Lab Manual

HEAT TREATMENT LABORATORY

Department of Metallurgical and Materials Engineering

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES, BASAR

Telangana – 504107

SAFETY IN THE LABORATORY

All students must read and understand the information in this document with regard to laboratory safety and emergency procedures prior to the first laboratory session. ***Your personal laboratory safety depends mostly on you***. Effort has been made to address situations that may pose a hazard in the lab but the information and instructions provided cannot be considered all-inclusive. Students must adhere to written and verbal safety instructions throughout the academic term.

Common Sense

Good common sense is needed for safety in a laboratory. It is expected that each student will work in a responsible manner and exercise good judgment and common sense. If at any time you are not sure how to handle a particular situation, ask your Teaching Assistant or Instructor for advice. **DO NOT TOUCH ANYTHING WITH WHICH YOU ARE NOT COMPLETELY FAMILIAR**!!! It is always better to ask questions than to risk harm to yourself or damage to the equipment.

A LIST OF BASIC SAFETY RULES

1. When you handle chemicals wear eye protection (chemical splash goggles or full face shield).
2. When you work with furnaces for heat treatment procedures or other thermally activated equipment you should use special gloves to protect your hands.
3. Students should wear durable clothing that covers the arms, legs, torso and feet. (Note: sandals, shorts, tank tops etc. have no place in the lab. Students inappropriately dressed for lab, at the instructors discretion, be denied access)
4. To protect clothing from chemical damage or other dirt, wear a lab apron or lab coat. Long hair should be tied back to keep it from coming into contact with lab chemicals or flames.
5. In case of injury (cut, burn, fire etc.) notify the instructor immediately.
6. In case of a fire or imminently dangerous situation, notify everyone who may be affected immediately; be sure the lab instructor is also notified.
7. If chemicals splash into someone's eyes act quickly and get them into the eye wash station, do not wait for the instructor.
8. In case of a serious cut, stop blood flow using direct pressure using a clean towel, notify the lab instructor immediately.
9. Eating, drinking and smoking are prohibited in the laboratory at all times.

10. Never work in the laboratory without proper supervision by an instructor.
11. Never carry out unauthorized experiments. Come to the laboratory prepared. If you are unsure about what to do, please ask the instructor.
12. Always remember that HOT metal or ceramic pieces look exactly the same as COLD pieces are careful what you touch.
13. Know the location and operation of :
    - Fire Alarm Boxes
    - Exit doors
    - Telephones

LABARATORY CLASSES - INSTRUCTIONS TO STUDENTS

1. Students must attend the lab classes with ID cards and in the prescribed uniform.
2. Boys-shirts tucked in and wearing closed leather shoes. Girls' students with cut shoes, overcoat, and plait incite the coat. Girls' students should not wear loose garments.
3. Students must check if the components, instruments and machinery are in working condition before setting up the experiment.
4. Power supply to the experimental set up/ equipment/ machine must be switched on only after the faculty checks and gives approval for doing the experiment. Students must start to the experiment. Students must start doing the experiments only after getting permissions from the faculty.
5. Any damage to any of the equipment/instrument/machine caused due to carelessness, the cost will be fully recovered from the individual (or) group of students.
6. Students may contact the lab in charge immediately for any unexpected incidents and emergency.
7. The apparatus used for the experiments must be cleaned and returned to the technicians, safely without any damage. Make sure, while leaving the lab after the stipulated time, that all the power connections are switched off.

List of Experiments

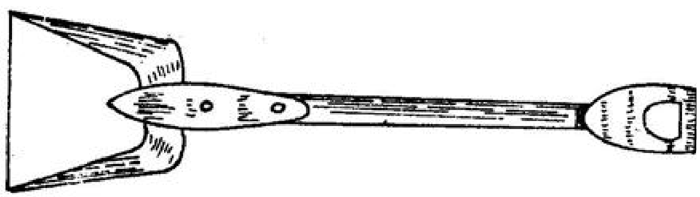
1. GRAIN FINENESS TEST
2. CLAY CONTENT TEST
3. PERMEABILITY TEST
4. COMPRESSION STRENGTH TEST FOR MOULDING SAND
5. SHEAR STRENGTH TEST FOR MOULDING SAND
6. TENSILE STRENGTH TEST FOR CORE SAND
7. BENDING STRENGTH TEST FOR CORE SAND
8. GREEN SAND MOULDING WITHOUT PATTERN
9. GREEN SAND MOULDING WITH PATTERN

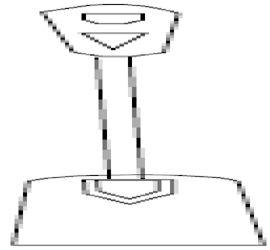
General Precautions for a Foundry Lab

1. Methods and materials involved in any form of metal casting operation are very hazardous. Educate yourself on the proper safety precautions before attempting any metal casting.
2. Never put water on a metal fire. This can cause a huge explosion!
3. Have a dry pile of sand and a shovel ready to put out fires or to control metal spills.
4. Have a sand bed the under all areas. The sand bed should be at least 3 inches thick. This will help in containing metal spills and will help protect flooring.
5. Never pour over wet ground. Remember, even trace amount of moisture can cause explosions.
6. Molten metal spilled on concrete will cause the concrete to explode. Use a thick sand bed over concrete.
7. Always use clean metal as feedstock. Combustion residues from some lubricants and paints can be very toxic.
8. Always operate in a well-ventilated area. Fumes and dusts from combustion and other foundry chemicals, processes and metals can be toxic.
9. Use a NIOSH (National Institute for Occupational Safety and Health) rated dusk mask. Dusts from sand, parting dusts and chemicals can be hazardous or cancer causing. Protect your lungs!
10. Always use safety glasses. Even minor mishaps can cause blindness.
11. Never use a crucible that has been damaged or dropped. It's just not worth the risk. Imagine what would happen if a white-hot crucible of brass crumbled as you were carrying it!
12. Always charge crucibles when cold. Adding metal to a hot crucible is really dangerous. If there is moisture on the metal, even just a haze, the metal can cause the entire contents of the crucible to explode.
13. Spilled molten metal can travel for a great distance. Operate in a clear work area.
14. Think about what you are doing at all times. Focus on the job at hand and the next step. Have all moves planned and rehearsed prior to any operation.
15. All foundry men should wear protective clothes, glasses, shoes, and gloves while handling molten metal for casting process.
16. One should be alert as severe burn injury can result from spillage of the molten metal.
17. One should always keep clean the work area.

FOUNDRY SHOP HAND TOOLS:

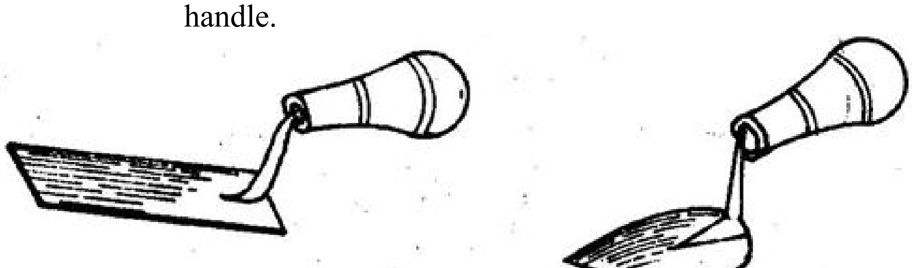
1. Showel: It consists of iron pan with a wooden handle. It can be used for mixing and conditioning the sand.



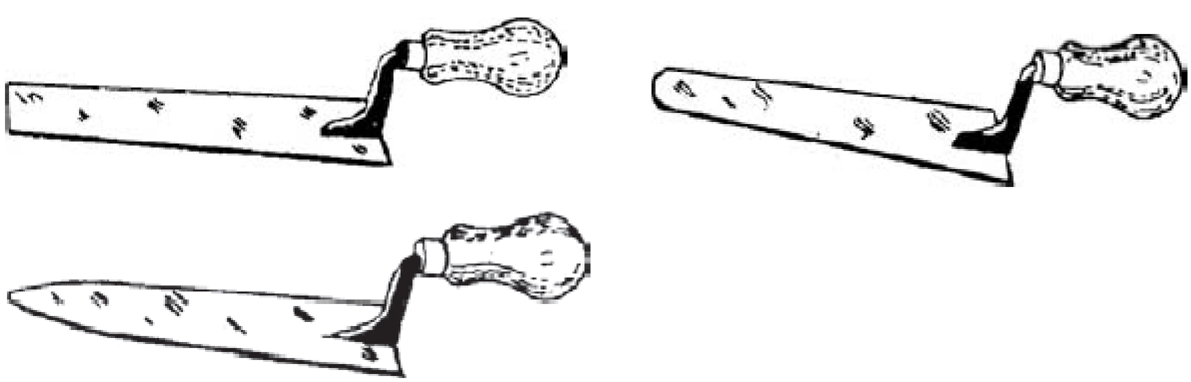


Showel

2. Trowels: These are used for finishing flat surfaces and comers inside a mould. Common shapes of trowels are shown as under. They are made of iron with a wooden handle.

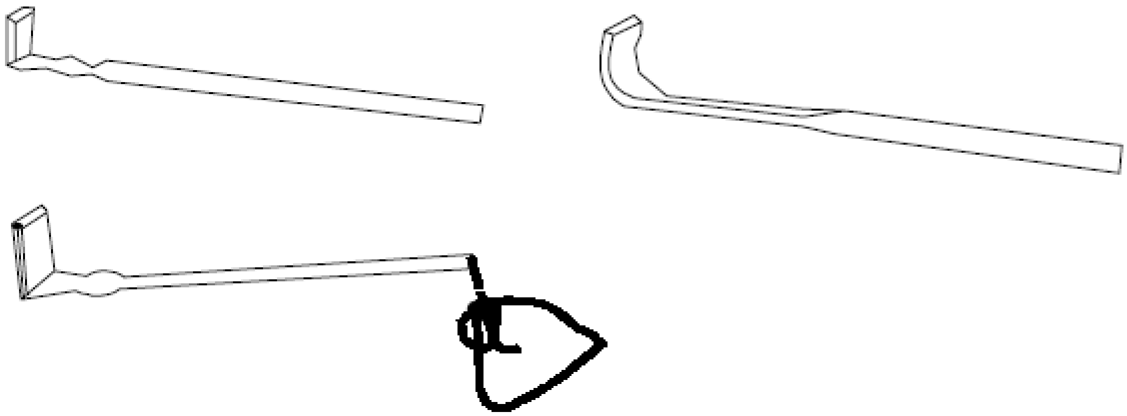


Trowels

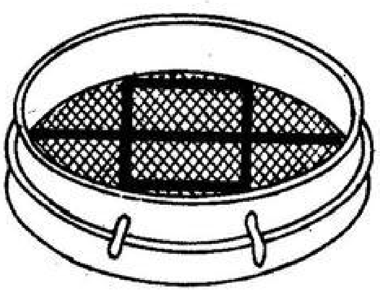


3. Lifter: A lifter is a finishing tool used for repairing the mould and finishing the mould sand. Lifter is also used for removing loose sand from mould.

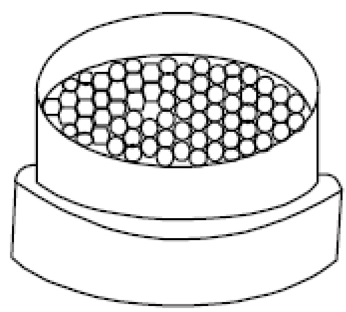
LIFTER



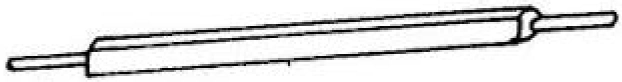
4. Hand riddle: It is used for ridding of sand to remove foreign material from it. It consists of a wooden frame fitted with a screen of standard wire mesh at the bottom.



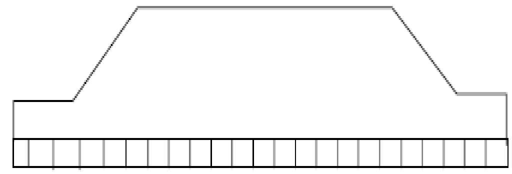
Riddle



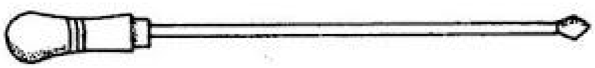
5. Strike-off bar: It is a cast iron or wrought iron bar with a true straight edge. It is used to remove the surplus sand from the mould after the ramming has been completed.



A strike off bar

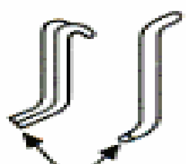


6. Vent wire: It is a thin steel rod or wire carrying a pointed edge at one end and a wooden handle or a bent loop at the other. After ramming and striking off the excess sand it is used to make small holes, called vents, in the sand mould to allow the exit of gases and steam during casting.



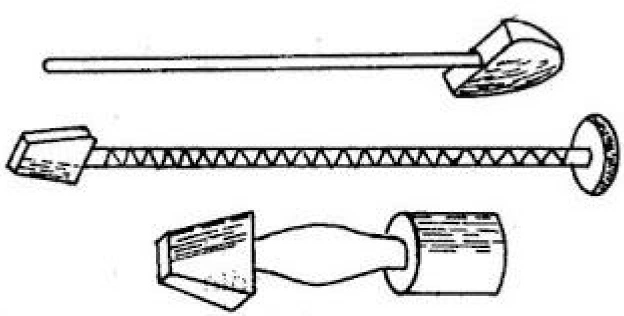
Vent wire

7. Gaggers: A gagger is a bent piece of wire and rod. It is generally used for reinforcing the downward projections of the sand mass in the cope.

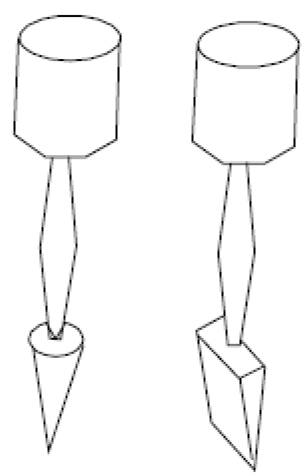


Gaggers

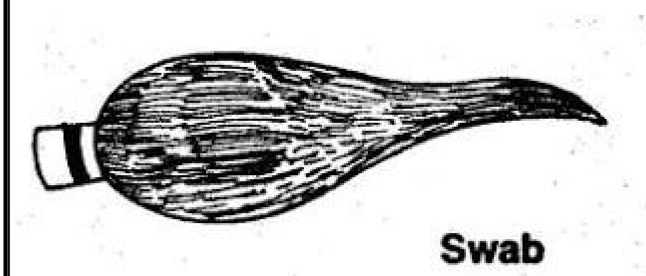
8. Rammers: Rammers are used for striking the sand mass in the molding box to pack it closely around one pattern. Common types of rammers are shown as under.

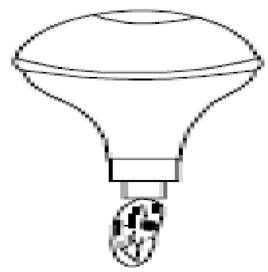


Rammers

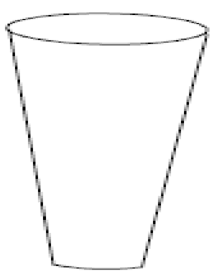


9. Swab: It is a hemp fiber brush used for moistening the edges of sand mould, which are in contact with the pattern surface, before withdrawing the pattern. It is also used for coating the liquid blacking on the mould faces in dry sand moulds.

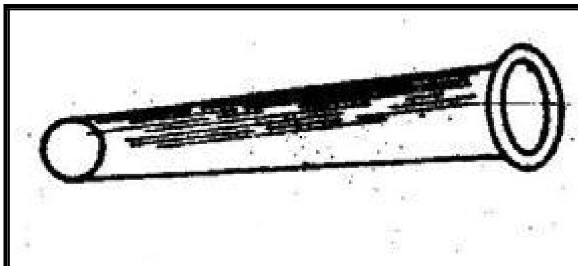




10. Sprue pin: It is a tapered rod of wood or iron, which is embedded in the sand and later withdrawn to produce a hole, called runner, through which the molten metal is poured into the mould.

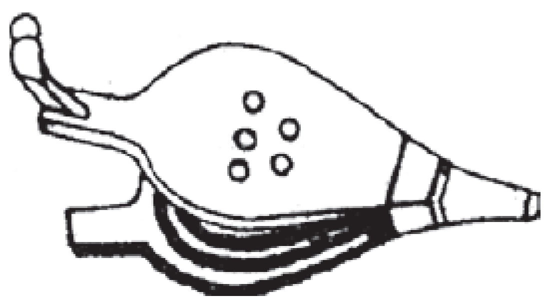


11. Sprue cutter: It is also used for the same purpose as a sprue pin, but there is a marked difference between their uses in that the cutter is used to produce the hole after ramming the mould. It is in the form of a tapered hollow tube, which is inserted in the sand to produce the hole.

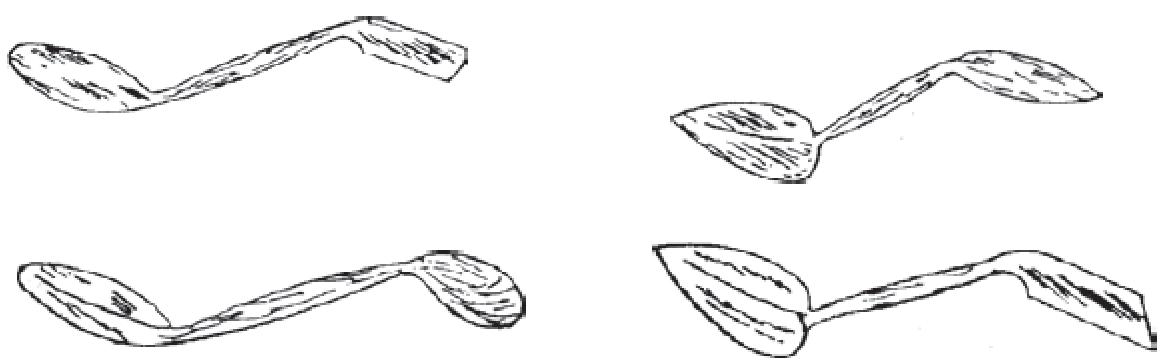


Sprue cutter

12. Bellows: It is hand operated leather made device equipped with compressed air jet to blow or pump air when operated. It is used to blow away the loose or unwanted sand from the surfaces of mold cavities.

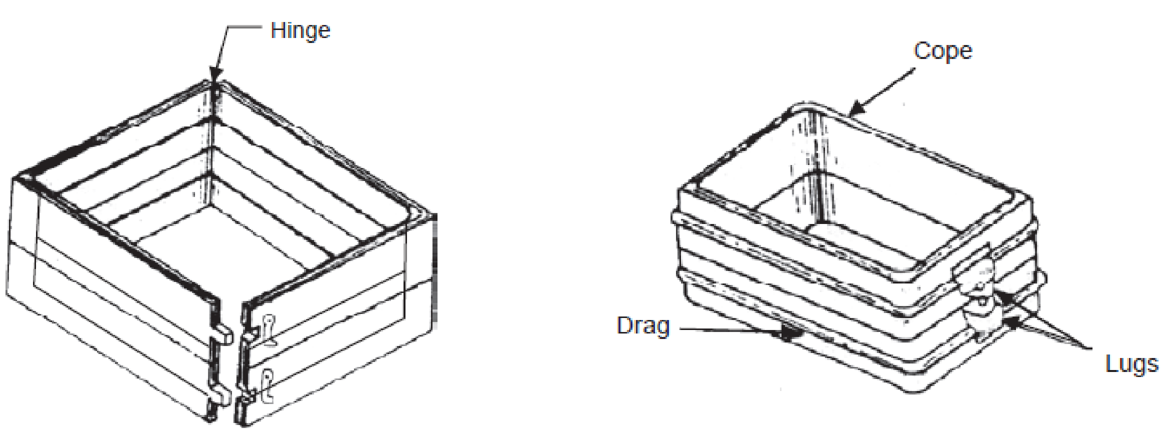


13. Slicks: It is also used for repairing and finishing the mold surface and the edges after the pattern has been removed from mold. The shape of slick is either like a heart and a leaf or a spoon and a heart. The slick (a spoon and a heart) is shown in Figure.

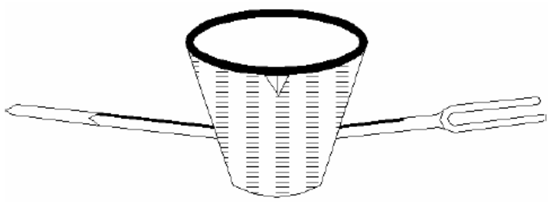


14. Draw Spike: It is a tapered steel rod having a ring at its one end and a sharp point at the other end. A draw spike is shown in Figure. It is used to rap and draw patterns from the mold.

15. Mould Boxes: Molding boxes used in sand industry are of two types such as closed 56v 5 molding box and open molding box. The boxes used in sand molding are generally made of wood, steel or cast iron. They consist of two parts. The lower part is called drag while the upper part is called cope. Generally, a wooden flask is used in green sand molding. Dry sand mold often requires metallic boxes because they are heated for drying. A closed metallic flask may have a rectangular or round shape as shown in Figure. Large and heavy boxes are made of cast iron or steel and carry handle and grips in order to enable handling by cranes. A snap flask is made of wood and is hinged at one corner as shown in Figure. The snap flask is widely used in green sand small non-ferrous castings.

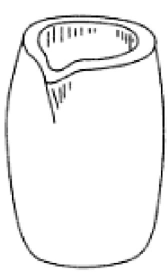


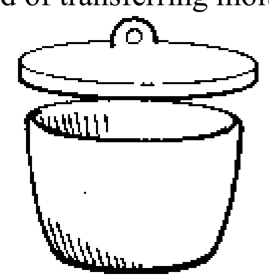
16. Ladle: A ladle is used to receive the molten metal from the melting furnace and pour the same into the mold. Its size is designated by the metal holding capacity. Figure shows a typical ladle used in the industry. Ladles facilitate a better pouring control and ensure more safety for workers. Ladle consists of an outer casting made of steel plate bent and welded in proper shape. A refractory lining is provided inside the casting. The casing is shaped so that it has controlled and well directed flow of a molten metal.



Hand Ladle

17. Crucible: It is made of a refractory material. It is used as a metal melting pot. The raw material or charge is broken into the small pieces and placed in crucible. Crucibles are then placed in a pit furnace which is coke fired. After melting of the metal, crucibles are taken out and received in handles. Pouring is done directly by using crucible instead of transferring molten metal to ladle.





EXPERIMENT – 1

GRAIN FINENESS TEST

Aim: To find the distribution of sand grains using a set of sieves and to find the average grain fineness number.

Material used: Base sand-Silica sand

Apparatus used: Balance, Set of Sieves (Indian & British standards), Stop watch, Vibrator or sieve shaker.

Introduction & Theory: The grain size of the sand is expressed by a number called "grain fineness number". A given grain fineness number corresponds to standard sieve of 200 mm diameter which has the identical number of meshes in it. To determine this number for a given sand sample, it is customary to use a standard sieve set which contain several sieves having one above the other, a varying but known number of meshes. The coarsest sieve is placed at the top and finest at the bottom.

A system has been developed to rapidly express the average grain size of a given and sample. The Grain Fineness Number (GFN) is the quantitative indication of the grain size distribution of the sand sample by carrying out a sand sieve analysis. GFN is important because it provides the foundry a way to verify that its sand is within specification for the castings being produced and helps avoid conditions that could lead to potential casting problems. Sand that is too fine (higher GFN) or too coarse (lower GFN) can affect the quality of castings produced. Sand that is too fine can create low permeability and result in casting gas defects. Sand with high permeability (too coarse) can create problems with metal penetration, rough surface finish, burn-in and burn-on. The grain fineness of sand is measured using a test called Sieve Analysis.

A sieve analysis is a practice or procedure used to assess the particle size distribution of a granular material. Sand sieve analysis is a method for determining the grain size distribution of particles typically between 1.0mm and 0.062mm. It is a relative accurate method for determining depositional hydrology and for refining sedimentary environments. With experience, most geologists can visually measure grain size within accuracy of the Wentworth grade scale at least down to silt grade. Silt and clay can be differentiated by whether they are crunchy or plastic between one's teeth. Clay stones and siltstones are not amenable to size analysis from an optical microscope. Their particle size can be measured individually by electron microscope analysis. Boulder, cobbles, and gravel are best measured manually with a tape measure or ruler. Sands are most generally measured by sieving.

Both graphic and statistical methods of data presentation have been developed for the interpretation of sieve data. The percentage of the samples in each class can be shown graphically in bar charts or histogram. Another method of graphic display is the cumulative curve or cumulative arithmetic curve. Cumulative curves are extremely useful because many sample curves can be plotted on the same graph and differences in sorting are at once apparent. The closer a curve approaches the vertical the better sorted it is, as a major percentage of sediment occurs in one class. Significant percentages of coarse and fine end-members show up as horizontal limbs at the ends of the curve.

The four statistical measurements for sieved samples consist of a measure of central tendency (including median, mode, and mean); a measure of the degree of scatter or sorting; kurtosis, the degree of peakedness; and skewness, the lop-sidedness of the curve. Various formulae have been defined for these parameters.

The size distribution is often of critical importance to the way the material performs in use. A representative sample of the sand is weighed and passed through a series of progressively finer sieves (screens) while being agitated for a 15-min test cycle. The sand retained on each screen is weighed and the weights are recorded. The weight retained one ach sieve is divided by the total sample weight to arrive at the percent retained on each screen. In economics, a numerical coefficient showing the effect of a change in one economic variable on another. The factors for the sieves are based on the fact that the sand that is retained on a particular sieve such as 50 mesh is not all 50 mesh in size, but rather it is smaller than 40 mesh (passed through 40 mesh screen), but larger than 50 mesh (won't pass through 50 mesh screen). The result should be rounded to one decimal place decimal place.

After performing the sieve analysis test, the distribution of sand grains on the screens can be just as significant as GFN. The distribution refers to how much is retained on each sieve, rather than the average of all of the sieves. Formula below used to calculate Grain Size Fineness;

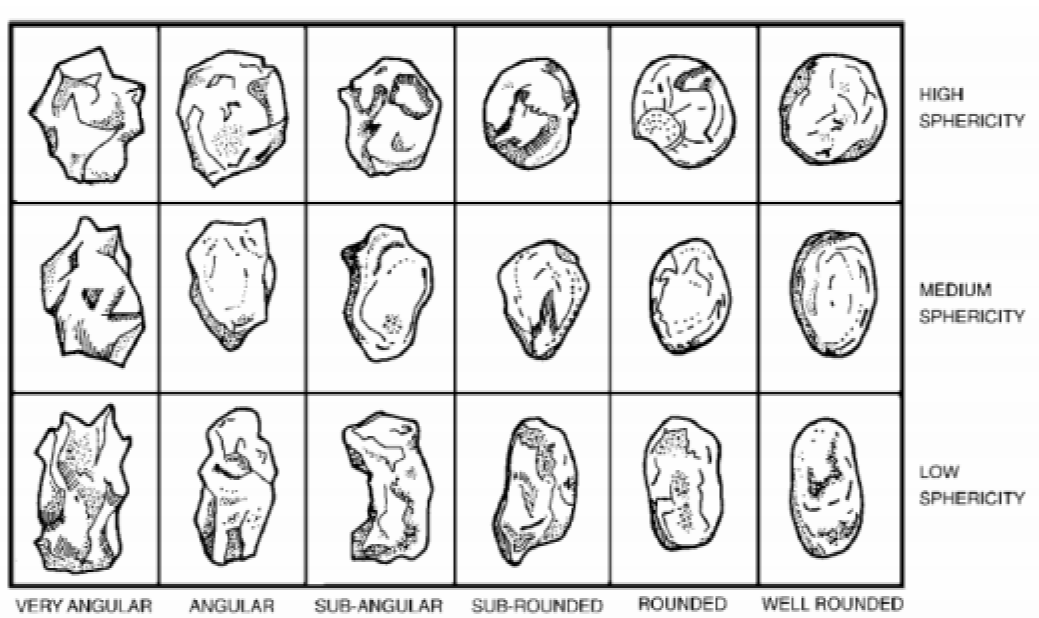


Fig: Different shapes of a foundry sand grain

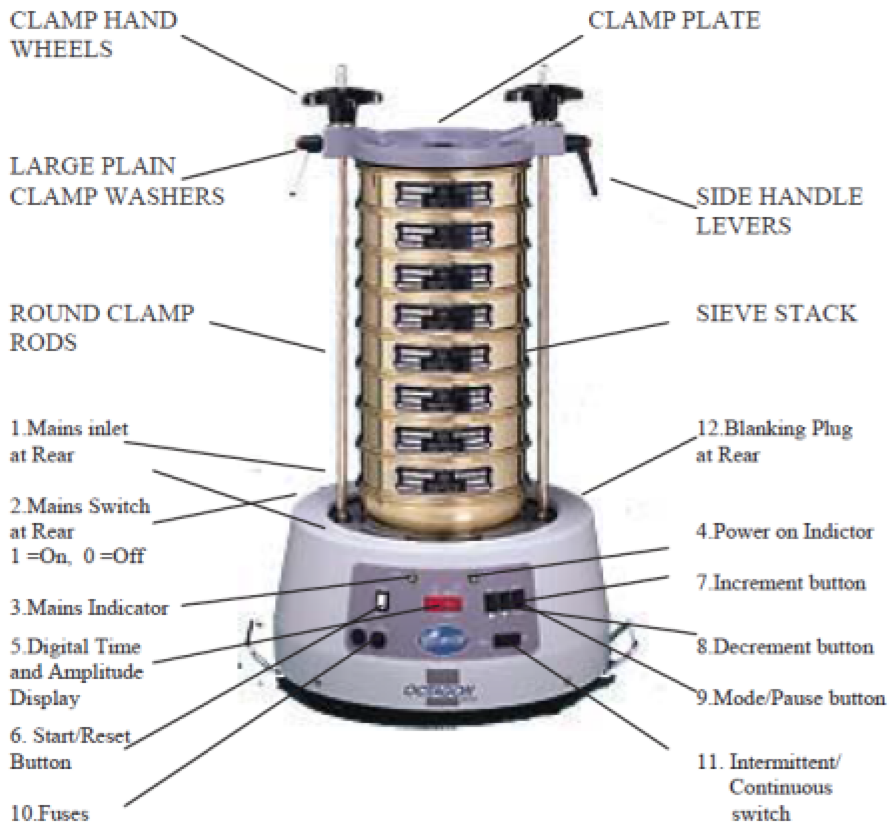
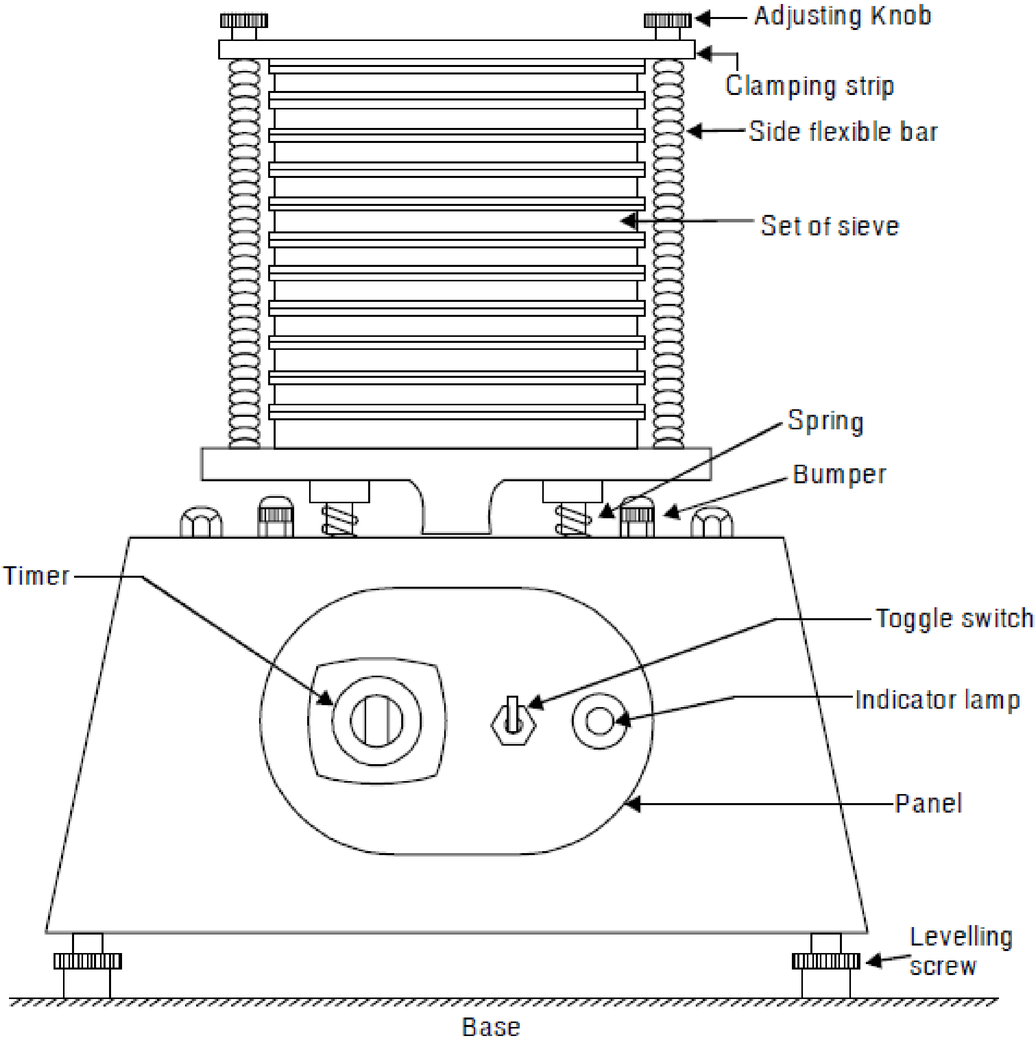


Fig: Set of sieves with shaker (Indian standard)



PROCEDURE

1. Weigh a 50 gm or 100 gm sample of the sand when it is perfectly dry (free of clay & moisture)
2. Place the sample of the sand into the coarsest (top most) sieve.
3. Place the set of sieves on shaking device to shake Shown in figure above.
4. Shake the sample in set of sieve on shaking device for definite length of time for 15 minutes.
5. After shaking start removing sieves form top sieve to bottom, weigh the quantity of remaining sample on each sieve.
6. The weight collected from each sieve is multiplied with sieve mesh number.
7. Finally divide the total product by the total sample weight & this produces the fineness number, which in the AFS (American Foundry Society). After calculating the number is called AFS number

Tabular Column:
(BS Set of sieves)

Sl. No.	Sieve No. (A)	Weight Retained (B)	Percentage of Sand retained (C)	Multiplier (D)	Product (DxC)	Cumulative % of sand retained
1	8			5		
2	10			8		
3	16			10		
4	22			16		
5	30			22		
6	44			30		
7	60			44		
8	100			60		
9	140			100		
10	200			140		
11	PAN			200		
			P=∑C		Q=∑(DxC)	

Tabular Column:
(IS Set of sieves)

Sl. No.	Sieve No. (A)	Weight Retained (B)	Percentage of Sand retained (C)	Multiplier (D)	Product (DxC)	Cumulative % of sand retained
1	1700			5		
2	850			10		
3	600			20		
4	425			30		
5	300			40		
6	212			50		
7	150			70		
8	106			100		
9	75			140		
10	53			200		
11	PAN			300		
			P=∑C		Q=∑(DxC)	

Average GFN=Q/P

Results: 1. Plot the frequency response distribution or normal distribution curve by taking percentage of sand retained on Y-axis v/s sieve no. on X-axis

2. Similarly plot the histogram

Cumulative % sand is calculated by adding the sum of % weight of sand retained of all the previous sieves and graph is plotted between % cumulative sand and sieve

Questions:

1. Define grain size, garin distribution and grain fineness number.

2. Write short notes on graph which obtained by plotting percentage of sand v/s sieve number.

3. Explain effects of fine grains in sand moulds

EXPERIMENT – 2

CLAY CONTENT TEST

Aim: Determination of the clay content of molding sand.

Apparatus: Bottle (Jar), Oven, Measuring Jar, Mechanical Stirrer, weighing balance, Heater, 5% NaOH Solution and siphon tube.

Theory: Clay can be defined as those particles having less than 20 micron size. Moulding sand may contain 2 to 50 percent of clay this is responsible for bonding and particles together. Clay influences strength , permeability and other moulding sand properties. Clay Tester measures the amount of live clay present by determining the Base Exchange capacity of the clay. This Test makes possible the rapid and accurate determination of live clay in foundry sand. The main advantage of this test is to balance the clay in moulding sand. Clay consists of two ingredients fine silt and true clay, fine silt has no binding power where as true clay imparts the necessary bonding strength to the moulding sand, there by the mould does not loose its shape after ramming .Clay also can be defined as "Those particles which when mixed with water, agitated and then made to settle ,fails to settle down at the rate of 1inch/min".

Procedure

1. A 50 gm. sample of sand under test first is dried & cooled (remove all moisture)
2. It is then transferred to the wash bottle (jar). Add in the jar 475c.c of distilled water and 25c.c standard solution of (NaOH) sodium hydroxide,
3. Under controlled condition (securely covered and sealed) using a rapid and stirrer, agitate the whole mixture for about 10minutes.
4. Lift the stirrer and add water to jar about 6" height from the bottom of the jar and stirrer with stirrer again for one minute with slow speed
5. Lift the stirrer and allow the mixture for two minutes so that silica particles are settle in the bottom and clay particles are floating in the water.
6. Sip hon the water about 125mm from top.
7. Repeat the steps 4,5 & 6, 3 to 4 times to remove all the clay particles from the sand.
8. Take the remaining sand from the bottle to a span.
9. Dry the sand with pan on heater to remove the moisture.
10. Weigh the dried sand (W2)
11. Find the weight and its percentage in the sand

Calculations:

Weight of sand W1= 50gms

Weigh the dried sand W2= ……..

Percentage of clay= $\frac{50-W2}{50}x100$

Result:

The percentage of clay in the green sand………………..%

Wash Bottle

CLAY CONTENT TEST

Questions:

1. Effect of clay content in casting quality.

2. What happened if we use 50 percent of clay in sand mould to make steel castings?

3. Explain different clays which use in sand castings.

EXPERIMENT – 3

PERMEABILITY TEST

AIM: To find the effect of the water, clay on the permeability of the green sand

APPARATUS: Weight balance, AFS Sand Rammer, specimen tube stop watch and Permeability Tester

THEORY

Permeability is a property of foundry sand with respect to how well the sand can vent, i.e. how well gases pass through the sand. And in other words, permeability is the property by which we can know the ability of material to transmit fluid/gases. The permeability is commonly tested to see if it is correct for the casting conditions.

Affecting Factors: The grain size, shape and distribution of the foundry sand, the type and quantity of bonding materials, the density to which the sand is rammed, and the percentage of moisture used for tempering the sand are important factors in regulating the degree of permeability.

Significance: An increase in permeability usually indicates a more open structure in the rammed sand, and if the increase continues, it will lead to penetration-type defects and rough castings. A decrease in permeability indicates tighter packing and could lead to blows and pinholes

PROCEDURE

1. The experiment may be conducted in the two ways.
    a. Vary clay content and keep water constant
    b. Vary water content and keep clay constant in both cases keep the no. of ramming of the specimen as three.
2. Weight quantities of sand, clay and water mixed thoroughly for three minute this sand mixture is transferred to specimen tube and rammed thrice under A.F.S sand rammer to get correct size specimen.
3. Place the specimen with the tube by inverting on the rubber pad of the permeability tester.
4. Collect 2000 cc of an air in the bell jar by keeping valve in the close position note down the manometer reading and force the air through the specimen, soon after the air passing start the stop lock and once again take manometer reading while pass air.
5. Note down the time to pass 2000 cc of air completely specimen, find the air pressure and substitute the values to formula and find the permeability.

Permeability Meter (AFS)

PN=VH/PAT
PN= Permeability No
V= Volume of the Air in CC (2000cc)
H= Height of the specimen in cm (5.08cm)
P=Air pressure in gm/cm^2
A= Cross section area of the specimen $A = \frac{\pi d^2}{4}$ in cm^2
D= Diar of specimen (5.08 cm)
T= Time in min.

Direct scale reading:
The permeability can also be determined making use of graduated maker provided near the monometer

Steps to be followed:

- Coincide the graduations on the transparent scale with the meniscus of the manometer liquid.
- Note the reading from the scale.
- This reading represents the permeability no. of sand.

Tabular column

Table 1: Varying percentage of water and constant clay content
(% of clay =…………………)

Sl. No.	Percentage of water	Pressure		Time in min. Calculated	Permeability number	
		gm/cm^2	N/mm^2		Indicated	Calculated
1						
2						
3						
4						
5						

Table 2: Varying percentage of clay and constant water content
(% of clay =…………………)

Sl. No.	Percentage of water	Pressure		Time in min. Calculated	Permeability number	
		gm/cm^2	N/mm^2		Indicated	Calculated
1						
2						
3						
4						
5						

Results: plot the permeability no. on Y axis and % of clay or % of water on X axis and comment on the result

Questions:

1. What is permeability?
2. Explain why permeability is an important factor in casting.
3. Effect of GFN on permeability property of sand.

EXPERIMENT – 4

COMPRESSION STRENGTH TEST FOR MOULDING SAND

Aim: To determine the Compressive strength of given sand.

Apparatus: Universal Sand Strength Testing Machine, measuring jar specimen tube, A.F.S sand rammer, stripper post.

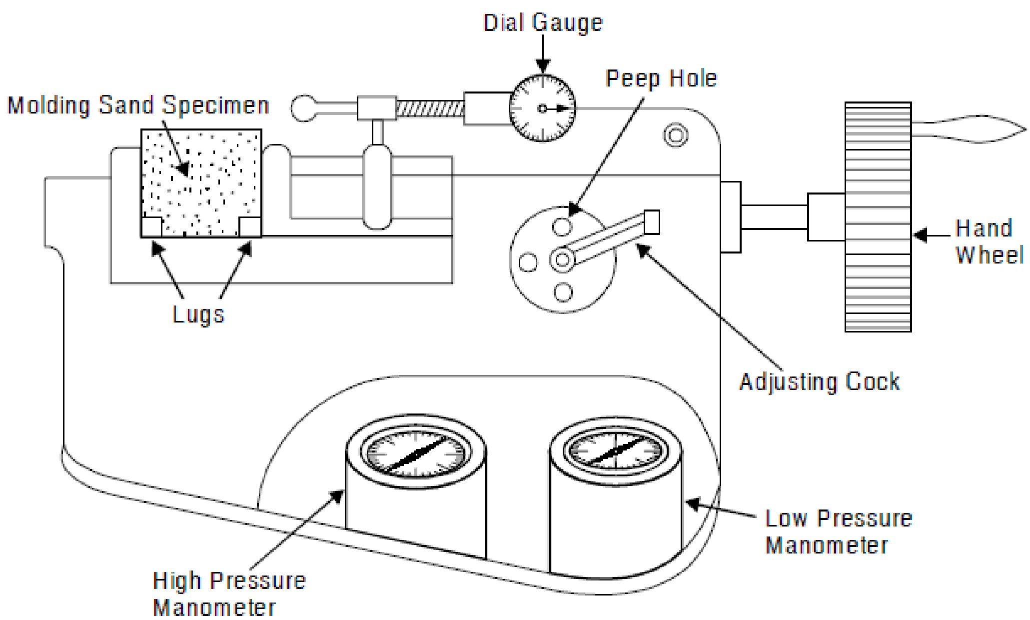
Theory: Periodic test are necessary to check the quality of foundry sand . compression strength is one among them. The constituents of moulding sand are silica sand, clay, water and additives. Clay imparts the necessary bond strength to the moulding sand when it is mixed with water. Compression test determine the holding power of various bonding materials in green sand. The green compression strength of foundry sand is the maximum compressive strength a mixture is capable of developing when it is in moist condition. The mould has to resist compressive stress due to pressure exerted by the molten metal.

PROCEDURE:

1. The experiment may be conducted in the two ways.
    a. Vary clay content and keep water constant
    b. Vary water content and keep clay constant

2. Weight quantities of sand, clay and water mixed thoroughly for three minute.
3. This sand mixture is transferred to specimen tube and rammed thrice in standard A.F.S and rammer so as to obtain a correct size specimen (5.08cm length & 5.08 cm dia.).
4. Remove specimen from the tube using stripper post
5. Place the specimen between compression shackles of the universal sand tester.
6. Rotate the handle wheel for applying load on the specimen.
7. After breaking the specimen note down the reading (compression strength) from the dial gauge of the universal sand tester.
8. Repeat the above procedure for other specimen and draw graph.

UNIVERSAL SAND TESTING MACHINE



Tabular column

Table 1: Varying clay content and constant water content

(% of water =…………………)

Sl. No.	Percentage of sand	Percentage clay	Compressive strength	
			gm/cm^2	N/mm^2
1				
2				
3				

4				
5				

Table 2: Varying water content and constant clay content

(% of clay =…………………)

Sl. No.	Percentage of sand	Percentage water	Compressive strength	
			gm/cm^2	N/mm^2
1				
2				
3				
4				
5				

Results: plot the graphs on compressive strength on Y axis and % of clay on X axis

plot the graphs on compressive strength on Y axis and % of water on X axis

Questions:

1 Analyze the effect of green compressive strength of moulding sand.

EXPERIMENT – 5

SHEAR STRENGTH TEST FOR MOULDING SAND

Aim: To determine the Shear strength of given sand.

Apparatus: Universal Sand Strength Testing Machine, measuring jar specimen tube, A.F.S sand rammer, stripper post.

Theory: Shear strength is the ability of sand particles to resist shear stress and stick together. Insufficient strength may lead to collapse of sand in the mould or its partial destruction during handling. The mould also be damaged during pouring of molten metal by washing of the walls and core by molten metal. The moulding sand must possess sufficient strength to permit the mould to be formed to the desired shape and retain thin shape even after the hot metal is poured in to the mould. In shear strength, the rupture occurs at 45^0, to the axis of the specimen. Flow of molten metal in the cavity and with drawl of pattern from the mould results in shearing of the mould cavity.

Procedure:

1. The experiment may be conducted in the two ways.
   a. Vary clay content and keep water constant
   b. Vary water content and keep clay constant

2. Weight quantities of sand, clay and water mixed thoroughly for three minutes.
3. This sand mixture is transferred to specimen tube and rammed thrice in standard A.F.S sand rammer so as to obtain a correct size specimen (5.08cm length & 5.08 cm dia.).
4. Remove specimen from the tube using stripper post.
5. Place the specimen between compression shackles of the universal sand tester.
6. Rotate the handle wheel for applying load on the specimen.
7. After breaking the specimen note down the reading (shear strength) from the dial gauge of the universal sand tester.
8. Repeat the above procedure for other specimen and draw graph.

Tabular column

Table 1: Varying clay content and constant water content

(% of water =…………………)

Sl. No.	Percentage of sand	Percentage clay	Shear strength	
			gm/cm^2	N/mm^2
1				
2				
3				
4				
5				

Table 2: Varying water content and constant clay content

(% of clay =…………………)

Sl. No.	Percentage of sand	Percentage water	Shear strength	
			gm/cm^2	N/mm^2
1				
2				
3				
4				
5				

Results: plot the graphs on Shear strength on Y axis and % of clay on X axis

plot the graphs on Shear strength on Y axis and % of water on X axis

Questions:

1 Analyze the effect of shear strength on green sand moulds.

EXPERIMENT – 6

TENSILE STRENGTH TEST FOR CORE SAND

Aim: To determine the Tensile strength of core sand using different types of binders-core oil binder, sodium silicate binder, etc.

Apparatus: Universal Sand Strength Testing Machine, specimen tube, sand rammer, split core box, oven

Theory: A core is a compacted sand mass of a known shape when a hallow casting is required a core is used in the mould or when a complex contour is required a mould is created out of cores. This core has to be properly seated in the mould with proper seating. To form these impressions, extra projections called core prints are added on the pattern surface at proper places. The core boxes are used for making of cores. They are made either single or in two parts. Spilt core box is widely used and is made in two parts which can be joined together by means of dowels to form complete cavity for making the core. The purpose of adding binder to the moulding sand is to impart strength and cohesiveness to the sand to enable it to retain its shape after the core has been made.

Procedure:

1. Conduct the experiments in two parts
    a. Using core oil as binder and
    b. Using Sodium silicate as binder or any other type of type of binder
2. Take proper proportions of base sand and binder then mix them together thoroughly.
3. Assemble the core box and mix the sand mixture into it.
4. Place the core box under sand rammer and ram the sand thrice.
5. Using wooden piece tap the core box gently from sides. Remove the core box leaving the rammed core on a flat metal plate.
6. Keep the specimen in oven along with specimen tube and bake it for about 30 minutes at 150^0 to 200^0C
7. If the binder is Sodium silicate, pass CO_2 gas for 5 sec. the core hardens instantly and the core can be directly used.
8. Fix the tensile shackles to universal sand tester and fix the specimen to shackle.
9. Apply load by rotating hand wheel till the specimen brake note down the tensile strength
10 After breaking the specimen note down the reading (tensile strength) from the dial gauge of the universal sand tester.
11. Repeat the above procedure for other specimen and draw graph.

Tabular column

Case 1: Tensile strength for varying content of organic binder =……… (say core oil)

Sl. No.	Percentage of sand	Tensile strength N/mm^2	Remarks
1			
2			
3			
4			
5			

Case 2: Tensile strength for varying content of inorganic binder =……… (say sodium silicate)

Sl. No.	Percentage of sand	Tensile strength N/mm^2	Remarks
1			
2			
3			
4			
5			

Result: plot the graphs tensile strength on Y axis and binder on X axis

Questions:

1 Analyze the effect of tensile strength of green sand mould

EXPERIMENT – 7

BENDING STRENGTH TEST FOR CORE SAND

Aim: To determine the bending strength of core sand using different types of binders-core oil binder, sodium silicate binder, etc.

Apparatus: Universal Sand Strength Testing Machine, specimen tube, sand rammer, split core box, oven

Theory: During casting, the core is placed inside the mould on the molten metal is poured into the cavity. The metal induces bending force on the core due to buoyancy force or metallostatic pressure. Thus measuring the bending strength of core sand is an important experiment to produce quality castings.

Procedure:

1. Conduct the experiments in two parts
    a. Using core oil as binder and
    b. Using Sodium silicate as binder or any other type of type of binder
2. Take proper proportions of base sand and binder then mix them together thoroughly.
3. Assemble the core box and mix the sand mixture into it.
4. Place the core box under sand rammer and ram the sand thrice.
5. Using wooden piece tap the core box gently from sides. Remove the core box leaving the rammed core on a flat metal plate.
6. Keep the specimen in oven along with specimen tube and bake it for about 30 minutes at 150^0 to 200^0C.
7. Fix the bending shackles to universal sand tester and fix the specimen to shackle.
9. Apply load by rotating hand wheel till the specimen brake note down the tensile strength
10 After breaking the specimen note down the reading (bending strength) from the dial gauge of the universal sand tester.
11. Repeat the above procedure for other specimen and draw graph.

Tabular column

Case 1: Bending strength for varying % of organic binder =……… (ex. core oil)

Sl. No.	Percentage of sand	Percentage of core oil	Bending strength N/mm^2	Remarks
1				
2				
3				
4				
5				

Case 2: Bending strength for varying % of inorganic binder =……… (ex. sodium silicate)

Sl. No.	Percentage of sand	Percentage of sodium silicate	Bending strength N/mm^2	Remarks
1				
2				
3				
4				
5				

Result: plot the graphs tensile strength on Y axis and binder on X axis

Questions:

1. Analyze the effect of bending strength of core during casting.

EXPERIMENT – 8

GREEN SAND MOULDING WITHOUT PATTERN

Aim:
Tools Required:

Procedure:

EXPERIMENT – 9

GREEN SAND MOULDING WITH PATTERN

Instructions for making a mould cavity using given pattern

Aim:

Tools Required:-

Procedure:

ACKNOWLEDGMENT

The department of Mechanical Engineering deeply indebted and wish to express the sincere thanks to the faculty for their constructive work in preparing this manual