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A STUDY OF CORE AND ITS TYPES FOR CASTING PROCESS

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ABSTRACT

Casting is one of most important t and prime process in manufacturing industry. Basically cast irons are used for casting purpose, as it is having highest fluidity characteristic, which will allow molten cast iron to flow properly into the cavities. Cores form internal cavities inside the structure which will then leads to the final casting shape. Sand inside the cores and pattern gives strength and rigidity to the casting structure. Properly conditioned sand will gives better results. This paper focus on casting and core in detail.

Keywords: Cast iron, Casting, core, fluidity, manufacturing industry, strength and rigidity

I. INTRODUCTION

Casting is the process of producing metal/ alloy component parts of desired shapes by pouring the molten metal / alloy into a prepared mold (of that shape) and then allowing the metal/alloy to cool and solidify. The solidified piece of metal/alloy is known as casting. Casting is the basic process in industry, so we never skip it from industry [1]. To enhance the casting process, we must need to improve the quality of sand and sand muller improves this quality.A core is essentially a body of materials which forms components of the mold. It possesses sufficient strength to be handled as an independent unit.Core is an obstruction which when positioned in the mold, naturally does not permit the molten metal to fill up the space occupied by the core. In this way a core produces hollow casting. Cores are required to create the recesses, undercuts and interior cavities that are often apart of castings. Cores are employed as inserts in mould to form design features that are otherwise extremely difficult to produce by simple moulding [2]. The dry silica sand is used as a basic refractory material for pre-preparing core .This sand withstands for high temperature of metal poured in the mould.

II. LITERATURE REVIEW

SR NO.	TITLE AND AUTHOR	CONCLUSION
1.	Accessing the performance of binders on core strength in metal	In this work, the highest valuable results for binder performance on core strength were achieved with Arabic gum, starch and molasses of 2, 3, 4, 6 and 8%, respectively

	casting Popoola A. P.1 and Fayomi O. S. [1]	at 200°C in 1.5 h. Composition of core properties shows that the core hardness/strength is affected by the nature of core treatment before, during and after baking.
2.	Green sand dilution by new and core sand additions paper 11 119 AFS proceedings Biersner and J.Thiel [3]	The new research attempted to emulate foundry operations by limiting the amount of time the sand was mulled.The testing recently conductedattempted to stress the sand by adding both dilutions sand and the correspondingamount of betonite but maintaining a minimum amount of mulling time.

In 1924, the Ford automobile company set a record by producing 1 million cars, in the process consuming one-third of the total casting production in the U.S. As the automobile industry grew the need for increased casting efficiency grew. The increasing demand for castings in the growing car and machine building industry during and after World War I and World War II, stimulated new inventions in mechanization and later automation of the sand casting process technology. There was not one bottleneck to faster casting production but rather several. Improvements were made in molding speed, molding sand preparation, sand mixing, core manufacturing processes, and the slow metal melting rate in cupola furnaces. In 1912, the sand slinger was invented by the American company Beardsley & Piper. In 1912, the first sand mixer with individually mounted revolving plows was marketed by the Simpson Company.[3] In 1915, the first experiments started with betonies clay instead of simple fire clay as the bonding additive to the molding sand. This increased tremendously the green and dry strength of the molds. In 1918, the first fully automated foundry for fabricating hand grenades for the U.S. Army went into production. In the 1930s the first high-frequency coreless electric furnace was installed in the U.S. In 1943, ductile iron was invented by adding magnesium to the widely used grey iron. In 1940, thermal sand reclamation was applied for molding and core sands. In 1952, the "D-process" was developed for making shell molds with fine, pre-coated sand. In 1953, the hotbox core sand process in which the cores are thermally cured was invented. In 1954, a new core binder—water glass (sodium silicate) hardened with CO_2 from the ambient air, came into use.

III. CORE

3.1 Types of core

3.1.1 According to the state or condition of core

A . Green sand core

Green sand cores are formed by pattern itself.

- A green sand core is a part of the mold
- A green sand core is made out of the same sand from which the rest of mold has been made i.e molding steel.

B. Dry Sand cores

- Dry sand cores, unlike green sand cores are not produced as a part of the sand.
- Dry sand cores are made separately and independent of that mold
- A dry sand core is made up of core sand which differs very much from the sand out of which the mold is constructed.

- A dry sand core is made in a core box and it is baked after ramming.
- A dry sand core is positioned in the mold on core seats formed by core print on the pattern.
- A dry sand core is inserted in the mold before closing the same.

3.2 According to the nature of core materials employed:

A Oil bonded cores

- Conventional sand cores are produced by mixing silica sand with a small percentage of linseed sand.

B. Resin – bonded cores

- Phenol resin bonded sand is rammed in a core box
- The core is removed from the core box and baked in a core oven at 375 to 450 f to harden the core

C . Shell cores

- Shell cores can be made manually or on machines.
- The procedure of making shell cores is as follows:
- The core box is heated to temperature of the order of 400 to 600 F.

i. Sand mixed with about 2 to 5 % thermosetting resin of phenolic type is either dumped or blown into the preheated metal core box.
ii. Where sand blowing is employed, it is preferred to use resin precoated sand to avoid resin segregation.
iii. The resin is allowed to melt to the specified thickness.
iv. The resin gets cured.
v. The excess sand is dumped and removed.
vi. The hardened core is extracted from the core box.
vii. Cores thus produced needs no further baking.
viii. Shell core posses very smooth surface (3125 micro mm root mean square) and close tolerance. (+_ 0.003 mm/mm).
ix. Shell core making process can be mechanized and several core making machines are commercially available.
x. High permeability is achieved in shell core making.
xi. Shell cores can easily stored for future use.
xii. Shell cores are costly as compared to cores produced by other methods.

D. Sodium silicate – CO2 cores

- These cores use a core material consisting of clean, dry sand mixed with a solution of sodium silicate.
- The sand mixture is rammed into the core box.
- The rammed sand while it is in the core box is gassed for several seconds with CO2 gas. As results a silica gel forms which binds sand grains into a strong solid form.Na2SiO3+CO2 –Na2CO3+SiO2 (silica sand)
- Cores thus produced usually need no baking.
- Cores thus formed possess more strength than the oil /resin bonded cores.
- Unhardened cores are not handled so that there is no chance of braking or sagging of cores.
- Core dryer is not required.

- Core formed by CO_2 process are used in the production of cast iron, steel, aluminum and copper base alloy castings.
- The used sand mixture however cannot be recovered and reused.

3.3 According to the type of core hardening process employed

A . Hot box process

- It uses heated core boxes for the production of cores.
- The core box is made up of cast iron, steel or aluminum and possesses vents and ejectors for removing core gases and stripping cores from the core box respectively.
- Core box is heated from 350 to 500 F.
- Heated core box is employed for making shell cores from dry resin bonded mixtures.
- Hot core boxes can also be used with core sand mixture employing liquid resin binders and a catalyst.

B. The cold set process

- While mixing the core sand, an accelerator to the binders.
- The sand mixture is very flowable and is easily rammed.
- Curing begins immediately with the addition of accelerators and continues until the core is strong to be removed from the core box.
- A little heating of the cores hardens it completely.
- Cold set process is preferred for jobbing production.

C . Castable sand process

- A setting or hardening agent such as dicalcium silicate is added to sodium silicate at the time of core sand mixing.
- The sand mixture possesses high flowability and after being poured in the core box, it chemically hardens after a short interval of time.
- As compared to CO_2 process, where it may not be possible to gas the full core uniformly and to obtain uniformly hardened cores, castable sand process produces much better and uniform results.

D Nishiyama process

- Nishiyama process uses sodium silicate bonded sand, which is mixed with 2% finely powered ferrosilicon.
- Hardening occurs because of exothermic reaction of silicon with Noah produced by hydrolysis in the solution of sodium silicate
- Cores thus made posses short bench life.

E Oil no-bake process

- The process employs a synthetic oil binder which when mixed with basic sands activated chemically produces cores that can be cured at room temperature.
- The sand may consists of:

  Washed and dried sand

  Oil no-bake binders and catalyst

  Oil no-bake cross linking agent

- In oil no-bake process, the polymerization reaction results in a complete and uniform setting of the complete core sand mass.
- This process assures better depth of set, fast baking, easier core withdrawal and lower production cost as compared to furan or oil bonding process.

3.4 According to the Shape and Position of the Core

A Horizontal Core

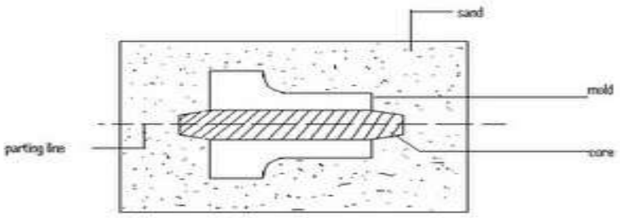

Fig1 Horizontal Core

B Vertical Core

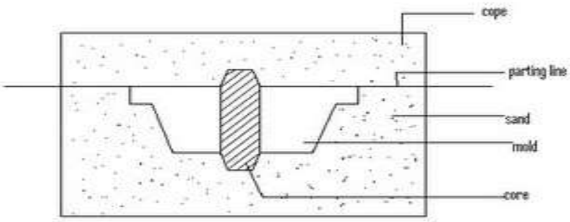

Fig 2 Vertical Core

C Hanging or Cover Core

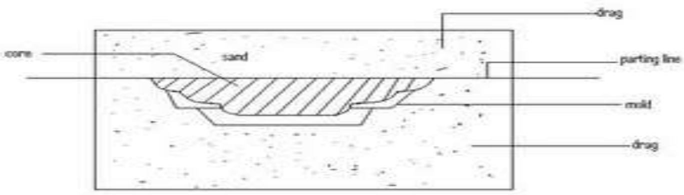

Fig. 3 Hanging or Cover Core

D Drop or Stop off Core

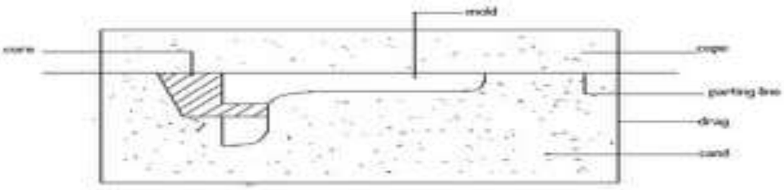

Fig. 4 Drop or Stopoff Core

E. Balanced Core

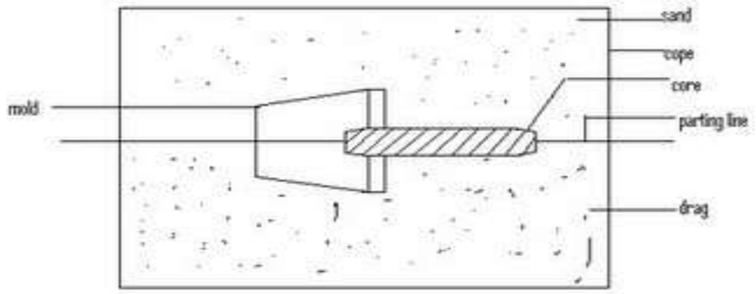

Fig. 5 Balanced Core

F Ram Up Core

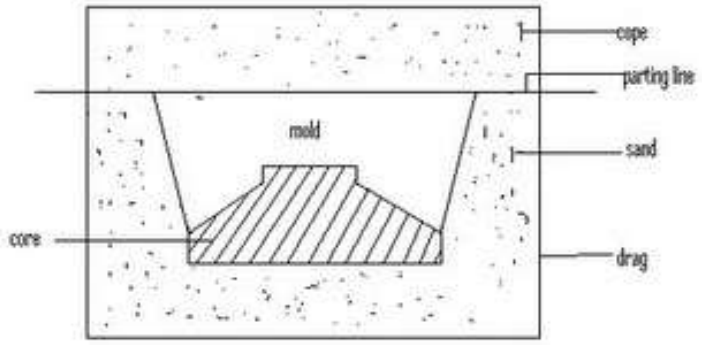

Fig.6 Ram up Core

G Kiss Core

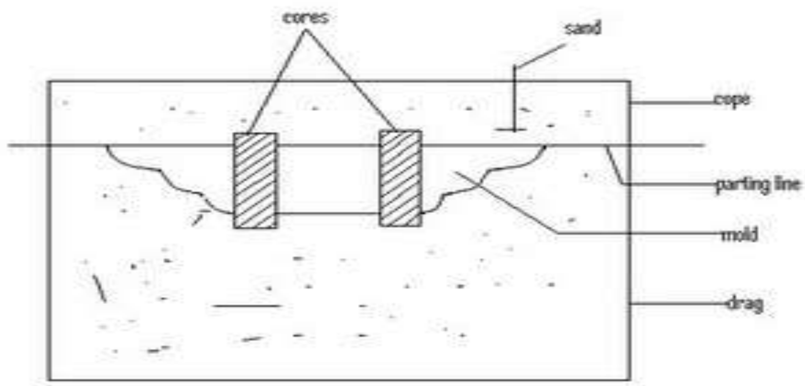

Fig. 7 Kiss Core

IV. CORE APPLICATIONS

1. Core and core forms greatly increase the versatility of molding and casting operations.

2. Before being used for forming recesses and holes in the castings, cores are also employed:

- As a strainer, gates and pouring cups.
- As riser core.
- For making molds.
- As core mold in centrifugal casting process.
- As slab core for increasing casting output from one mold.

V CORE BOX

5.1 Core box

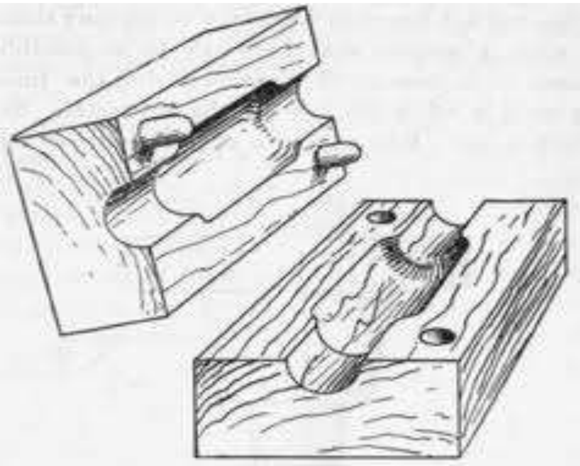

Fig 8 Conventional Core Box

1. A core box is basically a pattern for making cores
2. Core boxes are employed for ramming cores in them
3. Core boxes impart the desired shape to the core sand.
4. Core boxes range from simple wooden structures to precision metal assemblies which possess long life under extracting condition.

5.2 Types of core boxes

1. Half core box.
2. Slab or dump core box.
3. Split core box.
4. Left and right hand core box.
5. Strickle core box

5.3 Finishing of cores

1 Baked cores are finished before they can be set in the mald.

2 finishing consists of:

i. Cleaning

ii. Trimming

iii. Brushing
iv. Coating
v. Mudding Sizing
vi. Core assembly

5.4 Setting of Cores

- Core setting means placing cores in the mold
- In order to obtain correct cavities in the castings the cores should be accurately positioned in the molds.
- Cores in the moulds should be firmly secured so that they can withstand the buoyancy effect of the being poured molten metal.
- Small cores are set in the moulds by hand whereas big cores may required a crane for the purpose.

VI SAND CORE

The forming of holes, internal cavities and other internal surface of casting depends on cores. Therefore core can be defined as that portion of mould which form the hallow interior of casting or hole through the casting.[2] Casting is produced in the foundry by pouring in molten metal into a mould made to shape of the component required.

Castings play a vital part in all branches of engineering. The flexibility of casting production techniques enable practically, all shapes to be produced. Though naturally, production cost is important. In domestic application casting are used for stoves, gates, cookers, radiators, bath, piping for main water supply and drainage. However the product of casting on a large scale is a sophisticated and capital-intensive business. Cores are also used in shaping external surface of cast product when a pattern is so shaped that it forms a core as an integral part of the mould such a core is known as green sand core.

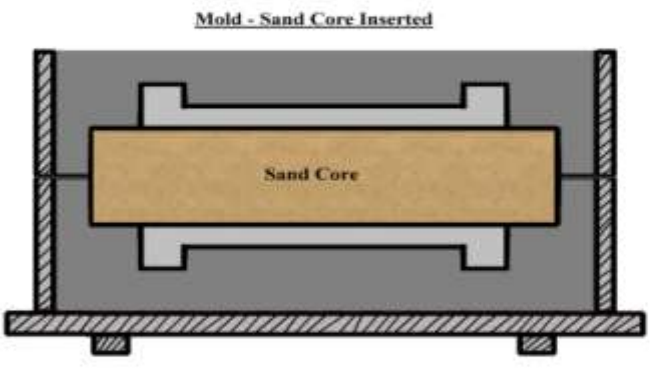

Fig 9 Sand Core

Though this is acknowledge as an economical method of forming cavities in casting. It is limited to hallow of short length. But binder suitable for foundry core must not only hold sand grain together but must also be sufficiently resistant to high temperature, in order for it to collapse and allow sand to be easily removed from the casting leaving it surface smooth [4]. The ability of the binder to collapse on cooling is known as breakdown and this property is very important to cores hole, which are in accessible to felting.

6.1 Requirements of Core

6.1.1 There are seven requirements for core:

a. In the green condition there must be adequate strength for handling.
b. Permeability must be very high to allow for the escape of gases.
c. As the casting or molding cools the core must be weak enough to break down as the material shrinks. Moreover, they must be easy to remove during shakeout.
d. Good refractoriness is required as the core is usually surrounded by hot metal during casting or molding.
e. A smooth surface finish.
f. A minimum generation of gases during metal pouring

6.2 Binders

Special binders are introduced into core sands to add strength. The oldest binder was vegetable oil, however now synthetic oil is used, in conjunction with cereal or clay.[1]The core is then baked in a convection oven between 200 and 250 °C (392 and 482 °F). The heat causes the binder to cross-link or polymerize. While this process is simple, the dimensional accuracy is low.

Another type of binder process is called the hot-box process, which uses a thermoset and catalyst for a binder. The sand with the binder is packed into a core box that is heated to approximately 230 °C (446 °F) (which is where the name originated from). The binder that touches the hot surface of the core box begins to cure within 10 to 30 seconds. Depending on the type of binder it may require further baking to fully cure

In a similar vein, the cold-box process uses a binder that is hardened through the use of special gases. The binder coated sand is packed into a core box and then sealed so that a curing gas can be introduced. These gases are often toxic (i.e. amine gas) or odorous (i.e. SO_2), so special handling systems must be used. However, because high temperatures are not required the core box can be made from metal, wood, or plastic. An added benefit is that hollow core can be formed if the gas is introduced via holes in the core surface which cause only the surface of the core to harden; the remaining sand is then just dumped out to be used again. For example, a cold-box sand casting core binder is sodium silicate which hardens on exposure to carbon dioxide.

Special binders are used in air-set sands to produce core at room temperature. These sands do not require a gas catalyst because organic binders and a curing catalyst are mixed together in the sand which initiates the curing process. The only disadvantage with this is that after the catalyst is mixed in there is a short time to use the sand. A third way to produce room temperature cores is by shell molding.

VII. CONCLUSION

Casting has shown wide range of applications. Core plays the important role without which casting process will not get complete. We have studied types of core used for casting processes. This paper in simple, presents a review on core and its types for casting processes in detail. To increase the strength of cores internal wires and rods can be added. To enhance collapsibility straw can be added to the middle of the core or a hollow core can be used. This attribute is especially important for steel casting because a large amount of shrinkage is present.

Except for very small cores, all cores require vent holes to release gases. These are usually formed by using small wires to create holes from the surface of the mold to the core.

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