 0.918 mm
d = 10mm

B. Design of Square Housing

Quantity=1no.
Material used=cast iron
We know that,
Torque=1731.473N-mm
Bending moment=490.5*400
=196200N-mm
Section modulus (z) = $(b*h^2)/6$
Therefore,
$Me = (1/2M) + \sqrt{(T^2) + (M^2)}$
$= (1/2*196200) + \sqrt{(1731.473^2) + (196200)^2}$
=1.84*10^6N-mm
m=z*(fb)
$1.84*10^6 = (b*h^2/6)(3.6)$
$1.84*10^6 = \{b*(1.75*b^2)^2*3.6\}/6$
b^3= (1.84*10^6*6)/ (3.5*1.75)
b=100mm
h=1.75*b
h=1.75*100
h =175mm

C. Cover Plate Design

Quantity=1no.
Material=M.S.
Density=$2.83*10^{-7}$kg/mm3
Volume=mass/density
$=250/(2.83*10^{-7})$
$=8.83*10^{-6}$
$v=\pi*r^2*h$ (r=1.5h)
$8.3*10^{-6}=\pi*(1.5*h)^2*h$
$8.833*10*-6=2.25*h^3$
h=500mm
h=50cm
d=150mm
Centrifugal force
Centrifugal force $=m*r*\omega^2$
Given,
M=250kg
R=400mm
N=33rpm
Therefore,
$C.P. = m*r(2*\pi*n/60)^2$
$=(250*400*\pi^2*33^2)/60^2$
=1171.5319N

D. Cover Plate Thickness Design

Force=1171.531912
Stress=413N/mm*mm
Area=1171.531972/413
Area=28387.43
Area $= (\pi/4)*(D^2-d^2)$
$A = (\pi/4)(1512^2-d^2)$
$d^2 = (4*A/\pi)+1512^2$
$d^2=2250000$
d=1500mm
d=150cm
t = (D-d)/2
t =12/2
t = 6mm

1) Brought out parts

a) Lead Screw

A lead screw (or lead screw), also known as a power screw or translation screw, is a screw designed to translate turning motion into linear motion. Common applications are Linear actuators, machine slides (such as in machine tools), vises, presses, and jacks.

Lead screws are manufactured in the same way as other thread forms.

Backlash can be reduced with the use of a second nut, or a tensioning spring, to create a static loading force known as preload; alternately, the nut can be cut across its diameter and preloaded by clamping that cut back together.

Fig. 4: Lead Screw

2) Synchronous Motor

A synchronous electric motor is an AC motor in which, at steady state,[1] the rotation of the shaft is synchronized with the frequency of the supply current; the rotation period is exactly equal to an integral number of AC cycles. Synchronous motors contain electromagnets on the stator of the motor that create a magnetic field which rotates in time with the oscillations of the line current. The rotor turns in step with this field, at the same rate.

The motor does not rely on "*slip*" under usual operating required.

3) Construction

The principal components of a synchronous motor are the stator and the rotor. The stator of synchronous motor and stator of induction motor are similar in construction. The stator frame contains *wrapper plate*. *Circumferential ribs* and *key bars* are attached to the wrapper plate. To carry the weight of the machine, *frame mounts* and *footings* are required. When the field winding is excited by DC excitation, brushes and slip rings are required to connect to the excitation supply.[The field winding can also be excited by a brushless exciter.

Fig. 5: Synchonous Motor

4) Bearings

As axial and thrust loads comes on main shaft, taper roller bearing is selected
From design data book,
For shaft diameter, d=20mm

V. ASSEMBLY

The size of the body 2*1*2.5feet

- Lead screw is for transmitting rotary into linear motion.
- Lead screw has various types of thread, the typrs of threads depend upon the type of application. We have used square thread as it has following advantages.
- It is a zero profile thread angle.
- As they transmit power without any side thrust.
- In this system force is applied on both directions hence, the square thread lead screw is used.
- Motors are basically type of actuators.
- There were many types of motors. In our project motor is used for giving the rotating motion to the lead screw and this lead screw transmits the linear power for enclosement for mould. The motor is attached to the lead screw and shaft.
- Synchronous motor is used has 10kg weight. The speed of motor is 60 rpm.
- The heating coil is inserted in the mould and its main function is to heat the Sand. If the sand is not properly heated the sand will not be uniformly binded. Therefore the coil material should be able to uniformly heat itself. The heating coil is made up of G.I.is of 240 V.

Mould is used to manufacture to component of the specific shape. As the shape of the mould is present, when the molten metal is poured into the mould, after is solidification the hardened object is obtained.In this mould we are inserting a cavity of a specific shape. This cavity is basically called as core. To form this cavity we normally use wooden object of that particular shape.

The size of the mould used is
100mm*100mm*10mm

VI. Advantages, Limitations and Applications

A. Advantages

- Sand mixing is uniform, the additives binds firmly.
- Sand Muller requires less time for condition the sand.
- Only one motor is required so consumes less electric power
- Sand Muller is easy to handle and safe in operation.
- It has low operating and maintenance cost.
- The efficiency of sand Muller is high.

B. Limitations

- Sand Muller is special purpose machine so that it is only used in foundry.
- It has high initial cost.
- Breakdown of main shaft causes machine to stop completely.

C. Applications

- Preparing core for industrial purpose.
- Core for specific applications.
- Core preparing and utilization for various application

VII. Conclusion

By using sand Muller we can mix the sand uniformly with enhanced capacity, large amount of sand can be easily prepared in minimum time. It requires less power, easy handling there are many ways to mull your sand, but a Muller is by far the most proficient, no extra motor is needed for roller power is given to main shaft only in which whole assembly is rotated.

VIII. Future Scope

1) To over the shortcomings and develop proper and faster working time
2) Sensors- To check for proper fitment and full efficiency of the machine.

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