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Research on optimization of sand Moulding process

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Abstract **-Casting is a manufacturing process in which molten metal or liquid is converted into desired shape for its application in different fields like automobile parts, firefighting parts, valve parts, electrical equipment. The solid parts received after the whole process is known to be casting .This process have been known for thousands of years and is one of the most popular and simplest method of casting that allows products to be generate at reasonable cost at manufacturing industry. In order to meet the overgrowing demand of the consumer industry need to produce large amount accurate products at suitable time so the companies are trying every possible means In order to done casting most of them are using hit and trial method to casting. That results involvement of error, time consumption and loss of cost in the process of casting .Origination of casting defects is one of limitation that is need to be consider as to diminish the effect of defects in the final casting product. Defects like gas porosity, shrinkage, mold material defects. As to determine the optimum condition for sand casting is challenging task. In order to find out optimum condition as to aquire minimum defects for best possible results. Selection of material and process is very important task which we have to keep in mind. Selection various parameters like grain size of 300 and 600 mics ,moisture content of 26 % and 28 % as to produce the sand moldings and test the sample for tensile and compressive strength is key method of our working .In this project we have taken 4 samples with different condition of operation in the end made an comparison between them to find the optimized result . The results indicated that the selected process parameters significantly affect in improving casting defects like gas porosity, shrinkage in foundry lab. This paper illustrates the optimizing the process parameters of sand casting process including optimum levels and the case study are done in foundry lab. The result obtained in the experiment demonstrate that smaller grain size particles with medium level of moisture(300 mics sand & 28% water content) delivers optimum results for casting.**

Keywords **- Casting, optimization, molding, tensile and compressive strength.etc**

I.INTRODUCTION

Creating a casting is one of the oldest manufacturing methods known to humankind and a very direct method of producing metal parts. The first castings can be dated back to ancient China is the 4th century B.C.Sand. Casting materials are usually metals or various cold setting materials that cure after mixing two or more components together; examples are epoxy, concrete, plaster and clay. Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods [1].Casting is a 6000-year-old process.

The oldest surviving casting is a copper frog from 3200 BC[2] While all metals can be cast, the most predominant are iron, aluminum, steel and copper-base alloys. Castings range in weight from less than an ounce to single parts weighing several hundred tons. Casting is a manufacturing process used in industries in which molten metal is poured in a mould (generally made of sand) which contains a hollow cavity of required shape allow to solidify by cooling. The solidified piece of metal which is taken out of the mould is called casting. a plant where the casting is made is called foundry .Various patterns are used to create cavity in the moulds wherein, pattern can be said as the replica of the final object to be made with some modifications.

1.Steps involved in casting

- Selection of material as to cast.
- Putting solidify material in a furnace as to convert into molten material by properly heating at 800 to 850 degree
- Prepare mould cavity by using sand.
- Liquid is poured into a prepared mould cavity
- Allowed to solidify by the process of cooling
- Product is taken out of the mould cavity, trimmed and made to shape.

2.Moulding- A mould is a hollow –out block that is filled with molten metal or pliable material such as metal, glass, plastics, ceramics .In the process of moulding liquid is allowed to enter in the hollow cavity

and fill till the level of liquid reaches at top of the cavity area and then it is being permitted to cool down and settle down in a solid shape. After that casting is separated from moulding and pass it to machining department for its finishing. In order to get fine result after conversion of molten metal into hard shape a releasing agent is used between molten material and contacting surface. Release agent act as critical barrier between two surface and not allow to create a bond as to[3] .without a barrier in the process it results in bonding between the mould surface and casting material which have a dramatic effect on the quality and consistency of final product. It is also responsible for quality and regular finishing of the casting. In the process of moulding an impression has to be generate with some sort of material that would be exactly same like object that has to cast.

Moulding can be generate either in one or multiple pieces. The selection of different types of mould material for produce moulding depends upon the shape and size of the desired object. Selection of moulding materials also depends upon the characteristics possess by them during the process. The general properties like refractoriness, permeability, collapsibility acquire by materials to be fit in foundries for manufacturing moulds and cores.

Types of moulding

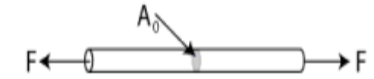
• Blow molding.
• Powder metallurgy plus sintering.
• Compression molding.
•Extrusion molding. • Injection molding.
• Laminating. Reaction injection molding.
•Matrix molding.

Sand casting generally refers to the casting product that is made by the application of sand in the process of moulding. Sand is used in this type of moulding. The products produced by sand molding are made in specialized factories known as foundries. More than 70% of all metal mouldings are produced via the sand molding process[4]. The moldings sand generally comprised of base sand, binder, additives and a partning compound. Moulding sand or foundry sand is describe by these Refractoriness, chemical inertness, permeability, surface finish, cohesiveness, flow ability, collapsibility, and availability/cost.. Therefore the casting done through sand as moulding material results in good suin good surface finish with accuracy in dimension. Automobile.

3.Casting defects- It is defined as the irregularity and undesired deformity arises in a metal casting process. Some of the defects arises during process can be eliminated or repaired by several methods like electrical welding for large cracks ,cast iron glue are used to eliminate the asymmetry of the casting.

4.Compressive strength - Also known as compression strength is a tendency of a material or structure to withstand force that tends to reduce size. It is the maximum stress force that a solid material can sustain without a fracture. It is calculated by dividing the maximum load by the original cross section area of the specimen in a compressive test done. Some material fracture at their compressive strengthother deform irrresibly.Compressive strength test is done on a specimen as to find how much amount of force it can bear without any fracture or deformation.In this test specimen is allowed to be in the middle of the force from two opposite side till specimen start cracking or deforming at Rotational molding (or Rotomolding).

5.Sand moulding-Sand and molding process[4]. The moldings sand generally comprised of base sand, binder, additives and a partning compound. Moulding sand or foundry sand is describe by these Refractoriness, chemical inertness, permeability, surface finish, parts of drivetrain and chassis like engine bracket, wheel carrier, intake manifold, oil sump are produced by sand casting. The materials used for these casting is generally Aluminum. that point the value is noted. The value is called compressive stress and it is denoted by "σ."



$$\text{Stress, } \sigma = \frac{\text{Force}}{\text{Cross-Sectional Area}} = \frac{F}{A_0}$$

II.EXPERIMENTAL SETUP

1.Furnace - The furnace is a device which is used in foundry lab during the process of casting. This device is capable of doing high temperature heating. Furnace works on the principle of providing heat energy directly by fuel combustion, by electricity such as the electric arc furnace, or through induction heating in induction furnaces .Furnace are designed and produced on the basis of its function, heavy duty, type of fuel for heating.

In this experiment we have used electric type furnace which produces heat with the help of electric heating element which provides high heating temperature as to melt the alloy metals and refractories.

2.UTM (universal testing machine)-It is a mechanical device which is used for the purpose of find out stress on test materials, components and structure. Universal testing machine can used for observe tensile, shear and compression strength. As to find out the failure or braking point specimen prepared to Processes Columns & Factors Level 1 Level 2 1 Moisture (%) 26 28 2.Sand particle size (MICS) 300 600.

Table 1 Factors with quantity used in experiments.

Columns & Factors	Level 1	Level 2
1.Moisture (%)	26	28
2.Sand particle size (MICS)	300	600

Table 2 Table for different experiment conducted.

Columns & Factors	Experiment 1	Experiment 2	Experiment 3	Experiment 4
1. Moisture (%)	26	28	26	28
2.Sand particle size (MICS)	300	600	300	600

3. Experiment- 1

Step 1:- Choose green sand as a moulding material in casting process.
Step 2:- Sand filtered by 300 MICS size sieve.
Step 3:- Addition of moisture content 26%.
Step 4:- Mesh the mixture of sand with water till it transformed into mould.
Step 5:- Pouring the mixture in a round hollow object for ramming to generate compact structure.
Step 6:- Put that moulded specimen into furnace at 850 c for an hour to dry.
Step 7:- Test the mould specimen in UTM for getting the actual values of shear, compressive and tensile strength.

Fig.2 Produced mould sample during experiment.

4.Experiment-2

Step 1:- Choose green sand as a moulding material in casting process.
Step 2:- Sand filtered by 600 MICS size sieve.
Step 3:- Addition of moisture content 28%.
Step 4:- Mesh the mixture of sand with water till it transformed into mould.
Step 5:- Pouring the mixture in a round hollow object for ramming to generate compact structure.
Step 6:- Put that moulded specimen into furnace at 850 c for an hour to dry.
Step 7:- Test the mould specimen in UTM for getting the actual values of shear, compressive and tensile strength.

Fig. 3 Moulding tool.

5. Experiment - 3

Step 1:- Choose green sand as a moulding material in casting process.
Step 2:- Sand filtered by 600 MICS size sieve.
Step 3:- Addition of moisture content 26%.
Step 4:- Mesh the mixture of sand with water till it transformed into mould.
Step 5:- Pouring the mixture in a round hollow object for ramming to generate compact structure.
Step 6:- Put that moulded specimen into furnace at 850 c for an hour to dry.
Step 7:- Test the mould specimen in UTM for getting the actual values of shear, compressive and tensile strength.

Fig.4 Load delivering tool for compressive test.

6. Experiment - 4

Step 1:- Choose green sand as a moulding material in casting process.
Step 2:- Sand filtered by 300 MICS size sieve.
Step 3:- Addition of moisture content 28%.
Step 4:- Mesh the mixture of sand with water till it transformed into mould.
Step 5:- Pouring the mixture in a round hollow object for ramming to generate compact structure.
Step 6:- Put that moulded specimen into furnace at 850 c for an hour to dry.

Step 7:- Test the mould specimen in UTM for getting the actual values of shear, compressive and tensile strength.

Fig. 5 Moulding tool.

III.RESULT AND DISCUSSION

This experiment illustrates us comparison between the different samples with different value of variables as to find the optimum condition to build moulding. The variable selected were sand particle of sizes 300mics and 600mics whereas the amount of moisture content is 26% and 28 % by volume. Total of four experiment were perform in foundry lab by inter mixing grain size and moisture %. Out of the 4 experiment conducted in the foundry lab after testing mould structure under utm machine result of 4th experiment proved to be the best with 32.3kg compressive strength, 3.5 tensile strength and 18.7 shear strength which comprises of grain size (sand) of 300 mics and moisture content of 28% on the other hand strength which brand them as strongest structure .on the other hand experiment 3rd proof to be the worst possess only 27.8 kg,2.3kg , 15.3kg of compressive, tensile and shear stress. While other two experiment contains average result.

Table 3- Different stress value from different sample of experiment.

Experiment	Compressive stress(kg)	Tensile stress(kg)	Shear stress(kg)
Exp 1	31.2	3.1	17.8
Exp 2	30.7	2.9	15.9
Exp 3	27.8	2.3	15.3
Exp 4	32.7	3.5	18.7

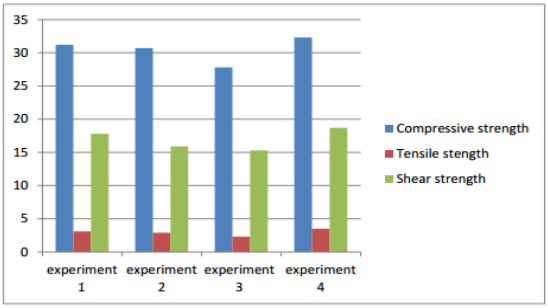


Fig.5Comparison of strength among different molding samples.

This bar graph holds information about the Tensile, Compressive and Shear stress value which is achieved by different samples after testing them under UTM.

IV.CONCLUSION

The study describe about moulding done through green sand and comparison between different level of sand size and moisture particle for create mould to receive peerless results

- When sand particle is taken into account we account strength of the mould increases with decrease in size particle of sand.
- With increase in moisture content from 26% to 28% we are able to accomplish better bonding with sand particle
- Better bonding between sand particles and moisture content is necessary as to have tightly packed dense structure of mould which characterised with greater strength which helps mould to stand from without flowing with the molten metal and protects defects like blow holes ,air trapping.

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