ANALYSIS OF FOUNDRY RAW MATERIALS

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Abstract: *Characterization of raw material for foundry totally depends upon the alloys which need to be casted. The sand which contains higher amount of carbon cannot be used for Ferrous castings because the amount of carbon present is high. Hence the sand should be free of carbon particles. Such sands also will be given coating which consists of pure silica added to the mould. The sand which is used for aluminum, copper, titanium or any other materials should be a good quality of* SiO_2 *and should have no impurities in it. The same* SiO_2 *cannot be used for magnesium castings because magnesium reacts with silica. Some special ingredients which will not allow the liquid metal come in contact with the sand should be applied on each grain of sand. All these characteristics of sand which is abundantly available in the crust of earth like sea, river, desert etc. The main source of making sand cannot be avoided because it is the most economical raw material for molding and also used for construction purpose. The sand of different varieties or places like sea, river, pond etc has different properties because of presence of surrounding chemicals in it and also because of temperature difference. Efforts will be made to test the sand with various additions like Bentonite or Dextrin which adheres the particles. Together and effects of those additions on the sand like weather, permeability, how much sand will be capable of withstanding with the available moisture, how much strength the sand can be made. In this project we have selected a sand characterization.*

Key Words: (Foundry, Casting, Pit sand, Godavari sand, Krishna sand, Sand Characterization)

1. INTRODUCTION

A **FOUNDRY** is a factory that produces metal casting. Metals are cast into shapes by melting them into a liquid, pouring the metal in a mould, and removing the mould material or casting after the metal has solidified as it cools. The most common metals processed are Aluminium and Cast Iron. However, other metals such as bronze, brass, steel, magnesium and zinc are also used to produce casting in foundries.

Casting is one of the most commonly used manufacturing processes. It may be defines as metal object obtained by allowing molten metal to solidify in a mould. The shape of the object being determined by the shape of the mould cavity, hence the mould determines the casting. Therefore, good castings can't be made without good moulds. Due to the importance of the mould, casting process and castings are often described by the materials and methods employed in molding and hence molding refers to the method of making a mould and the materials used,Of all the molding processes, sand molding is the oldest and a major production of castings in a sand mould. Therefore, the materials used in the sand mould plays an important role to decide the fate of castings. Keeping this in view it is necessary to test the mould before it is used for casting. The testing of mould sands performed on the standard specimens made from it.

The important properties that determine the mould are permeability, strength, hardness, refractoriness etc. Strength and hardness are always said to go together and refractoriness is the inheriting properties of silicon oxides is sand. Therefore, it is important to test permeability and hardness for molding sand.These are various factors that influence these properties. These factors show both individual and combined effect on the properties of molding sands, but both of them can't be separated. Therefore, efforts are made to enhance the individual effect of moisture besides that of bentonite, linseed oil, red-oxide, graphite, dextrin, wood floor.

1.1. Molding Material

A suitable and workable material possessing high refractoriness in nature can be used for mold making. Thus, the mold making material can be metallic or non-metallic. For metallic category, the common materials are cast iron, mild steel and alloy steels. In the non-metallic group molding sands, plaster of paris, graphite, silicon carbide and ceramics are included. But, out of all, the molding sand is the most common utilized non-metallic molding material because of its certain inherent properties namely refractoriness, chemical and thermal stability at higher temperature, high permeability and workability along with good strength. Moreover, it is also highly cheap and easily available.

1.2. Sources of Molding Sand

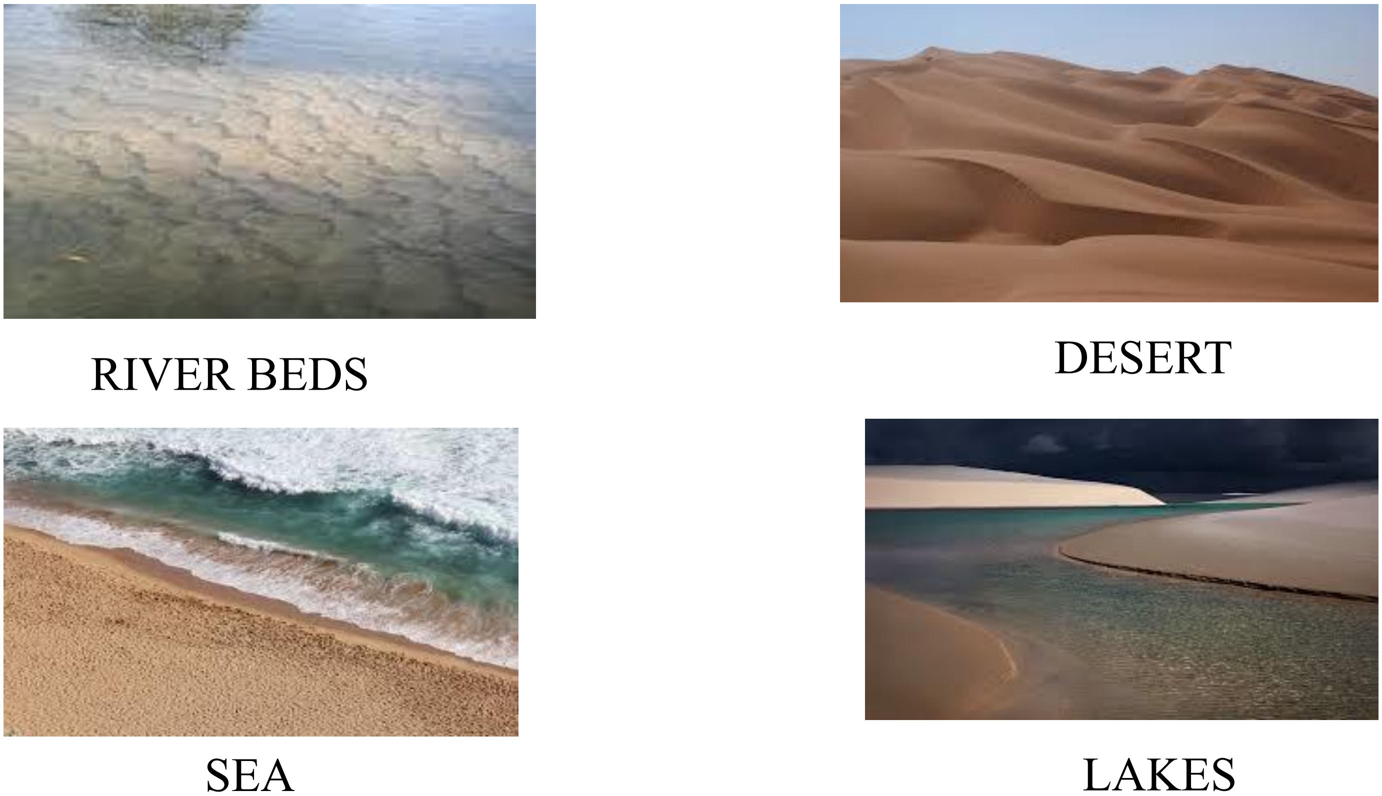


Fig- 1: Various Sources of Molding Sand

1.3. Types of Molding Sand

Fig- 2: Types of Molding Sand

1.4. Sand Properties and Test

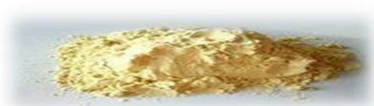
1. Moisture content test

2. Clay content test

3. Grain fineness test
4. Compression test
5. Shear test
6. Tensile test
7. Permeability test
8. Permeability test
9. Compatibility and flowability
10. Refractoriness test
11. Strength test

1.5. Sand Additives

BENTONITE 4-6%



DEXTRIN 0.5-1.5%

SODIUM SILICATE 0.5-1.5%

GRAPHITE 0.5%

RED OXIDE 0.5%

Fig-3: Various Sand Additives

2. EXPERIMENT

The initial compositions of additives and this composition is designated with a code RB_4. Experiments are been conducted with this sand mixture and the respective data is collected. All the sand sample is prepared with respective composition and it is been thoroughly mulled for 5 minutes in a Sand Muller/Mixer**.** Then the sample is been taken out for weighing two 150 grams samples and each sample is been rammed 50*50 dimension using Sand Rammer (capacity 14 pounds) and it is been rammed for 3 strokes. The samples are made for testing.

a) Hardness (using Brinnel Hardness Tester)
b) Permeability (using Permeability-meter)
c) Compression (using Universal Sand Testing Machine)
d) Shear (using Universal Sand Testing Machine)

The data is recorded in a tabular format. Now one more sample is been made with 100 grams and is rammed in a tensile core box using **Sand Rammer**. The tensile specimen or sample which is made is now heated for 30 minutes to 1 hour at 135°C-150°C in a **Furnace.** Then this sample is tested on **Universal Sand Testing Machine** using tensile attachment and the data is collected in a tabular form.

2.1. Collection of sand sample:

The Krishna river sand, Godavari river sand and pit sand were brought to college for the purpose of construction of a new building is being used for experimentation. The sand is collected at different areas from various heaps. This sand is then thoroughly mixed and the further process is carried out.

2.2 .Filtering sand:

The sand collected is poured onto the sand filter in order to remove the foreign particles such as weeds, stones etc.

2.3 Determination of clay content:

Clay influences strength, permeability and other molding properties. It is responsible for bonding sand particles together.

$$\textbf{Percentage of Clay Conte} = \frac{\mathbf{W1 - W2}}{\mathbf{W1}} * \mathbf{100}$$

W_1-weight of the sand before drying,

W_2-weight of the sand after drying

Table-1: Determination of clay content

Sample	Weight of sand before drying(W_1)	Weight of sand after drying(W_2)	Clay content $\frac{W1 - W2}{W1} * 100$
Pit sand	100	91.1	8.9%
Godavari sand	100	98.4	1.6%
Krishna sand	100	96.7	3.3%

The amount of natural clay content identified in Pit sand sample is 8.9%. The amount of natural clay content identified in Godavari sand sample is 1.6%

The amount of natural clay content identified in River sand sample is 3.3%

2.4. Determination of Grain fineness number

Sieve analysis: The test of determining the AFS grain fineness number is performed on a dried sand sample from which all clay substances have been removed. A set of standard sieves is used to screen the sand. These sieves are stacked in sequence with the coarsest sieve at the top and placed in a sieve shaker. About 100g sand is placed at the top sieve and, after 15 minutes of vibration, the weight of the sand retained in each sieve is obtained. The AFS grain fineness number of the sand tested can then be determined by taking the percentage of sand retained on each screen, multiplying each by a multiplier (which is simply the next available sieve old mesh number greater than the one being weighed out), adding the total, and then dividing by the total percentage of sand retained on the sieves.

Grain fineness number = $\frac{\text{weight of the product}}{\text{weight of the sand}}$

2.5. AFS-standard cylindrical test sample Preparation

Cylindrical test sample of 50.8 (±0.03mm) height and 50.8mm diameter (or of 50±0.3mm height and 50mm diameter) shall be used as the strength of a molding sand depends greatly on its degree of ramming, the conditions of molding the standard sample must be carefully controlled. Reproducible ramming condition can be obtained with the standard sand rammer and specimen tube accessories. The ramming device must be securely mounted. The sand is placed in the specimen tube and rammed by impact with three blows of a 14-16 weight.

The cam is actuated by a user by rotating the handle, causing a cam to lift the weight and let it fall freely on the frame attached to the ram head. This produces a standard compacting action to a pre-measured amount of sand.

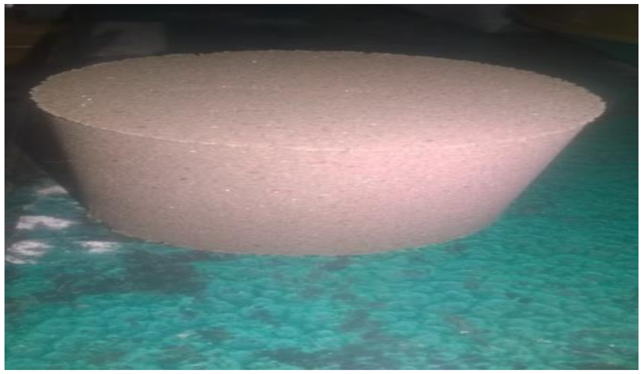


Fig-4: Preparation of Test Specimen using Rammer

The object for producing the standard cylindrical specimen is to have the specimen become 2 inches high (±1/32 inch) with three ramming of the machine. After the specimen has been prepared inside the specimen tube, the specimen can be used for various standard sand tests such as the permeability test, compression test, shear test, tensile test or other standard foundry tests.

The sand rammer machine can be used to measure the compatibility of prepared sand by filling the specimen tube with prepared sand so that it is level with the top of the tube. The tube is then placed under the ram head in the shallow cup and rammed three times. Compatibility in percentage is then calculated from the resultant height of the sand inside the specimen tube.

The proper height of specimen is most simply achieved by weighting the sand to be put into the specimen tube. If oversize, the weight can be reduced in increment until a proper weight to produce a 2.0 inch sample height is obtained. The sample weight necessary to produce a 2.0inch sample height after three rams, usually 145-175g, is actually a valuable piece of information.

3. RESULTS AND DISCUSSION

3.1. Godavari River Sand

3.1.1. Clay Content:

Table-2: Determination of clay content

Sample	Weight of sand before drying(W_1)	Weight of sand after drying(W_2)	Clay content $\frac{W1-W2}{W1} * 100$
Godavari sand	100	98.4	1.6%

The amount of natural clay content identified in Godavari river sand sample is 1.6%

3.1.2. Grain fineness number:

Grain fineness number = $\frac{\text{weight of the product}}{\text{weight of the sand}} = \frac{4847}{98.9} = 49.609$

The grain fineness number for Godavari river sand sample is 49.609

Table-3: Determination of grain fineness number for Godavari river sand

AFS sieve no.	Amount of sample attained on sieve(gm)	Multiplier factor	Product
12	0	5	0
20	0	12	0
30	4.8	20	96
40	24.1	30	723
50	24.1	40	964
70	21.6	50	1380
100	11.2	70	784
140	4.9	100	490
200	1	140	140
270	0.9	200	180
Pan	0.3	300	90
Total	98.9	-	4847

GRAIN SIZE AND STRUCTURE

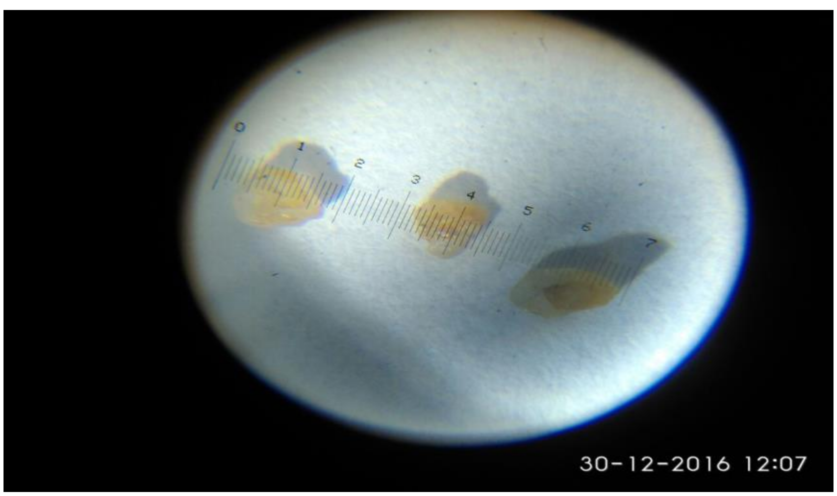


Fig-5: Grain Size and Structure of Godavari River Sand

Fig-6: Test analysis of Godavari River Sand

3.1.3. Codes for Godavari River Sand: (4% Bentonite)

Table -4: Codes for Godavari river sand: (4% Bentonite)

S No.	Composition	Codes
1	Bentonite (4%); Dextrin (0.5%); Moisture (5%); Sodium silicate (0.5%); Red oxide (0.5%); Graphite powder (0.5%)	$RB_4(1)$
2	Bentonite (4%); Dextrin (0.5%); Moisture (5%); Sodium silicate (1%); Red oxide (0.5%); Graphite powder (0.5%)	$RB_4(2)$

3.2. PIT SAND

3.2.1 Clay content

The amount of natural clay content identified in Pit sand sample is 8.9%

Table-5: Determination of clay content

Sample	Weight of sand before drying(W_1)	Weight of sand after drying(W_2)	Clay content $\frac{W1-W2}{W1} * 100$
Pit sand	100	91.1	8.9%

3.2.2. Grain fineness number

Grain fineness number = $\frac{\text{weight of the product}}{\text{weight of the sand}} = \frac{4899}{98.7} = 49.6$

The grain fineness number for pit sand sample is 49.6

Table-6: Determination of Grain Fineness Number of Pit Sand.

AFS sieve no.	Amount of sample attained on sieve(gm)	Multiplier factor	Product
12	0	5	0
20	0	12	0
30	4.3	20	86
40	20.9	30	627
50	23.9	40	956
70	29.3	50	1465
100	13.7	70	959
140	4.8	100	480
200	0.9	140	126
270	0.7	200	140
Pan	0.2	300	60
Total	98.7	-	4899

GRAIN SIZE AND STRUCTURE

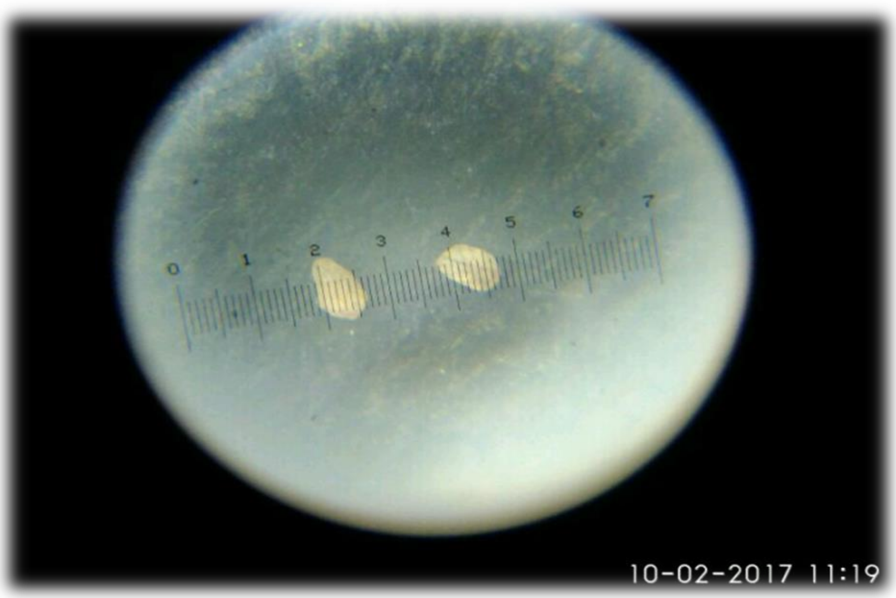


Fig-7: Grain Size and Structure of Pit Sand

Fig-8: Test Analysis of Pit Sand

3.2.3. Codes for Pit Sand: (4% Bentonite)

Table-7: Codes for Pit Sand: (4% Bentonite)

S No.	Composition	Codes
1	Bentonite (4%); Dextrin (0.5%); Moisture (7%); Sodium silicate (0.5%); Red oxide (0.5%); Graphite powder (0.5%)	$PB_4(1)$
2	Bentonite (4%); Dextrin (0.5%); Moisture (7%); Sodium silicate (1%); Red oxide (0.5%); Graphite powder (0.5%)	$PB_4(2)$

3.3. KRISHNA RIVER SAND

3.3.1 Clay content

Table-8: Determination of clay content

Sample	Weight of sand before drying(W_1)	Weight of sand after drying(W_2)	Clay content $\frac{W1- W2}{W1} * 100$
Krishna sand	100	96.7	3.3%

The amount of natural clay content identified in Krishna river sand sample is 3.3%.

3.3.2. Grain fineness number

Grain fineness number = $\frac{\text{weight of the product}}{\text{weight of the sand}} = \frac{4945}{98.9} = 50$

The grain fineness number for Krishna river sand sample is 50

Table-9: Determination of grain fineness number for Krishna River Sand

AFS sieve No.	Amount of sample attained on sieve(gm)	Multiplier factor	Product
12	0	5	0
20	0	12	0
30	3.9	20	78
40	17.8	30	534
50	21.8	40	872
70	35.1	50	1755
100	14.2	70	994
140	4.7	100	470
200	0.8	140	112
270	0.5	200	100
Pan	0.1	300	30
Total	98.9	-	4945

Fig-9: Grain Size and Structure of Krishna River Sand

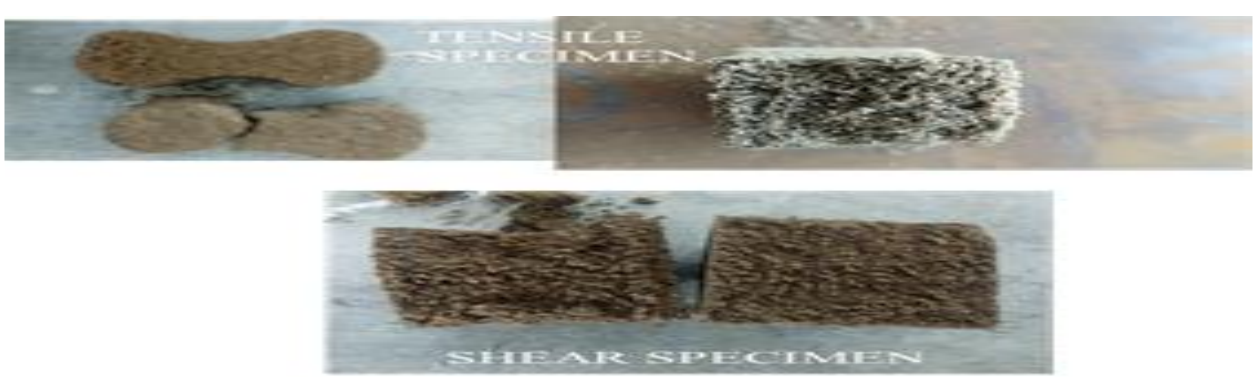


Fig -10: Test Analysis of Krishna River Sand

3.3.3. Codes for Krishna River Sand (4% Bentonite)

Table-10: Codes for Krishna River Sand: (4% Bentonite)

S No.	Composition	Codes
1	Bentonite (4%); Dextrin (0.5%); Moisture (5%); Sodium silicate (0.5%); Red oxide (0.5%); Graphite powder (0.5%)	KB_4(1)
2	Bentonite (4%); Dextrin (0.5%); Moisture (5%); Sodium silicate (1%); Red oxide (0.5%); Graphite powder (0.5%)	KB_4(2)

4. CONCLUSIONS

After analyzing various sands like Krishna River Sand, Godavari River Sand and Pit Sand. It has been found that by varying the additive composition, the sands can be used like addition of graphite will allow whereas river sand which has encouraging properties can used for any alloys excepting electron alloys, magnesium alloys and alloys of titanium group.

The sand is tested by various addition also give rise to the thought that small weight castings which needs normal usual properties can be used. For such uses, the uses of sand may control the requirements by performing trail & error methods. It is encourage here to know that many things for the standards are known. But none of the observations shows useful requirements for local uses. Hence we are little proud that a justice to their requirements.

On over testing of sand, it is found that by varying addition Krishna river sand, Godavari river sand and Pit sand can be used.

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