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DESIGN AND DEVELOPMENT OF PORTABLE CORE SHOOTER MACHINE

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Abstract: Core generation is an important step in casting, so it should never be skipped. Raising the core production level and reducing the core price will improve the process, depending on whether it is fabricated or purchased from the foundry. By using dry silica sand as an abrasive refractory, we can prepare the core in advance, which will reduce the number of defects caused by sand expansion. Additionally, adding coal bran and water to the sand will create a sand core that is more durable and expands more easily, reducing defects. All of these additives are blended in a blender before being pouredinto molds to create a sand insert that is formed, bonded, and can be used to shape the inside of a castingor a part of a casting that cannot be modeled.

Index Terms - Portable Core Machine; Cost Analysis; Core Machine

I. INTRODUCTION

Patterns are required to make a mold. The mould is made by packing moulding sand around the pattern. The mould is usually made in two parts so that the pattern can be withdrawn The bottom hub in horizontal moldings is also referred to as the drag, along with cope. The top hub of the mold is known to as the swing in vertical molding, while the rear hub is called as as the ram.

As the design is released from the molding material (sand and other), the print of the image provides the hole in the mold hub are pushed together. The mold cavity together in order with any inside core (c above) as required, is lastly filled with molten state steel to form the casting.

Additional patterns, called core boxes, are required if a casting appears too hollow in order to create the sand shapes, or the cores, that are put into the cavity of the mold to form the casting's inner surfaces as well as its exterior surfaces. Thus, the casting ultimately arises between the mold and core. The changes: The process that must be done to get a mold ready to receive metal is referred to as molding. To guide the steel into the opening in the mold created using the pattern, either by hand cutting it into the mold or, in the most common case, by putting it on the pattern, includes ramming sand around the pattern set in a support, such as a flask, taking off the pattern, putting cores in place, and building the gating/feeding system. When a worker in a foundry meets problems with core making, he usually has to decide if the plates are turning red hot effectively or not. But this can be difficult to do because there is no tools available to conduct this check, and he may even discover an issue with whether the proper quantity of Sand has been inserted. Improper finding of faults leads to improper core formation and failure to locate the defect, which causes rejection.

To overcome this limitation special equipment or machine should be made to make the cores easily and accurately to check whether the cores are good or faulty. Even the heat order can be checked for any faulty condition.

1.1 Core shooter [1,2]

Sand core production equipment produces these cores using the proper core molding technique in core boxes that are appropriate for the purpose. The most recent technology divides the core shooting machines into those for damp and dry mold material, dry mold material, and flowable, dry shell mold material. Typically, the mold material is chemically and physically consolidation during core manufacture rather than compacted.

1.2 Common technologies for making core.

The foundry industry uses the following procedures as their most prevalent methods for creating cores:
1.2.1 Oil sand core
1.2.2 CO_2 core
1.2.3 Amine core

1.2.1 Core of oil sand [3]

Oil sand is a different term of the sand used to make cores. Core sand, which is high in silica, is mixed with oil binders such as core oil, that consists of linseed oil, light mineral oil, resin, and other binders. Pitch or wheat and water can also be used in large cores for savings.

1.2.3 Amine core [5]

Sand that has been covered with a binder is stuffed into a core box and then sealed, allowing a curing gas to be released. Since these gases frequently have hazardous or offensive properties (such as SO2 or amine gas), particular handling techniques must be implemented. Shell moulding is a third method for creating cores at ambient temperature.

1.2.4 programmatic Logic Control (PLC) [6]

A programmable logic controller, or PLC for short, is a kind a specialist digital computer used in factories for controlling production lines, robotic systems, and other processes that need for reliable control, intuitive programming, and efficient detection of issues.

1.2 Heating Module

Nichrome, a nickel-chromium alloy, is the most widely used type of metal alloy for this purpose. The actual resistance is where the electrical load is found. The nichrome wire is wound around the ceramic core, but the amount of twists per inch varies based on the required watt density.

1.2 Pneumatics [7]

Compressed air is used in a pneumatic system to convey and regulate energy. Many firms have mobile compressors and compressed air supplies for their production lines. Our atmosphere has an infinite amount of air, which may be compressed.

1.5 objective of the project.

1) To build an electronic system that can produce micro core components
2) To construct a machine that is portable to any place.
3) To design a cheap machine that can be used by everyone in order to start core production at an affordable rate.
4) To improve core-making production speed in comparison to manual methods.

1.7 Industrial Relevance [16]

To remain competitive in today's market, companies need advanced skills and technology to produce high-quality products at low cost. This involves reducing machining costs, time, human involvement, and by developing special testing machines for efficient and quick inspection. This leads to increased profit and reduced fatigue.

1.2.1 CO2 core [4]

The internal chambers and characteristics within a casting are provided by cores. They are manufactured in a core box mold. Sand that has been packed into a core box is blasted with CO_2 gas to create a CO_2 core. A shell molding technique is used by a core machine to create a shell core.

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1.Literature Survey

Anup, Suresh, Raheimifar, Kamran.

The production of such complex hollow parts requires cores that we manufacture in our core business. In the manual core creation process the core is created manually and has ergonomic issues along with the core have significance Rejections raise the need for work, reduce efficiency, and raise costs.

Shell cores are therefore created by a process known as an automatic core creation technique. There is no need to do more baking while using a shell core.

2.2 Cowin S.C., Galvin K. P., and Mehrabadi M.

The author's prior research resulted in the development of an empirical formula to determine the average compaction degree of a specific type of core sand based on initial loose mixture apparent density, working pressure, and blowhole diameter. This formula simulates the critical pressure level that results in an average apparent density of sand in the modeled core.

2. Design Methodology

Core shooter machine is used to make core which is used in casting industries. The core shooter machine consists of a core, pneumatic cylinder, rotating body elements, handle, heating coil, hose pipes etc. When the heating coil reaches 250 degrees, the two die plates are closed using a Pneumatic cylinder. A pressure of 30 bar is applied using air pressure from an air compressor. [10] The core sand is inserted into the hollow chamber where the required shape of die plates is present. The die plates are kept closed for 10 minutes, then opened via a backward-acting pneumatic cylinder. [11] The core is then ready for cooling, which takes 20 minutes. A special collection chamber with two sections shown was designed and built for this test. [12]

The bottom half section consists of a cavity that allowed for an adequate amount of sand and binder mixture to be contained within its volume. The bottom half of the chamber also has a conical tube at the center with one open end within the bottom half and the other end connected to a 1/2 tube, facilitating connection to the heated sampling line and the holding chamber. The top half of the chamber meshed with the bottom half.

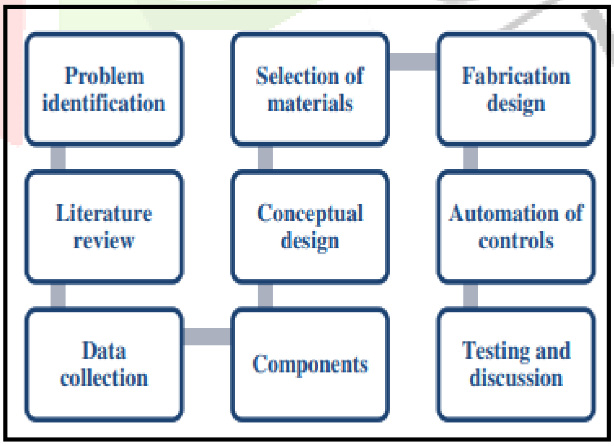

Fig. 1

Spacers were inserted between the top and bottom halves to provide gaps to allow air to be drawn into the collection chamber and transported via the heated sampling line to the sampling manifold. The thickness of the spacers was calculated to maintain an adequate flow velocity for complete capture of all emissions generated within the collection chamber Positive displacement pumps are reciprocating air pumps. [2] It means that they are drawing in more and more of air that is confined to a small area and forcing it up to a greater pressure. This is achieved by the reciprocating air pump, which uses a piston inside the cylinder as the compress and displacing element. When just one side of a piston is used to achieve compression, the rotary air pump is referred to as single-acting.

A double pump is one which employs the piston on both sides. Each cylinder of the revolving air pump has a series of manually was running, spring-loaded valves that only open when

There is an appropriate pressure difference across the valve. When the cylinder pressure is slightly lower than the intake pressure, the intel valves open. When the cylinder's acting pressure is slightly larger than the discharge pressure, the discharge valves open. A heating coil is connected to heat the core sand to form a core shape used in casting processes. The rotating body element acts as a Muller for thorough mixing of sand and to produce high- quality mixed sand in the core-making process.

2.1 Design Characteristics

(A) A mulling action is very much required for mixing sand, binder and moisture, thoroughly [4]
(B) Mixing can be carried out by hand shovels or mechanical Mixers-Muller.
(C) Hand mulling is suitable for mixing natural sand, but not effective with synthetic sands as they cannot be well mixed or blended by hand.
(D) A Muller mixes, cuts, and blends sand through the use of revolving wheels or rollers. (E) A handle is employed to rotate the component that mixes sand in the core-making procedure.
(F) A hose is utilized in piping and plumbing applications. In this scenario, the hose is utilized to transmit high- pressure air for pneumatic purposes, specifically for the creation of a core.

2.2 Actual, Isometric model and line diagram of core shooter machine.

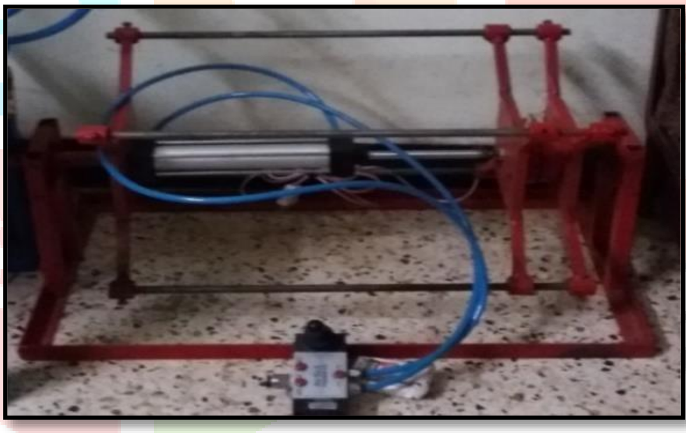

Fig. 2

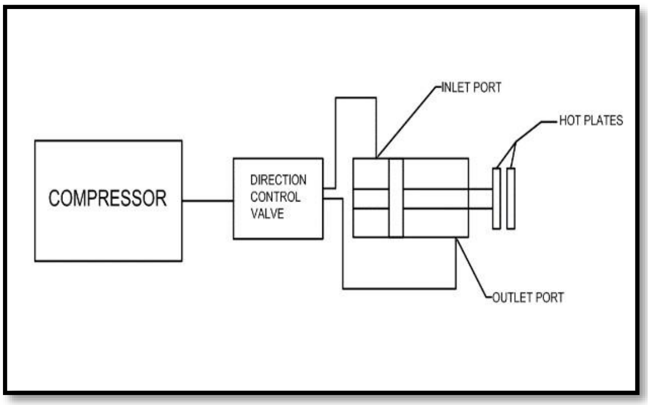

Fig 3

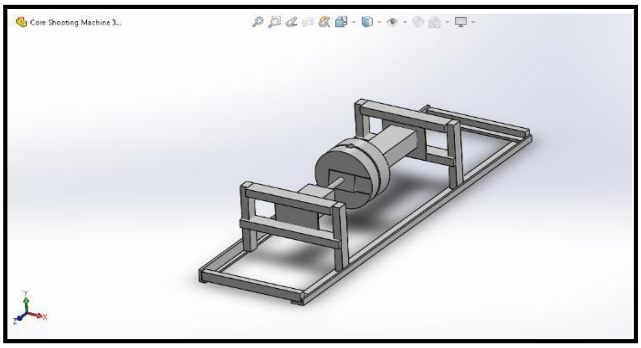

Fig 4

The compressor produces high-pressure air at approximately 35 bars, which is directed through a direction control valve. This movement of the piston in the desired direction, and the opening and closing of the heater plates, allows for the creation of cores in any shape with minimal manual labor. [17] The manual production of small cores in modern foundries leads to excessive human labor, resulting in various physical impacts on workers such as eye strain and hand burns. This results in decreased production and poses risks of injury to the workers.

2.3 Design Calculations

Force on the Core

F = P × C (1)

F = Force on the core

P = Air pressure in nozzle = 30 bar

C = maximum projected area = πr^2

= π × 302 = 2826

F = 30 × 2826 = 84.780 N

Design of cylinder When designing a pneumatic cylinder, the force exerted by a heavily loaded vehicle must be taken into account.

F1 = 2.5 ton at wheel pair

F1 = 2500 kg

Hence

F = 1.1 × F1 = 1.1 × 2500 = 27500N

Therefore, total force F = π/ 4 × D ^2 × P (2)

27500 = π/4 × D ^2 × 15

D = 48.31m

D ≈50m

Therefore, the thickness of Cylinder

t = P × d/ 26 × D (3)

t = 10 × 60/ 2 × 50 × 1

t = 7.5mm

d = D– 2 × t

d = 60 − (2 × 6) = 35mm

To find the power output of cylinder

Stroke of piston = 100mm = 0.1m

Time required for working stroke = 5sec Distance moved by piston = 1/s=0.02m

Work done = $force$ × $distance\ moved$

= 27500 × 0.02 = 550 Nm/sec

Force trying to separate the flanges =π/ 4 × D1 ^ 2 × P (4)

= π/4 × 502 × 15 =29453N

Force trying to be resisted by four bolts

F = F1/ 4 = 27500 /4 =6875

Let dc = core diameter = 50MPa

F = π/ 4 × dc ^2 × ft (5)

6875 = π 4 × dc ^2 × 50

dc= 13.23mm

Core diameter = 13.23mm

2.4 Difference Between New machine and Old.

• The old machine has a sturdy design and is able to produce large cores accurately with low vibration. However, its heavy weight makes it difficult to relocate.

• The new machine is lightweight and easily portable, but it is limited to producing small cores only due to its compact design. It utilizes several working principles and components, but is prone to higher levels of vibration, potentially causing cracking or breaking of the cores.

2.5 Idea

• The machine is necessary in the foundry as cores are crucial in casting production. Commercial core making machines are expensive, so the goal is to create a low-cost and portable alternative.
• To complete this project, we researched the operation of core-making machines and sought to implement a cost-effective and portable technology solution.
• We used AutoCAD and SolidWorks for the design, and utilized Ansys to analyze the effects of forces on the machine. Our efforts culminated in the successful operation of the machine.
• After finalizing the design, we constructed a frame to mount all components and successfully assembled the machine.

3. Advantages

1. As a result of core making, we obtain the proper amount of sand for core production, leading to best outcome
2. The core-making machine results in increased production.
3. This testing improves core making efficiency through proper automation, leading to increased core quantity.
4. The machine greatly reduces worker fatigue.

4. Result and Discussion

The machine is designed with ample space for future upgrades, such as full automation through the addition of limit switches and heat sensors. We feel the project that we have made has a lot of good future scope in any industrial sector. The product offers plenty of room for modification, further improvements, and operational efficiency, all of which should make it attractive and commercially available. If the device is properly marketed and is put into production for commercial use, we are sure that it will be accepted by the industry.

5. Summary

When the project work first began, the market's availability of spare parts was evaluated, and those that weren't easily accessible there were designed separately and then produced. Each component started as a separate design that was later put together. After finishing the design and design analysis, the right material was selected. The machine's measurements were then marked on the raw materials that were purchased for its construction, and the processes that were carried out were described in detail in chapters above. All necessary safety precautions were taken into consideration throughout the manufacturing process. Upon completion of the machine's fabrication and trail run, painting operations began.

5.1 Method Study

The method study for the portable core shooter thoroughly examines the various operations involved in its sequence of operation.

5.2 A financial analysis

The mobile core shooting machine's economic study took in factors such as return on investment, payback time, labor cost savings, and profit growth.

5.3 Savings

The main cost-saving benefit of the automatic core shooter is time savings. Additionally, productivity has increased, increasing the company's profits.

Conclusion

To produce shell cores with efficiency, a portable cores shooter was devised and built. The machine requires no trained staff and is simple to operate. The project concluded successfully and on timetable, with a focus on make sure that proper security measures were put in place during operation.

6. References

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