ANALYSIS OF SAND MOLD USING INDUSTRIAL POWDERS AND FLY ASH

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Abstract The greensand molding is one of the ancient ways of molding methods usually used for making castings in the foundry. The main components of molding sand are the sand, binder and additives. The characteristic of the molding sand depend upon those major constituents. Since, the properties like green compression and permeability can be varied by mixing various additives with the molding sand. The casting efficiency can be improved with the help of different additives added to the greensand in the correct proportions. The main focus of our project is to make an attempt on the analysis of the greensand mold with fly ash and clay. Fly ash and clay are the additives to be mixed with the greensand and the properties like green strength and permeability are tested and tabulated. The standard specimen of AFS size is to be made with different proportions of clay and fly ash. The properties like green compression strength and permeability are checked with the help of permeability meter and Universal strength testing machine. The strategic points are to be evaluated and the aluminum castings are to be made as per the effective points.

Key words: *Green Sand, fly Ash, AFS standard, Permeability test, Strength test.*

I. INTRODUCTION

In our paper an attempt is to be made on the analysis of green sand mold with the industrial binders. Here the fly ash and clay plays vital role in the aggregate of the molding sand. The fly ash is collected from the Mettur Thermal Power Plant. The fly ash and the clay are added to the green sand as per the AFS standard analysis of Sand Mold Using Industrial Powders and Fly Ash norms. The various percentages of the clay and fly ash is to be added with the one kilogram of green sand and the 35ml of water. The cylindrical sand specimen of about 50cm in height and 50cm in diameter is to be made with the help of sand rammer and then the permeability of the specimen is to be checked in the permeability meter. The Green compression strength can be found through the Universal Strength Testing machine. The permeability and the Green Compression Strength for various compositions are to be found and the values are tabulated and compared. The casting is to be made on the strategic values by melting the aluminum in the muffle furnace and poured in to the mold.

II. PROBLEM DEFINITION

The main focus of our paper is to make cost effective method by preparing the aggregate sand mold. There are two ways to reduce the production cost in the foundry either reduce the cost of metal or reducing cost of molding sand. It is impossible to reduce the cost of metal rather go for reducing the cost of molding sand, the cost of molding sand can reduce by reducing the molding sand consumption. Molding sand mainly consists of majority of natural sand, clay, saw dust and other additives. The additives are special agents that can be included for special purpose castings needs very good quality. Based on the application of the casting component the composition can be modified. In the foundry the molding sand are prepared, mold was made then the metal was melted and poured in the mold cavity. The sand has to be processed or reclaimed for further use. In the view of reducing the cost of the molding sand the way identified is the mixing of some other material which is cheaper than the molding sand in common practice. Some of the mixing agents currently in practice are combustion product of coal, agricultural by-products which are dumped as waste, waste from sugar industries (molasses).

III. MATERIALS

3.1. Sand Casting

The sand used for making castings is called as foundry sand. This sand consists of clean silica and which is of high quality lake sand which is bonded to make molds for ferrous and non ferrous castings. The following types of sand are used for making molds in the industry

Figure 1 Sand Casting

3.1.1. Sand

Silica sand is widely used as molding sand. Silica has 80- 90% of silicon dioxide. Silica gives refractoriness to the sand.

IV. METHODOLOGY

4.1. Fly Ash

Fly ash is collected from the Mettur Thermal Power Plant which contains the following compositions.

By combustion of coal the fly ash residues are generated. From the chimneys of coal fired power plants fly ash is generally captured and is also known as one type of ash jointly coal ash and from the bottom of coal furnaces the other bottom ash is removed. The components of fly ash vary considerably depending upon the source and makeup of the coal being burned, but all fly ash includes substantial amounts of silicon dioxide (SiO_2), calcium oxide (CaO). (both amorphous and crystalline)

Arsenic, beryllium, boron, cadmium, chromium, chromium VI, cobalt, lead, manganese, mercury, molybdenum, strontium, thallium, and vanadium, selenium, along with dioxins and PAH compounds are toxic constituents. By electrostatic precipitators or filter bags Fly ash material solidifies while suspended in the exhaust gases and is collected. In the exhaust gases the particles solidify while suspended; are generally spherical in shape and range in size from 0.5 µm to 100 µm. They consist mostly of (SiO_2) silicon dioxide, which is present in two forms: amorphous, which is rounded and smooth, and crystalline, and is sharp, pointed and hazardous; aluminium oxide (Al_2O_3) and iron oxide (Fe_2O_3).Crystalline phases such as quartz, mullite, and various iron oxides with various identifiable particles along with mixture of glassy particles are included in fly ashes and are highly heterogeneous.

V. EXPERIMENTAL WORKS

One kilogram of green sand, 35ml of water and required amount of clay and industrial powder are taken for analyzing the strength and permeability of the mixtures. All of them are mixed proportionately and a specimen is prepared using standard die. The prepared specimen is rammed using rammer up to 5 strokes.

After completion of ramming permeability of the mixture is tested with the help of the permeability testing meter. After that the strength of the specimen is tested with the help of universal testing machine. Specimen is placed on the required place on the testing machine; by compressing the specimen the green compression strength of the specimen is calculated. Tensile test and Shear test can be made on the sand specimen using the different attachment. By repeating the procedure to obtain compression and permeability value of different composition of green sand with industrial powders and the strength of the industrial powder along with mixture of the green sand is analyzed. The composition of green sand along with the industrial powder and clay is used for making the mold and casting of Aluminum is done.

The following test is conducted on the test specimen for the complete analysis of sand.

- Permeability test
- Green compression test

5.1 Permeability Test

During hot metal pouring in the mould the steam and other gases generated are made to escape out is the property of moulding sand is permeability. Permeability depends on grain size, grain shape, grain distribution, binder and its content, degree of ramming and water content of the molding sand. Standard size sand specimen is rammed first by a rammer specimen and is used for permeability tester for finding its permeability.

Permeability of the sand specimen prepared is determined by passing a given volume of air through the sand. The permeability tester consists of an inverted bell jar, which floats in a water seal and can permit 2000cc of air flow. Specimen tube to hold the sand specimen. A manometer to read the air temperature.

In standard method of sand permeability, permeability number can be determined by,

Permeability number = V.H / A.P.T

VI . EXPERIMENTATION

6.1. Molding process

Steps involved in making a mold,

Select a molding box which can accommodate mold cavity, risers and the gating system. Mold cavity should have sufficient wall thickness it will have hold molten metal. Place the drag pattern with parting surface down on the bottom board. Sprinkle off the excess sand carefully all around the pattern so that the pattern does not stick with molding sand. Fill the drag with loose molding sand. Ram the sand uniformly in the molding box around the pattern. Strike off the excess sand to bring it at the same level of the flask height. This completes the drag. Place the cope pattern on the drag pattern. Erect sprue and riser pins to form suitable sized cavities for pouring molten metal. Set the gaggers in the cope, if necessary. Gaggers should not be too close to the mold cavity otherwise they may chill the casting. Fill the cope with sand and ram. Strike off the excess sand from the top of the cope. Remove sprue and riser pins. Vent the cope with a vent wire. Sprinkle the parting sand over the top of the cope surface. Roll over the cope on the bottom board. Rap and remove both the cope and drag patterns. Cut the gate connecting the sprue basin with the mold cavity. Apply mold coating with a swab. Bake the mold in case of dry sand mold. Set the cores in the mold, if required. Close the mold by inverting cope over drag. Clamp cope with drag and the mold is ready for pouring.

Figure 8 Mold Preparation

Figure 9 Mold Preparation

6.2. Melting of Aluminum

Aluminum can be melted in a variety of ways. Coreless and channel induction furnace, crucible and open-hearth reverberate furnace fired by natural gas or fuel oil, and electric resistance and electric radiation furnaces. The furnace charge is as varied and important as the choice of furnace type for metal casting **operations**. The furnace charge may range from high quality prealloyed ingot to exclusively made low grade scrap. Under optimum melting and melt holding conditions, molten aluminum is susceptible to three types of degradation.

- With time at temperature, for an equilibrium value of specific composition and temperature, as a result in increased dissolved hydrogen content with adsorption of hydrogen.
- Magnesium containing alloys in which oxidation of metal occur with sometime of temperature oxidation losses and the formation of complex oxides may not be self-limiting.
- Transient elements characterized by low vapour pressure and high reactivity are reduced as a function of time at temperature. up to which mechanical properties directly or indirectly rely on Magnesium, sodium, calcium and strontium
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VII. TABULATIONS AND GRAPH

7.1. Properties of Greensand with Clay

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7.2. Comparision Values

Table 7.2.1. Properties of Greensand with Fly ash

Specimen No	% of powder	Permeability(gm/sq.cm)	Green compression(gm/sq.cm)
1	0	288	60
2	1	253	60
3	2	275	60
4	3	243	80
5	4	235	140
6	5	226	160
7	6	226	200
8	8	224	220
9	12	220	300
10	14	210	330
11	16	208	290

VIII RESULT AND DISCUSSION

From the experimental analysis conducted, the properties of the green sand mold can be varied when the fly ash and clay are used as an aggregate for the sand mold. The specimen was prepared according to the AFS size and it is undergone to the Green Compression and Permeability test. The values of the test of different compositions are tabulated and evaluated. Since the compression strength of the specimen is increased on both the proportions. The permeability values are increased to some extent and decreased. From the comparative graphs the strategic values are evaluated and the aluminum castings are made.

CONCLUSIONS

From the experimental analysis the compression strength of the green sand with fly ash increases up to the 14 % and for the clay it increases with the increase in the addition of clay. The permeability of the green sand with fly ash increases up to 2% and then decreases with the addition of fly ash. Simultaneously the permeability of the green sand with clay increases up to 3% and decreases with the addition of clay. With respect to the permeability values the strategic points are evaluated and the castings are made. The values which meet the normal technological properties are 2% for the fly ash and 3% for the clay. The aluminum casting components with moderate surface finish are obtained from the castings.

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