# Foundry work

## Level-II

# Learning Guide-17

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| **Unit of Competence:** | **Prepare and Mix Sand for molding and Core Making** |
| **Module Title** | **Preparing and Mixing Sand for molding and Core Making** |
| **LG Code** | **IND FDW2 M6 1019 LO1-LG-17** |
| **TTLM Code** | **IND FDW2 M6 TTLM 1019v1** |
| **LO 1** | **Load mixer (Mill/Muller)** |

| Instruction Sheet | Learning Guide 17 |
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This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Checking all pre start-up performed.
- Determining formula for sand mix.
- Measuring and loading **materials.**
- Using personal protective equipment and Applying safe work practice and procedure

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Perform all pre start-up checks are safely and according to standard operating procedures.
- Determine formula for sand mix according to standard operating procedures.
- Measure and load Materials according to formula specification.

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1"2,3,4
4. Accomplish the "Self-check1,2,3,4,
5. If you earned a satisfactory evaluation from the "Self-check" proceed to "Operation Sheet 1," **in page -20.**
6. Do the "LAP test" **in page – 20** (if you are ready).

| Information Sheet-1 | Checking all pre start-up performed. |
|---|---|

**1. Introduction**

The production of sand for the foundry industry requires a series of mining and refining steps to yield pure, consistent sands. The actual production flow sheets vary with the source of the sand, but in general they include mining, one or more scalping operations to remove roots and pebbles, and then repeated washing and des liming operations to remove naturally occurring clays. The sand is screened and/or classified and then prepared for shipment to the foundry.

The first and foremost step in sand casting process is the preparation of moulding sand. This preparation basically constitutes sieving and mixing of foundry sand.
If the quality of the final casting is to be ensured, then appropriate sieving, even and uniform mixing of sand with bindles and water should be guaranteed among other considerable factors.

### 1.1. MOULDING SAND AND ITS PROPERTIES

In foundries, sand is used for making moulds. Natural sand found on the bed and banks of rivers provides an abundant source, although high quality silica sand is also mined. Sand is chemically $SiO_2$ silicon dioxide in granular form.
Ordinary river sand contains a contain percentage of clay, moisture, non-metallic impurities and traces of magnesium and calcium salts besides silica grains.
This sand, after suitable treatment, is used for mould making.

- A good, well prepared moulding sand should have the following properties:
  - ✓ ***Refractoriness***: it should be able to with stand high temperatures.
  - ✓ ***Permeability***: ability to allow gases, water vapour and air to pass through it.
  - ✓ ***Green sand strength***: when a mould is made with moist sand, it should have sufficient strength, otherwise mould will break.
  - ✓ ***Good flow ability***: when it is packed around a pattern in a moulding box, it should be able to fill all nooks and corners; otherwise the impression of pattern in mould would not be sharp and clear.
  - ✓ ***Good collapsibility***: it should collapse easily after the casting has cooled down and has been extracted after breaking the mould. It is particularly important in case of core making.
  - ✓ ***Cohesiveness***: ability of sand grains to stick together. Without cohesiveness, the moulds will lack strength.

- ✓ ***Adhesiveness: ability*** of sand to stick to other bodies. If the moulding sand does not stick to the walls of moulding box, the whole mould will slip through the box.
- ✓ Properties like permeability, cohesiveness and green strength are dependent upon size and shape of sand grains, as also upon the binding material and moisture content present in sand.
- ✓ Clay is a natural binder. Chemical binders like bentonite are sometimes added if clay content in natural sand is not enough.

## 1.2. Types of moulding sand:

Moulding sands may classify according to their use into a number of varieties, as given below:

- Green sand
- Dry sand
- Loam sand
- Facing sand
- System sand
- Parting sand and
- Core sand

- **Green sand:**
  - ✓ By green sand we denote sand in its natural, more or less moist state.
  - ✓ It is a mixture of silica sand with 18 to 30 percent clay, having a total water of from 6 to 8 percent.
  - ✓ The clay and water furnish the bond for green sand.
  - ✓ It is fine, soft, light and porous.
  - ✓ Being damped, it retains the shape, the impression given to it under pressure when squeezed in the hand.
  - ✓ Moulds prepared in this sand are known as green sand moulds.
- **Dry sand:**
  - ✓ Green sand that has been dried or baked after the mould is made is called dry sand.
  - ✓ These are suitable for large castings.
  - ✓ Moulds prepared in this sand are known as dry sand moulds.
- **Loam sand:**
  - ✓ It has high clay content, as much as 50 percent and dries hard.
  - ✓ This is particularly employed for loam moulding usually for large castings
- **Facing sand:**
  - ✓ It forms the face of the mould.
  - ✓ It is used directly next to the surface of the pattern and it comes into contact with the molten metal when the mould is poured.
  - ✓ It must possess high strength and refractoriness.
  - ✓ It is made of silica sand and clay, without the addition of used sand.

- ✓ Different forms of carbon are used to prevent the metal from burning into the sand.
- ✓ The layer of moulding sand usually ranges from 20 to 30 mm.
- ✓ It is about 10 to 15 percent of the whole moulding sand used in the foundry.
- ✓ A facing sand for green sand moulding of cast iron may consist of 25 percent fresh and specially prepared sand, 70 percent old sand, and 5 percent sea coal.

- **Backing sand or floor sand:**
  - ✓ It is used to back up the facing sand and to fill the whole volume of the flask.
  - ✓ Old, repeatedly used moulding sand is mainly employed.
  - ✓ It is sometimes called black sand because of the fact that old, repeatedly used moulding sand is black in colour due to the addition of coal dust and burning on coming in contact with molten metal.
- **System sand:**
  - ✓ The sand used to fill the whole flask in machine moulding is called system sand.
  - ✓ In mechanical sand preparation and handling units, no facing sand is used, the used sand is cleaned and reactivated by the addition of water binders and special additives is known as system sand.
  - ✓ As the whole mould is made of this system sand, the strength, permeability and refractoriness of the sand must be higher than those of backing sand.
- **Parting sand:**
  - ✓ It is used to keep the green sand from sticking to the pattern and
  - ✓ Also to allow the sand on the parting surface of the cope and drag to separate without clinging.
  - ✓ It is clean clay-free silica sand, which serves the same purpose as parting dust.
- **Core sand:**
  - ✓ It is used for making cores and sometimes called oil sand.
  - ✓ This is silica sand mixed with core oil composed of linseed oil, resin, light mineral oil and other binding materials.

### 1.3. conditioning of sand

- Natural sands are generally not well suited for casting purposes. On continuous use of molding sand, the clay coating on the sand particles gets thinned out causing decrease in its strength.
- Thus proper sand conditioning accomplish uniform distribution of binder around the sand grains, control moisture content, eliminate foreign particles and aerates the sands.
- Therefore, there is a need for sand conditioning for achieving better results.
- The foreign materials, like nails, gaggers, hard sand lumps and metals from the used sand are removed.
- The economics of a foundry operation require sand reclamation to reduce the costs associated with new sand and the costs of landfill use, and to reduce the

problems associated with the control of environmentally undesirable contaminants in the discarded sand.

- A properly designed sand reclamation system begins with green sand and converts it to a product very similar to new sand.
- For removing the metal pieces, particularly ferrous pieces, the sand from the shake-out station is subjected to magnetic separator, which separates out the iron pieces, nails etc. from the used sand. Next, the sand is screened in riddles which separate out the hard sand lumps etc.
- These ***riddles may be manual*** as well as ***mechanical***.
- Mechanical riddles may be either compressed air operated or electrically operated. But the electrically operated riddles are faster and can handle large quantities of sand in a short time.

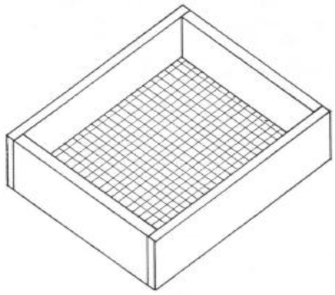

Figure 1.1: Riddle

- **Riddle:** sand is screened through a riddle to riddle to remove trash and lumps before it is poured in to the flask stretching hardware cloth with ¼ inch holes over a wood frame makes a small hand riddle

| **Self-Check -1** | **Multiple choice Test** |
|---|---|

**Directions:** chose the best answer and write the letter of your choice on given answer sheet (14%)

**1.** The purposes of mobilizing conditioning molding sand is____________ (3%)

A. Distribution of binder around the sand grains
B. Control moisture content
C. Eliminate foreign particles
D. Aerates the sands.
E. All of the above

**2.** _____Separating iron pieces, nails etc. from the used sand is done by________ (2%)

A. Riddle B. magnet C. mixer D. all

**3.** _____The first step in sand casing process is: (2%)

A. mold making B .melting C. sand preparation D. pouring molten metal to mold

**4.** _____one of the following **is not** preparation of molding sand process ;(2%)

A. Conditioning of sand B. riddling of sand C. mixing of sand and other ingredient D. none of the above

**5.** ____ Green sand that has been dried or baked after the mould is made is called (2%)

A. Core sand
B. Parting sand
C. Backing sand or floor sand
D. Dry sand

**6.** ___It is used to back up the facing sand and to fill the whole volume of the flask (2%)

A. Facing sand
B. Backing sand or floor sand
C. System sand
D. Loam sand

**Part II Matching match the word under column "A" with column ‘' B" (14%)**

| Column ''A" | column'' B'' |
| --- | --- |
| 1. ____Cohesiveness | A. ability with stand high temperatures |
| 2. ____ Collapsibility | B. ability to allow gases, water vapour |
| 3. ____Flow ability | C. sufficient strength |
| 4. ____ Green sand strength | D. ability to fill all nooks and corners |
| 5. ___ _Permeability | E. collapse easily after the casting |
| 6. ____ Refractoriness | F. ability of sand grains to stick together |
| 7. ____ Adhesiveness | G. ability of sand to stick to other bodies |

***Note:*** **Satisfactory rating – 14 and above points** **Unsatisfactory - below 14 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet- 2 | Determining formula for sand mix |
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### 2.1 Composition

The main ingredients of any molding sand are:

a. Silica sand ($SiO_2$) 80.8%
b. Alumina ($Al_2O_3$) 14.9%
c. Iron oxide ($Fe_2O_3$) 1.3%
d. Combined water 2.5%
e. Other inert materials 1.5%

- Besides, some other materials are also added to these to enhance the specific properties of molding sand.
- Molding sands may be of two types namely ***natural or synthetic***. Natural molding sands contain ***sufficient binder***.
- Whereas synthetic molding sands are prepared artificially using basic sand molding constituents (***silica sand in 88-92%, binder 6-12%, water or moisture content 3-6%)*** and other additives in proper proportion by weight with perfect mixing and mulling in suitable equipments.
-

### 2.2. CONSTITUENTS OF MOLDING SAND

- The main constituents of molding sand involve **silica sand**, **binder**, **moisture** content and additives.

**Silica sand**

- Silica sand in form of granular quarts is the main constituent of moulding sand having enough refractoriness which can impart strength, stability and permeability to molding and core sand.
- But along with silica small amounts of iron oxide, alumina, lime stone, magnesia, soda and potash are present as impurities.
- The chemical composition of silica sand gives an idea of the impurities like lime, magnesia, alkalis etc. present.
- The presence of excessive amounts of iron oxide, alkali oxides and lime can lower the fusion point to a considerable extent which is undesirable.
- The silica sand can be specified according to the size (small, medium and large silica sand grain) and the shape (angular, sub-angular and rounded).

### 2.3. Effect of grain shape and size of silica sand

- The shape and size of sand grains has a significant effect on the different properties of molding and core sands.
- The shape of the sand grains in the mould or core sand determines the possibility of its application in various types of foundry practice.
- The shape of foundry sand grains varies from **round to angular**.

- Some sands consist almost entirely of grains of one shape, whereas others have a mixture of various shapes.
- According to shape, foundry sands are classified as **rounded, sub-angular**, **angular** and **compound**.
- Use of angular grains (obtained during crushing of rocks hard sand stones) is avoided as these grains have a large surface area.
- Molding sands composed of angular grains will need higher amount of ***binder and moisture*** content for the greater specific surface area of sand grain.
- However, a higher percentage of binder is required to bring in the desired strength in the molding sand and core sand.
- For good molding purposes, **a smooth surfaced** sand grains are preferred. The smooth surfaced grain has a higher sinter point, and the smooth surface secures a mixture of greater **permeability** and **plasticity** while requiring a higher percentage of blind material.
- Rounded shape silica sand grain sands are best suited for making permeable molding sand.
- These grains contribute to higher bond strength in comparison to angular grain. However, rounded silica sand grains sands have higher thermal expandability than angular silica grain sands.
- Silica sand with rounded silica sand grains gives much **better compact** ability under the same conditions than the sands with angular silica grains.
- This is connected with the fact that the silica sand with rounded grains having the **greatest degree of close packing** of particles while sand with angular grains the worst.
- The green strength increases as the grains become more rounded. On the other hand, the grade of compact ability of silica sands with rounded sand grains is higher, and other, the contact surfaces between the individual grains are greater on rounded grains than on angular grains.
- As already mentioned above, the compact ability increases with ***rounded grains.***
- The **permeability or porosity** property of molding sand and core sand therefore, should increase with ***rounded grains*** and decrease with ***angular grains.***
- Thus the round silica sand grain size greatly influences the properties of molding sand.
- The characteristics of sub-angular sand grains lie in between the characteristics of sand grains of angular and rounded kind.
- Compound grains are cemented together such that they fail to get separated when screened through a sieve.
- They may consist of round, sub-angular, or angular sub-angular sand grains. Compound grains require higher amounts of binder and moisture content also.
- These grains are least desirable in sand mixtures because they have a tendency to disintegrate at high temperatures.
- Moreover the compound grains are cemented together and they fail to separate when screened.

- Grain sizes and their distribution in moulding sand influence greatly the properties of the sand.
- The size and shape of the silica sand grains have a large bearing upon its strength and other general characteristics.
- The sand with wide range of particle size has higher compact ability than sand with narrow distribution.
- The broadening of the size distribution may be done either to the fine or the coarse side of the distribution or in both directions simultaneously, and a sand of higher density will result.
- Broadening to the coarse side has a greater effect on density than broadening the distribution to the fine sand. Wide size distributions favor green strength, while narrow grain distributions reduce it.
- The grain size distribution has a significant effect on ***permeability***.
- Silica sand containing finer and a wide range of particle sizes will have low permeability as compared to those containing grains of average fineness but of the same size i.e. narrow distribution.
- The compact ability is expressed by the green density obtained by three ram strokes. Finer the sand, the lower is the compact ability and vice versa.
- This results from the fact that the specific surface increases as the grain size decreases.
- As a result, the number of points of contact per unit of volume increases and this in turn raises the resistance to compacting.
- The green strength has a certain tendency, admittedly not very pronounced, towards a maximum with a grain size which corresponds approximately to the medium grain size.
- As the silica sand grains become finer, the film of bentonite becomes thinner, although the percentage of bentonite remains the same.
- Due to reducing the thickness of binder film, the green strength is reduced. With very coarse grains, however, the number of grains and, therefore, the number of points of contact per unit of volume decreases so sharply that the green strength is again reduced.
- The sands with grains equal but coarser in size have greater void space and have, therefore greater permeability than the finer silica sands. This is more pronounced if sand grains are equal in size.

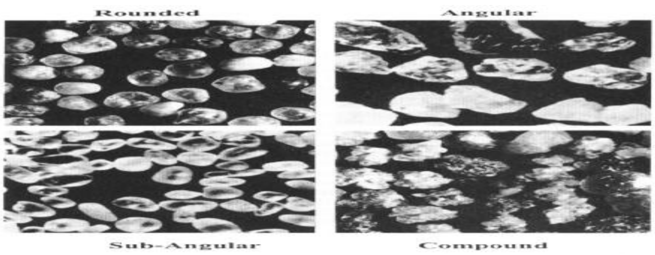


figure2.1: Grain structure (shape)

**Binder**

- In general, the binders can be either ***inorganic or organic*** substance.
- The inorganic group includes clay sodium silicate and port land cement etc. In foundry shop, the clay acts as binder which may be Kaolonite, Ball Clay, Fire Clay, Limonite, Fuller's earth and Bentonite.
- Binders included in the organic group are dextrin, molasses, cereal binders, linseed oil and resins like phenol formaldehyde, urea formaldehyde etc. Organic binders are mostly used for core making.
- Among all the above binders, the bentonite variety of clay is the most common. However, this clay alone cannot develop bonds among sand grains without the presence of moisture in molding sand and core sand.

- **Moisture**
  - ✓ The amount of moisture content in the molding sand varies generally between 2 to 8 percent.
  - ✓ This amount is added to the mixture of clay and silica sand for developing bonds.
  - ✓ This is the amount of water required to fill the pores between the particles of clay without separating them.
  - ✓ This amount of water is held rigidly by the clay and is mainly responsible for developing the strength in the sand.
  - ✓ The effect of clay and water decreases permeability with increasing clay and moisture content.
  - ✓ The green compressive strength first increases with the increase in clay content, but after a certain value, it starts decreasing.
  - ✓ For increasing the molding sand characteristics some other additional materials besides basic constituents are added which are known as additives.
- **Additives**
  - ✓ Additives are the materials generally added to the molding and core sand mixture to develop some special property in the sand. Some common used additives for enhancing the properties of molding and core sands are discussed as under.
- **Coal dust**
  - ✓ Coal dust is added mainly for producing a reducing atmosphere during casting.
  - ✓ This reducing atmosphere results in any oxygen in the poles becoming chemically bound so that it cannot oxidize the metal.
  - ✓ It is usually added in the molding sands for making moulds for production of **grey iron and malleable cast iron** castings.

- **Corn flour**
  - ✓ It belongs to the starch family of carbohydrates and is used to increase the collapsibility of the molding and core sand.
  - ✓ It is completely volatilized by heat in the mould, thereby leaving space between the sand grains.

- This allows free movement of sand grains, which finally gives rise to mould wall movement and decreases the mould expansion and hence defects in castings.
- Corn sand if added to molding sand and core sand improves significantly strength of the mould and core.

- **Dextrin**
  - Dextrin belongs to starch family of carbohydrates that behaves also in a manner similar to that of the corn flour.
  - It increases ***dry strength*** of the moulds.
- **Sea coal**
  - Sea coal is the fine powdered bituminous coal which positions its place among the pores of the silica sand grains in molding sand and core sand.
  - When heated, it changes to coke which fills the pores and is unaffected by water: Because to this, the sand grains become restricted and cannot move into a dense packing pattern.
  - Thus, sea coal reduces the **mould wall movement** and the **permeability** in mould and core sand and hence makes the mould and core surface **clean and smooth.**
- **Pitch**
  - It is distilled form of soft coal. It can be added from 0.02 % to 2% in mould and core sand.
  - It enhances hot strengths, surface finish on mould surfaces and behaves exactly in a manner similar to that of sea coal.
- **Wood flour**
  - This is a fibrous material mixed with a granular material like sand; its relatively long thin fibres prevent the sand grains from making contact with one another.
  - It can be added from 0.05 % to 2% in mould and core sand.
  - It volatilizes when heated, thus allowing the sand grains room to expand.
  - It will increase mould wall movement and decrease expansion defects.
  - It also increases collapsibility of both of mould and core.
- **Silica flour**
  - It is called as pulverized silica and it can be easily added up to 3% which increases the hot strength and finish on the surfaces of the moulds and cores.
  - It also reduces metal penetration in the walls of the moulds and cores.

| Self-Check -2 | Multiple choices test |
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**Directions:** part I chose the best answer and write the letter of your choice on given answer sheet (8%)

**1.** The constitutes of molding sand includes :( 2%)

A. Silica sand
B. Binder
C. Moisture
D. Additives
E. All

**2.** Which shape of silica sand grain is best suited for making permeable molding sand? (2%)

A round B. angular silica grains c. sub angular D. compound
E None

**3.** Which one of the following are not additives in sand molding preparation? (2%)

A. Sea coal
B. Coal dust
C. Dextrin
D. None

**4.** The permeability or porosity property of molding sand and core sand decrease with _______ (2%)

A. Round sand
B. Angular sand
C. Compound sand
D. All

**Part II Matching (10%)**

**Directions: match the word under column "A" with column ‘’ B"**

| Column A | column B |
|---|---|
| 1. ______Dextrin | A. Reduce atmosphere during casting |
| 2. ______sea coal | B. improve the strength of the mould and core |
| 3. ______pitch | C. increase dry strength |
| 4. ______corn flour | D.hin hence hot strength |
| 5. ______Coal dust | E. reduce the mold wall movement and permeability |

***Note:*** **Satisfactory rating – 9 points and above** **Unsatisfactory - below 9 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-3 | Measuring and loading **materials.** |
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### 3.1 Procedures of measuring and loading material

- **Preparation of the green sand:**
  - ✓ Sift (separate) the silica with the fine metal mesh and mix with the Bentonite clay in a large container.
  - ✓ The mixture should be moist to the touch.
  - ✓ Test wetness by grabbing a handful of the mixture and squeezing it.
  - ✓ If there is water it is too wet and more silica should be added.
  - ✓ If it crumbles then it is too dry and more clay should be added.
  - ✓ The green sand is ready to be used when you can squeeze it and no water is visible and it can retain its shape without falling apart. Once it's ready place a top on
  - ✓ The container in order to seal it and prevent it from drying out.

Figure 3.1 sand moisture tests.

- ✓ The combination of properties required in the moulding material depends upon the weight and composition of the casting and upon the moulding practice to be adopted, itself partly governed by quantity and quality requirements.
- ✓ Properties are developed by blending sands or other refractoriness with bonding materials, water and special additions.

- **Materials**
  - ✓ The material which is used in making the molds in the foundry must be porous enough to allow the escape of the air and the steam and gas generated by the heat of metal poured and yet at the same time compact enough to hold the liquid metal
  - ✓ It must be refractory that is ,able to stand very high temperature and it must not produce any chemical action with the metal at this temperature

- ✓ It must be readily removed from the casting, and leave a clean, smooth surface
.

- **Selection**: it is very important that a proper sand be selected for the class of work to be done, for upon this success of the casting largely depends

✓Mold sand used in making molds for cast iron composed chiefly of ***silica (sand), magnesium, aluminum (clay) lime, and some metallic oxides.***

✓The proportion in which these substances vary or, occasionally, the presences of some other substances determine the quality and use of sand.

✓There is a little to aid the beginner in selecting molding sand or in applying it to its proper use.

✓This either must be left to someone experienced in the use of sand or must be determined by chemical analysis.

Moulding sands may be of two types namely natural or synthetic.

- ✓ Natural moulding sands contain sufficient binder.
- ✓ Whereas synthetic moulding sands are prepared artificially using basic sand moulding constituents (silica sand in 88-92%, binder 6-12%, water or moisture content 3-6%) and other additives in proper proportion by weight with perfect mixing and mulling in suitable equipments.

- **Controlling Clay Properties.**

- ✓ All clays can be made plastic and will develop adhesive qualities when mixed with the proper amounts of water.
- ✓ All clays can be dried and then made plastic again by the addition of water, provided the drying temperature is not too high. However, if the temperature does become too high, they cannot be replasticized with water.
- ✓ It is this third condition that dictates the durability of the clay in system sand.
- ✓ All clays, regardless of type, develop both ***adhesive and cohesive properties*** when mixed with water.
- ✓ The amount of adhesive or cohesive property depends on the amount of water added.
- ✓ When the water content is low, the cohesive properties are ***enhanced*** and the clays tend to cohere, or stick to them, rather than adhere, or stick to the sand grains to be bonded.
- ✓ With high water additions, the converse is true.
- ✓ In addition to having different bonding and durability characteristics, the various clays have very distinctive behaviour patterns as a result of their differing physical characteristics.
- ✓ System sands formulated with high levels of Western bentonite have high levels of hot strength.

- ✓ System sand formulated with an equivalent level of Southern bentonite will have a significantly lower hot strength.
- ✓ In addition, the flow ability of the two sands is different because of the greater swelling tendency of the Western bentonite clays compared to that of the Southern bentonite materials.
- ✓ Therefore, the proper formulation of clay materials for a green sand system must take into consideration the flow ability requirements as well as the shakeout requirements of the sand.
- ✓ The ***ratio of clay to water*** is of critical importance in optimizing the properties of clays.
- ✓ The shear strength of a clay-water mixture is representative of the green strength of the compacted sand, because it is the shear strength of the films of clay coating the sand grains that bonds the sand together.
- ✓ This parameter is controlled by the amounts of water and clay added to the mixture and is measured by monitoring the pressure required to extrude various clay-water mixtures through a fixed orifice

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|---|---|
| **Self-Check -3** | **True false** |

**Directions:** write true if the statement is correct and false if the statement is not correct on the separate answer sheet (10%)

1. ______The green sand is ready to be used when you can squeeze it and no water is visible and it can retain its shape without falling apart.
2. ______Natural moulding sands contain sufficient binder.
3. ______ the material which is used in making the molds in the foundry must be porous enough to allow the escape of the air and the steam and gas generated by the heat.
4. _____ Refractory sand is used for resistance of very high temperature.
5. _____ The combination of properties required in the moulding material depends upon the weight and composition of the casting.

***Note:*** **Satisfactory rating – 5 points and above** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-4 | Using personal protective equipment and applying safe work practice and procedure |
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**4.1 foundry safety**

- Hazards that may be encountered include Sand plant
  - ✓ Atmospheric contaminants including respirable silica
  - ✓ working in confined spaces (e.g. sand sampling)
  - ✓ Conveyors
  - ✓ Moving machinery
  - ✓ Noise
  - ✓ falls from heights
  - ✓ Pressure build-up during sand transportation
  - ✓ Working with hot sand and foreign objects.
  - ✓ Safety is a critical concern in a foundry. Since one minor mistake can make serious consequence which is deathful and irrevocable.
  - ✓ Foundry accident normally influences not only the operator, but also the surroundings and the family members of the injurers.
  - ✓ One of the most important safety rules in a foundry is never put water-containing object into melting furnace, explosive power of one pound of alumnium melt is equivalent with 3 pounds of TNT / 7.5 pounds of normal bomb, if water is contacted with the melts accidentally.
  - ✓ Therefore, preventive safety measures are essential and more valuable than post actions to save the human life.
  - ✓ Clothes and shoes should be made from cotton or natural fibbers. Synthetics melt and stick to the skin.
  - ✓ If any part of the equipment fails while being used, report it immediately to your supervisor. Never try to fix the problem yourself because you could further damage the equipment and harm yourself and others in the lab.

**4.2 FOUNDRY BUILDINGS AND WORK AREAS**

- Control measures include:
  - ✓ Ensuring work platforms are horizontal where possible and a minimum of 600 mm wide to allow workers to move unobstructed.
  - ✓ The risk of objects falling from the platform should be prevented by a wall or in-filled handrail.
  - ✓ Ensuring the work area is clear of rubbish and hoses and cords should not cross the floor.
  - ✓ Repairing leaking or dripping water pipes or fittings immediately.
  - ✓ Ensuring aisles are open and clear.

- ✓ Storing flammable and combustible substances and other hazardous chemicals safely to minimise unnecessary exposure of workers to chemical and handling hazards.
- ✓ Cylinders containing gases should be chained into position outside furnace areas, with clear and controlled access.
- ✓ They should be protected from vehicle impact and other shocks and located away from doorways and windows.
- ✓ The area should be ***clear of rubbish*** and have **lighting and signs**.
- ✓ Positioning cables and pipe work where they are protected from molten metal splashes.
- ✓ Minimising the number ledges and exposed beams.
- ✓ Ensuring the work area is well lit.
- ✓ Ensuring the roof is high allowing natural convection of gases and fumes, along with ventilation allowing air exchange.
- ✓ Checking the floor surface is suitable.
- ✓ Concrete can spall and explode when in contact with molten metal due to trapped moisture. Refractory brick is a safer floor surface for the foundry area.
- ✓ Fencing open pits, deep moulds and other floor openings securely to stop workers falling in.
- ✓ Ensuring where pits and deep moulds are used permanently, their internal walls are lined with bricks, concrete or other similar material.
- ✓ Ensuring pouring pits are large enough to safely accommodate a ladle. At least 300 mm clearance should be provided between parts of, and attachments to, a ladle and the sides of the pit to allow unhindered removal of the ladle.
- ✓ Ensuring where a worker has to stand or work over or near a floor opening, the edge of the opening is covered by substantial grating to stop the falling into the opening.
- ✓ The grating should be flush with the surrounding floor or have ramps to eliminate the risk of tripping.

### 4.3 Personal safety

- Personal cleanness can play a significant role in protecting foundry workers from exposure to hazardous substance.
- This special vital in the corer room area where skin irritation sensitization or dermatitis may cause by prolonged or repeated skin contact with resinous binders.
- Workers /trainees are encouraged to wash their hands or other contaminated parts of the body immediately after skin contact and before eating Smoking to reduce the risk of ingestion or inhalation of toxic material .eg. lead, abrasive skin cleaner and strong alkalis or solvent that defeat the skin should be avoided
- Therefore, wear proper Personal Protective Equipment (PPE
  - ✓ Leather shoes
  - ✓ Fireproof apron
  - ✓ Foot and leg protection
  - ✓ Proper gloves, wire mesh face shield
  - ✓ Safety glasses

- ✓ Cotton baseball hat.
- ✓ A leather foundry hat is the best choice.
- ✓ A long sleeve cotton shirt.
- ✓ Wear safety glasses as well as the mesh face shield

| Self-Check -4 | True false item |
|---|---|

**Directions: write true if the statement is correct and false if the statement is not correct on the separated answer sheet. (10%)**

1. ______The risk of objects falling from the platform should be prevented by a wall or in-filled handrail.
2. ______ Foundry accident normally influences only the operator.
3. ______ wearing Leather shoes, fireproof apron and Safety glasses are grouped under shop safety
4. _____Personal cleanness can play a significant role in protecting foundry workers from exposure to hazardous substance.
5. _____One of the most important safety rules in a foundry is put water containing object into melting furnace.

***Note:*** **Satisfactory rating –5 points & above Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

| Operation Sheet 1 | Checking all pre start-up performed. |
|---|---|

**Checking all pre start-up performed.**

**Step 1-** wear all necessary safety cloth

**Step 2-** select and prepare sand and other additives

**Step 3-** conditioning or reclamation previously used sand

**Step 4-** screening sand in riddles which separate out the hard sand lumps.
**Step 5**. Determine formula for sand mix and measure the required amount of sand and other additives

| LAP Test 1. | Practical Demonstration |
|---|---|

Name: _____________________________ Date: ________________

Time started: ________________________ Time finished: ________________

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within ___ hours.

**Task 1: perform** recondition of founder sand and preparing the required amount of additives

**Task 2: perform riddling** the required amount of founder sand for mold preparation.

## List of Reference Materials


1. Rajender Singh, introduction to manufacturing processes and work shop technology, 2006.
2. The ASM Handbook Committee, casting volume 15 9th Edition'
3. H.N Gupta, manufacturing processes second edition, newdelhi, 2009.
4. Stephen D.chastain, metal casting :a sand casting manual for small foundry vol.1,USA 2004
5. **https://www.youtube.com/watch?v=zolk3B4kYXI**
6. https://www.youtube.com/watch?v=LwrLoeAHpZM

# Foundry work

## Level-II

# Learning Guide-18

| | |
|---|---|
| **Unit of Competence** | **Prepare and Mix Sand for molding and Core Making** |
| **Module Title** | **Preparing and Mixing Sand for molding and Core Making** |
| **LG Code** | **IND FDW2 M6 0919 LO2-LG-18** |
| **TTLM Code** | **IND FDW2 M6 0919 TTLM 0919v1** |
| **LO 2** | **Mix sand** |

| Instruction Sheet | Learning Guide 2 |
|---|---|

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Mixing sand at the correct time and specifications.
- Monitoring performance of **mixer** and condition of sand.
- Regulating and Maintaining Material supply.
- Reporting **faults**

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:

- Mix sand at the correct time and specifications
- Monitor performance of **mixer** and condition of the sand according to operational procedures
- Regulate and maintain Material supply according to operations
- Report faults following workplace procedures and format.

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 2,
4. Accomplish the “Self-check 1, Self-check 2, Self-check 3, and Self-check 4. ” **in page 30, 33, 36 and 39 respectively**.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 **in page 36.**
6. Do the “LAP test” **in page – 36** (if you are ready).

| Information Sheet-1 | Mixing sand at the correct time and specifications. |
|---|---|

### 1.1. Concept of mixing foundry sand

- The amount of fine material can be controlled to the maximum possible extent by its removal through exhaust systems under conditions of shake out.
- Sand, clay, water, and carbonaceous materials are charged into the mixing device.
- The length of time these ingredients are left in the mixing device is best determined by the type of device used and the desired sand properties. These devices are called either Muller or mixers.
- As with moulding equipment, different types of mixing equipment can be used. Most foundries use either a continuous or a batch-type Muller.
- The sand constituents are then brought at required proper proportion and mixed thoroughly.
- Next, the whole mixture is ***mulled suitably*** till properties are developed. After all the foreign particles are removed from and the sand is free from the hard lumps etc., proper amount of pure sand, clay and required additives are added to for the loss because of the burned, clay and other corn materials.
- As the moisture content of the returned sand known, it is to be tested and after knowing the moisture the required amount of water is added
- Now these things are mixed thoroughly in a **mixing Muller**
- The main objectives of a ***mixing Muller*** is to ***distribute the binders, additives and moisture or water content uniformly*** all around each sand grain and helps to develop the optimum physical properties by kneading on the sand grains.
- Inadequate mulling makes the sand mixture weak which can only be compensated by adding more binder.
- Thus the adequate mulling economizes the use of binders.
- There are ***two methods of adding clay and water*** to sand.
- In the first method, first **water** is added to sand follow by **clay,** while in the other method**, clay** addition is followed **water**.
- It has been suggested that the best order of adding ingredients to clay bonded sand is **sand with water** followed by the ***binders***.
- In this way, the clay is more quickly and uniformly spread on to all the sand grains.
- An additional advantage of this mixing order is that ***less dust*** is produced during the mulling operation.

- The Muller usually consists of a cylindrical pan in which two heavy rollers; carrying two ploughs, and roll in a circular path.
- While the rollers roll, the ploughs scrap the sand from the sides and the bottom of the pan and place it in front of For producing a smearing action in the sand, the rollers are set slightly off the true radius and they move out of the rollers can be moved up and down without difficulty mounted on rocker arms.

## 1.2. Sand Muller

- **Continuous Muller.**
  - ✓ In a continuous Muller (Fig. 2.1), the sand is fed to the Muller into one bowl, and it exits through a door in the other bowl.

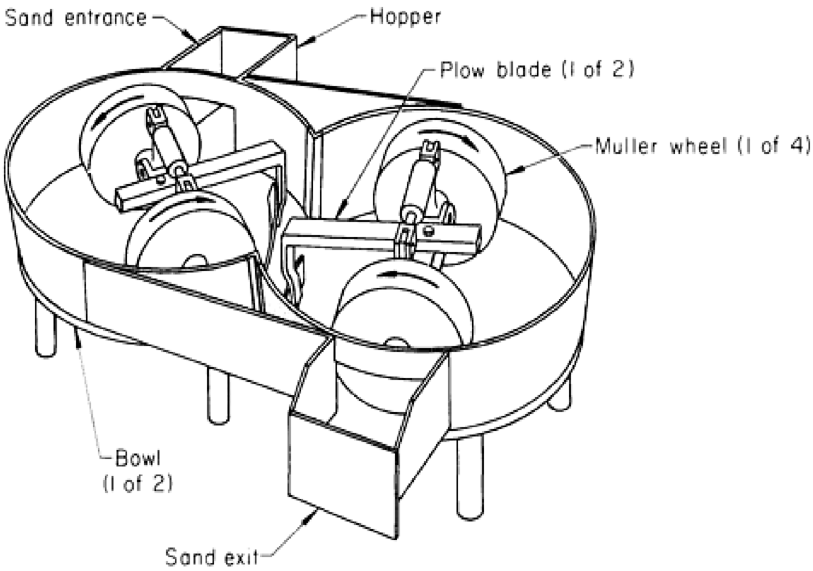


Figure: 2.1 Primary components of a continuous Muller

- **Batch-Type Muller.** Although not a new design, the batch-type Muller (Fig. 2.2) can produce high-quality moulding sand.
  - ✓ It is equipped with plows to move the sand mass under the large, weighted rolling wheels, which are vertically oriented.
  - ✓ This kneading action provides the capability of consistent control but not short cycle times.

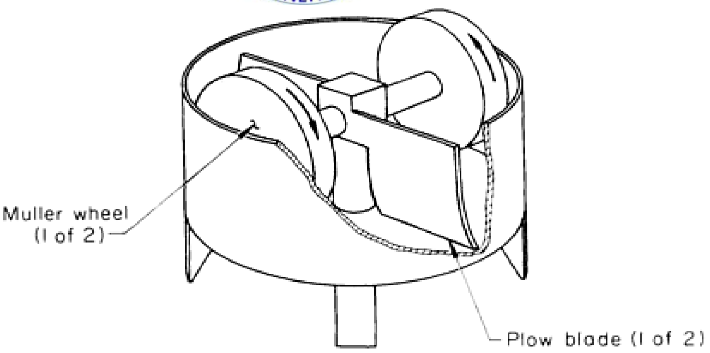


Fig 2.2 Essential components of a conventional vertical wheel batch-type Muller

- **The high-speed batch Muller**

  - ✓ The high-speed batch Muller shown in (Fig.2.3) has been adapted to meet the requirements of both high production moulding lines and jobbing foundries
  - ✓ Sand is plowed from the floor of the Muller up to the position where the rubber-tired wheels knead the sand against the rubber-lined sidewall.
  - ✓ However, not all of the mulling action takes place as a result of the wheels; much of the mulling action takes place as a result of the amount of sand in the Muller.
  - ✓ For maximum mulling efficiency, the weight of sand charged into this type of Muller should not be too small.
  - ✓ This type of Muller also offers the possibility of cooling the aggregate. A blower can be installed that will force air into the bottom of the unit.
  - ✓ As the air flows through the aggregate, it picks up moisture and is exhausted through the top of the Muller.
  - ✓ By adding sufficient amounts of water, the sand can be evaporative cooled.

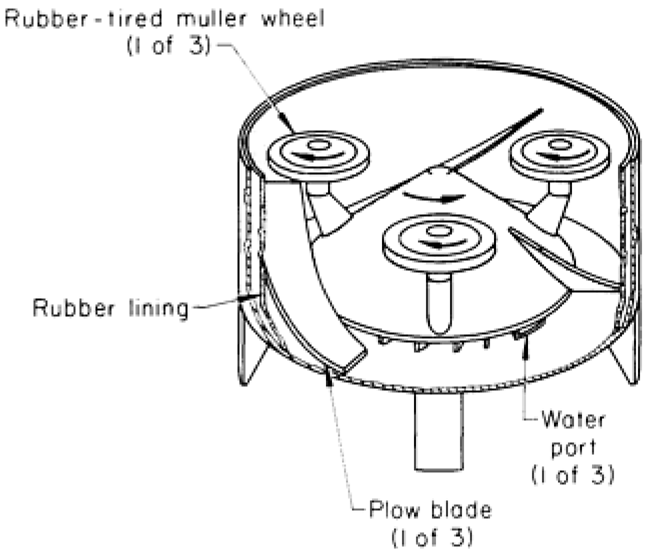


Fig: 2.3 the high-speed batch Muller

| Self-Check -1 | True false item |
| --- | --- |

**Directions:** write true if the statement is correct and false if the statement is not correct on the separated answer sheet (10%)

1. ______the best order of adding ingredients to clay bonded sand is sand with water followed by the binders.
2. ______ The high-speed batch Muller is used to meet the requirements of both high production moulding lines and jobbing foundries
3. _______Batch-Type Muller can produce high-quality moulding sand
4. _______ mixing Muller is to distribute the binders, additives and moisture or water content uniformly all around each sand grain.
5. _______ Adequate mulling makes the sand mixture weak which can only be compensated by adding more binder.

***Note:*** **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-2 | Monitoring performance of mixer and condition of sand |
|---|---|

## 2.1. Introduction

In addition to the various types of moulding machines, the modern foundry makes use of a variety of equipment to handle the sand and castings.

**Sand Preparation and Handling**

Sand is prepared in **Muller,** which conjunction to loosen the sand to make it more amenable to moulding.

## 2.2 Mixing Variables.

- Regardless of the type of equipment used, a minimum of 80% of the total added water should go into the Muller immediately before the sand or at least with the sand to allow the maximum amount of time for cooling (if applicable) and/or clay activation and to provide the maximum control.
- Most mulling equipment does not discharge prepared sand in its most flow able condition.
- Even if it did, prepared sand will normally be routed through at least one hopper (probably two or more) and will be transferred from one belt conveyor to another.
- Each time the sand is dropped into a hopper or onto another belt, some pre packing takes place.
- For these reasons, each moulding station should be equipped with a good aerator to perform the final conditioning of the prepared sand.
- The amount of fine material can be controlled to the maximum possible extent by its removal through exhaust systems under conditions of shake out.
- The sand constituents are then brought at required proper proportion and mixer thoroughly.
- Next, the whole mixture is mulled suitably till properties are developed.
- After all the foreign particles are removed from and the sand is free from the hard lumps etc., proper amount of pure sand, clay and required additives are added to for the loss because of the burned, clay and other corn materials.
- As the moisture content of the returned sand known, it is to be tested and after knowing the moisture the required amount of water is added.
- Now these things are mixed thoroughly in a mixing Muller
- Good sand mulling requires the ingredients should be accurately measured.
- Water is the most critical of the sand clay mixture and should be measured exactly.

- Second it must be well distributed throughout the batch proper mulling time is essential for good mixing.
- Under mulled sand causes moulding problems so there is no time saved by using cycles
- Six to seven minutes is generally used to develop a good bond.
- The water and clay bond must be kneaded into dough like consistency.
- The best mulling action is to rollout the sand and bond like rolling pin roll out dough.
- The pressure of a roller is important .if there is too much pressure, the roller cuts completely through the sand to the base of the machine.
- If there is not enough pressure the roller goes over the top of sand mixture without shearing the mass.
- The mass must be compressed, sheared in to sections and re-mixed to properly distribute the water and bond.
- The lugs and ploughs are positioned to fragment gather and redirect the sand back under the Muller wheels.
- Some Muller is adjustable to account for change in the consistency of the sand.
- The Muller started off with light pressure. As the bond is built up and the sand becomes more resistant to compression and shear, the pressure is increased .the height of the mixture increases as the clay absorbs water and swells.

### 2.3. Typical mulling sequence

- Add all the base sand and any wood flour or cellulose.
- Mull for at least 30 seconds up to 2 minutes
- While continuing to mull, quickly and all the temper water continue to mull.
- When the water is well distributed, add the clay and continue to mull.
- Add any sea coal or carbons.
- Mull for an additional 3minutes ,finer sand may require longer mulling times to fully distribute the bond

| Self-Check -2 | True or false item |
|---|---|

**Directions:** write true if the statement is correct and false if the statement is not correct on the separated answer sheet

1. ______Most mulling equipment does not discharge prepared sand in its most flow able conditions.
2. ______small amount of foreign materials in the sand cannot be change on the quality of mould sand
3. ______ Some Muller is adjustable to account for change in the consistency of the sand.
4. ______ In the process of mixing sand and other ingredient, as the bond is built up and the sand becomes more resistant to compression and shear, the pressure of Muller is decreased.
5. ______ The final conditioning of the prepared sand is performed around moulding station.

***Note:* Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-3 | Regulating and Maintaining Material supply |
|---|---|

**3.1 concept of regulating and maintain material supply.**

- Clay, combustible material, return sand, and new sand must all be added consistently and in amounts indicated by sand test results.
- Some sand systems are run on a volumetric basis, while others are run on a weight basis.
- The preferred method is to add return sand and additives by weight, thus affording closer control.
- Water additions are controlled in a number of different ways.
- Some equipment samples the sand going into the Muller and bases water additions on testing those samples for heat and moisture content.
- Other water addition equipment samples the sand inside the Muller and adds additional amounts of water as needed. Still other systems use a combination of these.
- Regardless of the type of equipment used, a minimum of 80% of the total added water should go into the Muller immediately before the sand or at least with the sand to allow the maximum amount of time for cooling (if applicable) and/or clay activation and to provide the maximum control ..
- To provide more flow able sand at the pattern face, operators of manual moulding machines may, at the expense of time, riddle the first sand that enters the flask.
- In addition, again at the expense of time, an operator may even hand tuck the deeper pockets.
- Automatic moulding equipment affords little or no opportunity for this special treatment.
- For these reasons, each moulding station should be equipped with a good aerator to perform the final conditioning of the prepared sand.
- The aerator should be located on the last belt feeding the moulding equipment in order to avoid any subsequent pre packing of the aggregate.
- It is suggested that prepared sand always be conveyed to the moulding equipment by belt conveyors. Other methods of conveying sand have been known to introduce unwanted moisture into the aggregate or to scrub clay from the coated sand grains.
- Prepared sand systems should always be designed with the receiving hoppers large enough to accept the total amount of sand from the feeding equipment.
- For example, the prepared sand hopper at the moulding machine should always have enough capacity to receive all the sand from the Muller (or another hopper).

- Thus, belts can be kept running, minimizing the drying time of the prepared sand on the belt.
- In no case should sand that will be used for moulding be allowed to dry on a delivery belt.
- At best, this drying will be intermittent and will lead to inconsistent results at the moulding station.
- The requirements of dimensional stability and casting integrity do not tolerate poor or inconsistent control moulding sand.
- The old hand squeeze method of testing is not capable of controlling sand within the necessary specifications.
- Manual operation of the Muller can and does lead to incorrect assumptions and corrections.
- For example, sand that feels as though it does not have enough body indicates a system that is beginning to run low on clay.
- The operator is then likely to add additional water.

- When this additional water is added, the sand may seem to have the correct body, but in fact, it will have an excessive amount of moisture.
- Defects resulting from oxidation will increase, green sand pockets will be harder to fill, mould wall movement will increase and cause shrinkage defects, casting surfaces will become rougher and shakeout may become more difficult.
- Sand test samples should be taken at the point where the sand enters the moulding machine.
- Samples taken from other points, such as at the Muller discharge, will provide a false indication of production conditions.
- The properties tested often vary from foundry to foundry, as will the necessary frequency of testing.
- Those properties often include (but are not limited to) moisture content, active clay content, loss on ignition, grain size distribution, compression strength, permeability, and compact ability.
- In some cases, green shear and wet tensile tests are also performed.
- All these tests provide the operating personnel with useful information.
- It is recommended that green tensile tests be conducted along with the other tests. Green tensile strength does not follow the same conditions that apply to green compression and shear strength.
- Although not documented, tensile strength decreases more rapidly and earlier than the other strength properties.
- This combined with the fact that many moulding defects (stickers, drops, and so on) are the result of poor tensile strength, makes the test well worth running.
- The test has not found widespread use, probably because it is more difficult to conduct and it requires expensive additions to the sand test equipment.

- Fortunately, another test has been developed whose results have a numerical relationship to green tensile.
- This test is spalling (splitting) strength.

.

| Self-Check -3 | True false item |
|---|---|

**Directions: write true for correct statement and false for not correct statement**

1. _____Some sand systems are run on a volumetric basis, while others are run on a weight basis
2. _____ The moulding defects (stickers, drops, and so on) are the result of poor tensile Strength makes the test well worth running.
3. _____ Sand test samples should be taken at the point where the sand enters the moulding machine.
4. _____The first sand that enters the flasks should be coarser than the backing sand
5. _____ Green tensile strength does follow the same conditions that apply to green compression and shear strength.
6. _____The requirements of dimensional stability and casting integrity do not tolerate poor or inconsistent control moulding sand
7. _____ Manual operation of the Muller can and does lead to incorrect assumptions and Corrections.
8. _____ Automatic moulding equipment affords little or no opportunity for special treatment.

***Note:*** **Satisfactory rating – 9 points** **Unsatisfactory - below 9 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-4 | Reporting faults |
|---|---|

### 1.1 gas defects

- Too much oil in the mix .Dilute the mixture with fresh sand and dry petro bond powder. Mull it to proper green strength.
- Too much catalyst in the mix. If there is too much catalyst, then there is an increase in oil absorption .this gives the sand a dry feel. Do not add more oil to the sand .two ounces is the maximum for 5 pounds of dry binder.
- Gas defect occur when oil is 10%

### 4.2. Mould material casting defects and causes

- Cuts and washes. Cuts and washes are areas of excess metal.
- Fusion
- Run out
- Swells
- Drops
- Rat tails, veins and buckles.
- Metal penetration

| No | Defect | Root cause | Remedy |
|---|---|---|---|
| 1 | Blow holes | ✓ Excessive moisture content in moulding sand.<br>✓ Excessive use of organic binders. | ✓ Control of moisture content.<br>✓ Ram the mould less hard. |
| 2 | Drops | ✓ Low green strength in moulding sand and core. | ✓ Increase green strength of sand mould. |
| 3 | Swells | ✓ Low strength of mould and core. | ✓ Increase the strength of both mould and core. |

| Self-Check -4 | Written Test |
|---|---|

**Directions:** Directions: match the word under column "A" with column '' B" (10%)

| Column "A''. | Column ''B'' |
|---|---|
| 1. _____ Too much oil in the mix | A. Low green strength of mould and core. |
| 2. ______ Too much catalyst in the mix | B. Excessive moisture content in molding sand. |
| 3. ______ Drops | C. Low strength of mould and core |
| 4. ______ Blow holes | D. gives the sand a dry feel |
| 5. ______ Swells | E. Mull it to proper green strength. |

***Note:*** **Satisfactory rating –5 points** **Unsatisfactory – below 5 points**

You can ask you teacher for the copy of the correct answers.

| Operation Sheet- 1 | Mixing sand at the correct time and specifications |
|---|---|

**Mixing sand at the correct time and specifications**

**Step 1**- prepare the correct amount of sand, binders and additives

**Step 2**- check the machine performance

**Step 3-** Loading mixers
**Step 4**. Mixing sand and monitoring the process.
**Step 5**. Regulating and Maintaining Material supply
**Step 6**. Reporting faults

| LAP Test | Practical Demonstration |
|---|---|

Name: ________________________________ Date: ________________

Time started: __________________________ Time finished: ________________

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

**Task 1.** Prepare the correct amount of sand binders and additives for the required mold.

**Task 2.** Loading the mixer and mix the sand.

# List of Reference Materials


1. Rajender Singh (2006), introduction to manufacturing processes and work shop technology,.
2. The ASM Handbook Committee, casting volume 15 9th Edition'
3. H.N Gupta ,manufacturing processes second edition, newdelhi,2009.
4. Stephen D.chastain, metal casting :a sand casting manual for small foundry vol.1,USA 2004
5. Baylor university, ( January 6, 2016),shop safety manual , *Published by the Department of Environmental Health & Safety*
6. https://www.youtube.com/watch?v=cwDqjmSmtMQ
7. https://www.youtube.com/watch?v=BPM3PVSUlms
8. https://www.youtube.com/watch?v=VaNloZa0W-A
9. https://www.youtube.com/watch?v=l0RzJmUWdsY

# Foundry work

## Level-II

# Learning Guide-19

| | |
|---|---|
| **Unit of Competence** | **Prepare and Mix Sand for molding and Core Making** |
| **Module Title** | **Preparing and Mixing Sand for Molding and Core Making** |
| **LG Code** | **IND FDW2 M6 0919 LO1-LG-19 TTLM** |
| **TTLM Code** | **IND FDW2 M6 0919 TTLM 0919v1** |
| **LO 3** | **Test samples** |

| Instruction Sheet | Learning Guide 19 |
|---|---|

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- extracting samples
- Applying test
- Comparing test result
- Making adjustments formula/mix

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:

- Extract Sample properly and correctly by observing safety measures
- Apply test in accordance with standard operating procedures
- Compare Test results against specifications
- Make adjustments to formula/mix as required in accordance with standard operating procedures

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3,and Sheet 4
4. Accomplish the “Self-check 1, Self-check 2, Self-check 3 and Self-check 4” respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -54-57**
6. Do the “LAP test” **in page – 57** (if you are ready).

| Information Sheet-1 | Extracting sample |
| --- | --- |

## 1.1. Introduction to mold sand testing

- Molding sand and core sand depend *upon shape,* ***size composition and distribution of sand grains***, amount of clay, moisture and additives.
- The increase in demand for good surface ***finish and higher accuracy*** in castings necessitates certainty in the quality of mould and core sands.
- Sand testing often allows the use of less expensive local sands. It also ensures reliable sand mixing and enables a utilization of the inherent properties of molding sand.
- Sand testing on delivery will immediately detect any variation from the standard quality, and adjustment of the sand mixture to specific requirements so that the casting defects can be minimized.
- It allows the choice of sand mixtures to give a desired surface finish.
- Thus sand testing is one of the dominating factors in foundry and pays for itself by obtaining lower per unit cost and increased production resulting from sound castings.
- Generally the following tests are performed to judge the molding and casting characteristics of foundry sands:
    - ✓ Moisture content Test
    - ✓ Clay content Test
    - ✓ Chemical composition of sand
    - ✓ Grain shape and surface texture of sand.
    - ✓ Grain size distribution of sand
    - ✓ Specific surface of sand grains
    - ✓ Water absorption capacity of sand
    - ✓ Refractoriness of sand
    - ✓ Strength Test
    - ✓ Permeability Test
    - ✓ Flow ability Test
    - ✓ Shatter index Test
    - ✓ Mould hardness Test.

## 1.2 Sample preparation

- When preparing a number of specimens from the same sample, replace the lid of the container after weighing out each specimen.
- Carefully level out the sand surface in the specimen tube before placing under the plunger of the Standard Rammer.
- Never use sand which has ***already been rammed*** up once to form a specimen.

- Always ensure that the height of a specimen is correct, that is within the tolerance specified.
- Reject any specimen which shows any sign of damage.
- Green sands should be ***tested immediately***; dried or baked sands as soon as they have ***cooled*** in a desiccators and with cured sands the length of time between curing and testing should be stated when reporting results.
- Any deviation from standard ramming practice should be reported with results.

| **Self-Check -1** | **True false item** |
|---|---|

**Directions: write true if the statement is correct and false if the statement is not correct on the separated answer sheet. (10 points)**

1. _______mold sand test detects any variation from the standard quality.
2. _______in the process of sample preparation we can use sand which has already been rammed up once to form a specimen.
3. _______ Green sands should be tested immediately were as dried or baked sands as soon as they have cooled.
4. _______Sand testing often allows the use of less expensive local sands.
5. _______while preparing samples each sample or specimen differs from each other.

**Part II matching**

Instruction: matches the word phrase under column "A'' with the word or phrase which have similar meaning under column "B" (6%)

| **Column A** | **Column B** |
|---|---|
| 1. _____Mold and core sand depends on | A. specimen |
| 2. _____sample | B. brings quality of mould and casting |
| 3. _____Molding sand test | C. shape, size composition and distribution of Sand grains, amount of clay, moisture and additives |

***Note:*** **Satisfactory rating 8 and above points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-2 | Applying Test |
|---|---|

## 2.1. Introduction

**Foundry sand testing** is a process used to determine if the **foundry sand** has the correct properties for a certain **casting** process. The **sand** is used to make moulds and cores via a pattern. The defects arising from the **sand** can be prevented by using **sand testing** equipment to measure the various properties of the **sand.**

## 2.2. Concept of specimen testing

- Handle specimens carefully.
- Always test three specimens and report the average result.
- For research work never use the same specimen for two different tests, i.e., Permeability and Compression Tests.
- Always follow the instructions with regard to rate and method of applying load to specimens ex, the Hand Operated Universal Sand Strength Machine should be loaded evenly at the rate of 7.5 psi compression in 15 seconds.

## 2.3. Test method

- **Moisture Content Test**
  - ✓ The moisture content of the molding sand mixture may determined by drying a weighed amount of 20 to 50 grams of molding sand to a constant temperature up to 100°C in a oven for about one hour.
  - ✓ It is then cooled to a room temperature and then reweighing the molding sand.
  - ✓ The moisture content in molding sand is thus evaporated.
  - ✓ The loss in weight of molding sand due to loss of moisture, gives the amount of moisture which can be expressed as a percentage of the original sand sample.
  - ✓ The percentage of moisture content in the molding sand can also be determined in fact more speedily by an instrument known as a speedy moisture teller.
  - ✓ This instrument is based on the principle that when water and calcium carbide react, they form acetylene gas which can be measured and this will be directly proportional to the moisture content.
  - ✓ This instrument is provided with a pressure gauge calibrated to read directly the percentage of moisture present in the moulding sand. Some moisture testing instruments are based on principle that the electrical conductivity of sand varies with moisture content in it.

- **Clay Content Test**
  - ✓ The amount of clay is determined by carrying out the clay content test in which clay in molding sand of 50 grams is defined as particles which when suspended in water, fail to settle at the rate of one inch per min. Clay consists of particles less than 20 micron, per 0.0008 inch in dia.

- **Grain Fineness Test**
  - ✓ For carry out grain fineness test a sample of dry silica sand weighing 50 gms free from clay is placed on a top most sieve bearing U.S. series equivalent number 6.
  - ✓ A set of eleven sieves having U.S. Bureau of standard meshes 6, 12, 20, 30, 40, 50, 70, 100, 140, 200 and 270 are mounted on a mechanical shaker (Fig. 12.1).
  - ✓ The series are placed in order of fineness from top to bottom.
  - ✓ The free silica sand sample is shacked in a mechanical shaker for about 15 minutes.
  - ✓ After this weight of sand retained in each sieve is obtained sand and the retained sand in each sieve is multiplied by 2 which gives % of weight retained by each sieve.
  - ✓ The same is further multiplied by a multiplying factor and total product is obtained.
  - ✓ It is then divided by total % sand retained by different sieves which will give G.F.N.
- **Refractoriness Test**
  - ✓ The refractoriness of the moulding sand is judged by heating the American Foundry Society (A.F.S) standard sand specimen to very high temperatures ranges depending upon the type of sand.
  - ✓ The heated sand test pieces are cooled to room temperature and examined under a microscope for surface characteristics or by scratching it with a steel needle.
  - ✓ If the silica sand grains remain sharply defined and easily give way to the needle.
  - ✓ Sintering has not yet set in. In the actual experiment the sand specimen in a porcelain boat is placed into an electric furnace.
  - ✓ It is usual practice to start the test from l000°C and raise the temperature in steps of 100°C to 1300°C and in steps of 50° above 1300°C till sintering of the silica sand grains takes place.
  - ✓ At each temperature level, it is kept for at least three minutes and then taken out from the oven for examination under a microscope for evaluating surface characteristics or by scratching it with a steel needle.
- **Strength Test**
  - ✓ Green strength and dry strength is the holding power of the various bonding materials.
  - ✓ Generally green compression strength test is performed on the specimen of green sand (wet condition).
  - ✓ The sample specimen may of green sand or dry sand which is placed in lugs and compressive force is applied slowly by hand wheel until the specimen breaks.
  - ✓ The reading of the needle of high pressure and low pressure manometer indicates the compressive strength of the specimen in $kgf/cm^2$.
  - ✓ The most commonly test performed is compression test which is carried out in a compression sand testing machine (Fig. 2.1).
  - ✓ Tensile, shear and transverse tests are also sometimes performed. Such tests are performed in strength tester using hydraulic press.

- ✓ The monometers are graduated in different scales. Generally sand mixtures are tested for their compressive strength; shear strength, tensile strength and bending strength.
- ✓ For carrying out these tests on green sand sufficient rammed samples are prepared to use.
- ✓ Although the shape of the test specimen differs a lot according to the nature of the test for all types of the strength tests can be prepared with the of a typical rammer and its accessories.
- ✓ To prepare cylindrical specimen bearing 50.8 mm diameter with for testing green sand, a defined amount of sand is weighed which will be compressed to height of 50.8 mm. by three repeated rammings.
- ✓ The predetermined amount of weighed molding sand is poured into the ram tube mounted on the bottom.
- ✓ Weight is lifted by means of the hand lever and the tube filled with sand is placed on the apparatus and the ramming unit is allowed to come down slowly to its original position.
- ✓ Three blows are given on the sample by allowing the rammer weight to fall by turning the lever.
- ✓ After the three blows the mark on the ram rod should lie between the markings on the stand.
- ✓ The rammed specimen is removed from the tube by means a pusher rod.
- ✓ The process of preparing sand specimen for testing dry sand is similar to the process as prepared before, with the difference that a split ram tube is used.
- ✓ The specimen for testing bending strength is of a square cross section.
- ✓ The various tests can be performed on strength tester.
- ✓ The apparatus can be compared with horizontal hydraulic press.
- ✓ Oil pressure is created by the hand-wheel and the pressure developed can be measured by two pressure manometers.
- ✓ The hydraulic pressure pushes the plunger.
- ✓ The adjusting cock serves to connect the two manometers.
- ✓ Deformation can be measured on the dial.

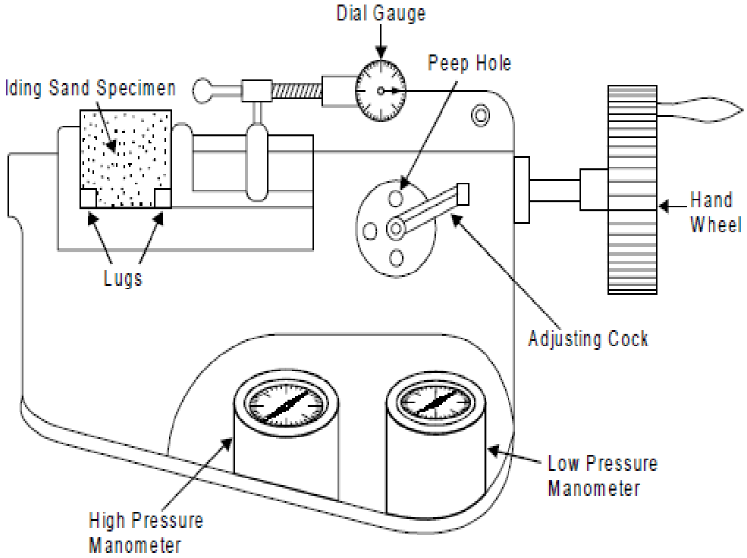


Figure 2.1 Strength testing machine

- ✓ The compression strength of the moulding sand is determined by placing standard specimen at specified location and the load is applied on the standard sand specimen to compress it by uniform increasing load using rotating the hand wheel of compression strength testing setup.
- ✓ As soon as the sand specimen fractures for break, the compression strength is measured by the manometer.
- ✓ Also, other strength tests can be conducted by adopting special types of specimen holding accessories.
- ✓

- **Permeability Test**

  - ✓ Initially a predetermined amount of moulding sand is being kept in a standard cylindrical tube, and the moulding sand is compressed using slightly tapered standard ram till the cylindrical standard sand specimen having 50.8mm diameter with 50.8 mm height is made and it is then extracted.
  - ✓ This specimen is used for testing the permeability or porosity of moulding and the core sand.

  - ✓ This test is applied for testing porosity of the standard sand specimen.
  - ✓ The test is performed in a permeability meter Fig. 2.2 which permits to read the permeability directly.
  - ✓ The permeability test apparatus comprises of a cylinder and another concentric cylinder inside the outer cylinder and the space between the two concentric cylinders is filled with water.
  - ✓ A bell having a diameter larger than that of the inner cylinder but smaller than that of outer cylinder, rests on the surface of water.

- ✓ Standard sand specimen of 5.08 mm diameter and 50.8 mm height together with ram tube is placed on the tapered nose piece of the permeability meter.
- ✓ The bell is allowed to sink under its own weight by the help of multi-position cock.
- ✓ In this way the air of the bell streams through the nozzle of nosepiece and the permeability is directly measured.
- ✓ Permeability is volume of air (in $cm^3$) passing through a sand specimen of 1 $cm^2$ cross-sectional area and 1 cm height, at a pressure difference of 1 $gm/cm^2$ in one minute.
- ✓ In general, permeability is expressed as a number and can be calculated from the relation
  - o P = vh/pat

  Where, P = permeability
  v = volume of air passing through the specimen in c.c.
  h = height of specimen in cm
  p = pressure of air in $gm/cm^2$
  a = cross-sectional area of the specimen in $cm^2$
  t = time in minutes.
- ✓ For A.F S. standard permeability meter, 2000 cc of air is passed through a sand specimen (5.08 cm in height and 20.268 sq. cm. in cross-sectional area) at a pressure of 10 $gms/cm^2$ and the total time measured is 10 seconds = 1/6 min.
- ✓ Then the permeability is calculated using the relationship as given as under.
  P = (2000 × 5.08) / (10 × 20.268 × (1/6)) = 300.66 App.

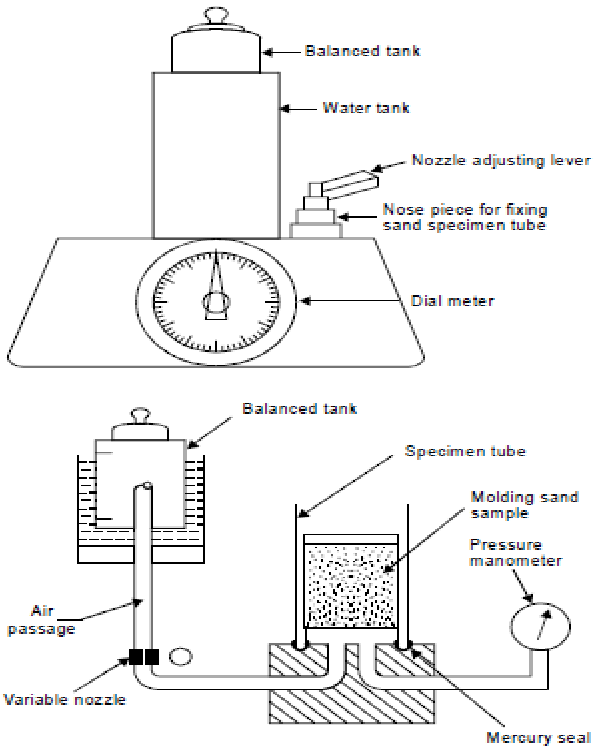


Figure: 2.2 Permeability meter

**Flow ability Test**

- Flow ability of the moulding and core sand usually determined by the movement of the rammer plunger between the fourth and fifth drops and is indicated in percentages.

- This reading can directly be taken on the dial of the flow indicator.
- Then the stem of this indicator rests again top of the plunger of the rammer and it records the actual movement of the plunger between the fourth and fifth drops.

| Self-Check -2 | Matching |
|---|---|

**Directions:** matches the word phrase under column "A'' with the word or phrase which have similar meaning under column "B" (10%)

| **Column "A"** | **column "B"** |
|---|---|
| 1. _____Green strength | A. drying molding sand &reweighing |
| 2. _____Refractoriness test | B. done by placing silica sand on the sieve & shaking it. |
| 3. _____Grain fitness test | C. done by heating specimen to very high temperature range |
| 4. _____Moisture content | D. the holding power of the various bonding materials |
| 5. ____ Tensile, shear and | E. strength tester using hydraulic press transverse tests |

***Note:*** **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-3 | Comparing test results. |
| --- | --- |

***3.1 Methods of comparing test result***

- Of utmost importance in controlling a green sand system is the selection and consistency of the raw materials introduced into the system sand.
- Acquisition of the basic raw materials should be from reputable sources only, that is, those that have ***ongoing quality improvement programs***, including the understanding and application of statistical process control techniques.
- This is critical for a successful control program: Inconsistency in the raw materials used in the system results in sand variations that no amount of attention or corrective action can overcome.
- Next in importance is the **condition** of the sand ***processing equipment***.
- This includes the sand Muller or mixer, sand cooling equipment, and dust collection equipment.
- It is important to coat the individual sand grains with a uniform thickness of the bonding agent; this governs the physical property development of the sand.
- The coating action, in turn, is controlled by the condition of the mixing and/or the Muller equipment.
- Failure to monitor the equipment and to maintain it adds appreciably to variations in the sand and a loss of casting quality.
- Third is the identification of the critical primary and secondary control parameters.
- The primary control parameters for a system sand are:
- Determination of the ***organic components*** measured by the total combustible and/or percent volatile tests
- Determination of clay content measured by the methylene blue titration method
- Percent compact ability of the sand controlled by the molding machine
- For the majority of foundries, primary controls are limited to the system clay and the content of water and carbonaceous material
- Actual sampling of system sand should be accomplished as close to the point in time of use as is practical without compromising worker safety.
- By so doing, corrective actions can be carried out prior to the molding operation.
- The clay content of the system sand is normally measured by the methylene blue titration method.
- This method of determining clay content is based on the ability of a test sample of the system sand to absorb the methylene blue dye.
- In this test, the dye is added to the test sample by a buret.
- Clay control can be enhanced by close monitoring of clay additions.
- Simply knowing what goes into the sand can result in a significant reduction in system sand variations.

| Self-Check -3 | Written Test |
|---|---|

**Directions:** : matches the word phrase under column "A'' with the word or phrase which have similar meaning under column "B" (8 %)

| **Column A** | **Column B** |
|---|---|
| 1. ____Coat the individual sand grains | A. measured by the methylene blue titration method |
| 2. ____The coating action | B. controlled by the condition of the mixing and/or Muller |
| 3.______The primary control parameters | C. Governs the physical property development of the sand for a system sand |
| 4______ clay content | D. Determination of the organic components |

***Note:*** **Satisfactory rating – 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-4 | Making adjustments formula/mix. |
| --- | --- |

### *4.1 Raw Material Additions*

- The sand in a green sand molding system is primarily made up of recycled, reclaimed, and reused sand.
- The rejuvenation (upgrade) of this sand is the principal function of the sand preparation system.
- Sand for the green sand molding system is recovered from the shakeout, cooled, cleaned, and screened.
- New sand is added to compensate for that which has been lost from spillage or carried away in deep pockets of the casting.
- Clay, water, and other additives are introduced to bring the sand mix to specification.

### 1.2 Maintain Sand System Quality.

- Because the system sand is basically made up of recycled sand, it consists not only of mold sand, but also of core sand.
- The size and shape of core sand, and the binders used for core sands, are frequently quite different from those used for molding sands, and this must be considered for maintaining the sand system.
- Also, over time, the sand in the system breaks down as a result of mechanical attrition and thermal cycling, and therefore changes in size, size distribution, and shape.
- Daily variations in the product mix affect the ratio of core sand to molding sand being recycled.
- Raw or virgin sand additions to the system should be made to dilute the contaminating effects of residual core binders.
- The introduction of additives to system sand based on a programmed approach greatly reduces system variations.
- Additives are consumed at identifiable rates. Core sand dilution can be determined as well as any raw virgin sand additions.
- Losses due to sand carry-out, dust collection loss and material handling can be calculated or approximated.
- By monitoring sand system variations, a predictable quantity of bonding material can be determined and added to the system.
- This approach helps minimize system variations and also reduces the necessity for clay analysis as a control tool.
- New or reclaimed sand additions to system sand are of critical importance.
- Their most important function is to reduce the concentration of contaminants in the system sand.

- The origin of these contaminants may be alloy by-products or contamination from a core process.
- A second function is to maintain the total system volume.
- All ingredients added to system sand should be added gravimetrically.
- Volumetric or timed additions of dry additives are generally not consistent enough to ensure adequate control and only contribute to overall consistency problems.
- This applies to the addition of new or reclaimed sand as well as to the return system sand for a batch system.
- Most system sands contain additives other than clays; monitoring those additions is critical to the production of quality castings.
- Carbon additives are either single- or multiple-component.
- The relative concentration of the carbon additive must remain constant for a laboratory-derived measurement to be of any value.
- For example, casting finish produced in a system sand with a total combustible value of 3.50% derived from a carbon additive based totally on sea coal can differ drastically from a similar system sand with an equivalent total combustible value derived from a multiple-component carbon additive.
- In cases in which the benefits can be justified, the use of pre blended sand additives is recommended.
- Compatibility is the only physical characteristic of system sand that a molding machine realizes, and it is of paramount importance that it be controlled within a tight band.
- The desired range will be specific to each foundry.
- The range chosen should allow optimum strength of the clay as well as adequate moisture levels to minimize sand friability while satisfying the requirements of the molding equipment.
- The secondary control parameters are as important as the primary, but must be looked at over a period of time.
- It is necessary to realize that problems develop gradually in system sand.
- The specific secondary tests that should be run on system sand include green compressive strength, permeability, moisture, AFS clay, screen distribution, and AFS washed fineness tests.
- While testing system sand is very important, of equal importance is knowledgeable and responsible review of the data and corrective actions when necessary.
- Routine review of all test results should include representation from all the various disciplines within the foundry.
- Included in the control program for a green sand system should be routine monitoring of the dust collection system.
- In addition, tangible operational advantages result from sand reclamation.
- These begin with the ability to select the best sand for the casting process, knowing that most of it will be reclaimed during operation.
- In addition, the use of reclaimed sand reduces the number of variables that must be controlled, and provides operational consistency over a period of time.
- Sand grain shape and distribution and binder system bonding are more uniform, thus reducing sand defects.

| Self-Check -4 | True false item |
|---|---|

**Directions:** write true if the statement is correct and false if the statement is not correct on the separated answer sheet.(12%)

1. _____The size and shape of core sand, and the binders used for core sands, are frequently quite different)
2. _____ The sand in a green sand molding system is primarily made up of recycled, reclaimed, and reused sand.
3. _____New or reclaimed sand additions to system sand are not critical importance.
4. _____Routine review of all test results should include representation from all the various disciplines within the foundry.
5. _____New or reclaimed sand additions to system sand is to increase the concentration of contaminants in the system sand
6. _____ Sand grain shape and distribution and binder system bonding are more uniform, thus reducing sand defects.

***Note:*** **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

| Operation Sheet-1 | Sample preparation |
|---|---|

- Sample preparation for moisture content, strength, Grain Fineness refractoriness , Flow ability, Permeability Test

**Step 1 -**prepare 3 specimens for each test.

**Step 2-** perform pretreatment of sample for the required test.

| Operation Sheet-2 | compression strength test |
|---|---|

**Testing procedure**

1. Conduct the experiment in two parts:
    - Vary the clay content keeping the water content constant
    - Vary the water content keeping the clay content constant
2. Take weighed proportions of sand and clay and dry mix them together in a Muller for 3minutes.
3. Adjust the weight of the sand to get standard specimen
4. Remove the standard specimen by the stripper and place it between shackles which are fixed in the sand testing machine.
5. Rotate the handle of the testing machine to actuate the ram. Thus, hydraulic pressure is applied continuously till the specimen aptures.
6. Read the compression strength from the gauge and record the same.
7. Conduct the experiment for the above said two cases and tabulate the result.

| Operation Sheet-3 | **Shear strength test** |
|---|---|

**Procedure**

1. Conduct the experiment in two parts:
   - Vary the clay content keeping the water content constant
   - Vary the water content keeping the clay content constant
2. Take weighed amount of foundry sand (mixture of sand, clay & water as specified).
3. Transfer the sand mixture into the tube and ram it with the help of a sand rammer thrice.
4. Fix the shackles to the universal sand testing machine.
5. Remove the specimen from the tube with the help of a stripper and load it into the universal sand testing machine.
6. Apply the hydraulic pressure by rotating the handle of the universal sand testing machine continuously until the specimen ruptures.
7. Read the shear strength directly from the scale and tabulate the readings.

| Operation Sheet-4 | tensile strength test |
|---|---|

**Procedure:**

1. Conduct the experiment in two parts.
   - ✓ Using core oil as binder and
   - ✓ Using sodium silicate as binder.
2. Take proper proportions of base sand and binder then mix them together thoroughly.
3. Assembly the core box and fill the mixture in to it.
4. Place the core box under sand rammer and ram the sand thrice.
5. Using a wooden piece tap the core box gently from sides. Remove the core box leaving the rammed core on a flat metal plate
6. Bake the specimen (which is on a plate) for about 30 minutes at a temperature of $150^{O}$ – $200^{O}$ C in an oven. (When the binder is core oil)
7. If the binder is sodium silicate, pass Co2 gas for 5 seconds. The core hardens instantly and the core can be directly used.
8. Fix the tension shackles on to the sand testing machine, and place the hardened specimen

| Operation Sheet-5 | permeability test |
|---|---|

**Procedure:**

1. Conduct the experiment in two parts. In the first case vary water percent keeping clay percent constant. In the second case vary clay percent and keep water percent constant.
2. Take weighed proportions of sand dry mix them together for 3 minutes. Then add required proportions of water and wet mix for another 2 minutes, to get a homogeneous and mixture. Take the total weight of the mixture between 150-200 grams. The correct weight has to be determined by trial and error method.
3. Fill the sand mixture into the specimen tube and ram thrice using sand rammer. Use the tolerance limit provided at the top end of the rammer for checking the specimen size.
4. Now the prepared standard specimen is having a dia.50.8mm and height50.8mm.
5. Place the standard specimen along with the tube in the inverted position on the rubber seal or on the mercury cup (specimen in the top position in the manometer reading).
6. Operate the valve and start the stop watch simultaneously. When the zero mark on the inverted jar just touches the top of water tank, note down the manometer reading.

7. Note down the time required to pass 2000cc of air through the specimen. Calculate the permeability number by using the formula given.

- **Direct scale reading:**
  - ✓ The permeability can also be determined by making use of the graduated marker provided near the manometer.
- **Procedure to be followed:**
  - ✓ Coincide the graduations on the transparent scale with the meniscus of the manometer liquid.
  - ✓ Note the reading of the scale.
  - ✓ This reading represents the permeability number of the sand.

| Operation Sheet-6 | Clay content test |
|---|---|

**Procedure:**

1. Take 100g of base sand in a wash bottle and add 475ml of distilled water and 25ml of NaOH solution to it.
2. **.** Using the mechanical stirrer, stir the mixture for about 5 minutes adds distilled water to make up the level to 6"height. Stir the mixture again for 2 minutes. Now allow the content of the bottle to settle down.
3. Siphon out 5" level of unclean water using a standard siphon.
4. Add distilled water again up to 6" height and stir the content again. Allow the mixture to settle down for5 minutes
5. . Siphon out 5" level of water from the bottom of the bottle.
6. Repeat the above procedure for 3-4times till the water becomes clear in the wash bottle.
7. Transfer the wet sand from the bottle in to a tray and dry in it in an oven at 110 o C to remove moisture. Note down the dry sand weight accurately. Using the calculations find percentage of clay.

| LAP Test 1 | Practical Demonstration |
|---|---|

Name: _________________________________ Date: __________________

Time started: ___________________________ Time finished: __________________

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

**Task 1-** prepare test sample.

**Task 2**- perform compression strength test, clay content test testing, moisture test Shear strength test of samples.

## List of Reference Materials


1. The ASM Handbook Committee, casting volume 15 9th Edition'
2. H.N Gupta , manufacturing processes second edition, newdelhi, 2009.
3. Stephen D.chastain, metal casting :a sand casting manual for small foundry vol.1,USA 2004
4. jss mahavidyapeetha jss science & technology university , Foundry and Forging Laboratory Manual
5. Foundry sand testing equipment operating instructions, Dietert Foundry Testing Equipment Inc. Detroit, USA www.basrid.co.uk
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# Foundry work

## Level-II

# Learning Guide-20

| | |
|---|---|
| **Unit of Competence** | **Prepare and Mix Sand for molding and Core Making** |
| **Module Title** | **Preparing and Mixing Sand for molding and Core Making** |
| **LG Code** | **IND FDW2 M6 1019 LO1-LG-20** |
| **TTLM Code** | **IND FDW2 M6 0919 TTLM 1019v1** |
| **LO 4** | **Discharge mixture** |

| Instruction Sheet | Learning Guide 20 |
|---|---|

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Charging Load correctly and timely.
- Disposing unwanted treated sand.
- Completing appropriate documentation.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:

- Charge load is correctly and timely according to standard operating procedures
- Dispose unwanted treated sand is of according to standard operating procedures and safety measures.
- Complete appropriate documentation is per workplace procedures

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5".
4. Accomplish the "Self-check 1, Self-check t 2, Self-check 3 and Self-check 4" **in page -63, 67, and 69** respectively.
5. If you earned a satisfactory evaluation from the "Self-check" proceed to "Operation Sheet 1" and operation 2. **In page -70**
6. Do the "LAP test" **in page – 71**(if you are ready).

| Information Sheet-1 | Charging Load correctly and timely. |
|---|---|

## 1 .1 Foundry sand charging method

- ✓ Various types of blending equipment are used to disperse the binders uniformly over the sand used in the other processes.
- ✓ Batch or continuous mixers can be employed to coat the sand used in the cold or heat-activated processes.
- ✓ If a batch mixer is used, the sand and additives are ***weighed or volumetrically measured*** before being introduced into a mix.
- ✓ There the mixture is agitated by a revolving mixer or by vibratory motion for 20 s to 5 min.
- ✓ Prepared sand is then discharged and transferred to the core making station.
- ✓ A continuous mixer is almost a necessity for a no-bake core making operation, but is also adequate for mixing sand for the cold or heat-activated processes, with the exception of the shell process.
- ✓ Sand and additives are continuously metered into a mixing trough or chamber that contains revolving mixers of various designs, and prepared sand is discharged.
- ✓ In the no bake process, the sand is discharged directly into the core box, where it is immediately compacted. Prepared sand for the cold and heat-activated processes is generally discharged into a storage hopper above a core making machine.

## 1.3 Procedures for charging load

- In most cases, sand is fed into the Muller in a regulated, continuous stream, and discharge is controlled based on the power draw of the Muller motor.
- As explained, to bond the sand particles together additives, such as water, fire clay, are needed to be added.
- All of the ingredients are required to be mixed again if the mixture has been used or new additives were refilled.
- For mass production, sand Muller is employed to prepare green sand mixture whereas sand mixer is Used for small scale production
- As power draw reaches a predetermined level, the discharge door opens for a short period, allowing some of the sand to leave the Muller.
- On average, sand will pass through both bowls twice before it is ejected. It is possible, however, that a small percentage of sand will pass directly from the input to the exit in one pass.
- This type of Muller is designed to produce large quantities of sand continuously.
- In a continuous Muller the sand is fed to the Muller into one bowl, and it exits through a door in the other bowl.
- Thus the adequate mulling economizes the use of binders.

- As discussed in learning guide two information one there are two methods of adding clay and water to sand.
- In the first method, first water is added to sand follow by clay, while in the other method, clay addition is followed water.
- It has been suggested that the best order of adding ingredients to clay bonded sand is ***sand with water*** followed by the ***binders***.
- In this way, the clay is more quickly and uniformly spread on to all the sand grains.
- An additional advantage of this mixing order is that ***less dust is produced*** during the mulling operation.
- The Muller usually consists of a cylindrical pan in which two heavy rollers; carrying two ploughs, and roll in a circular path.
- While the rollers roll, the ploughs scrap the sand from the sides and the bottom of the pan and place it in front of For producing a smearing action in the sand, the rollers are set slightly off the true radius and they move out of the rollers can be moved up and down without difficulty mounted on rocker arms.
- After the mulling is completed sand can be discharged through a door.
- The mechanical aerators are generally used for aerating or separating the sand grains by increasing the flow ability through whirling the sand at a high speed by an impeller towards the inner walls of the casting.
- Aerating can also be done by riddling the sand mixture oil on a one fourth inch mesh screen or by spraying the sand over the sand heap by flipping the shovels.
- The aeration separates the sand grains and leaves each grain free to flow in the direction of ramming with less friction.
- The final step in sand conditioning is the cooling of sand mixture because of the fact that if the moulding sand mixture is hot, it will cause moulding difficulties.
-

| **Self-Check -1** | **True false item** |
|---|---|

**Directions: write true if the statement is correct and false if the statement is not correct on the separated answer sheet** (10%)

1. ______ sand mixer is Used mass production
2. _____Small percentage of sand will pass directly from the input to the exit in one pass.
3. ______The final step in sand conditioning is the cooling of sand mixture
4. ______The best order of adding ingredients to clay bonded sand is sand with binders followed by the Water.
5. ______If a batch mixer is used; the sand and additives are *weighed or volumetrically measured* before being introduced into a mix.

***Note:*** **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-2 | Disposing unwanted treated sand. |
|---|---|

### 2.1 Concept disposing unwanted treated sand

Nationally, only two percent of **foundry sand** is considered **hazardous**. The remaining 98 percent is a non-**hazardous** industrial by-product that can be reused in a variety of products or disposed of in non-**hazardous** landfills

Mould release agents can contain ***organic solvents and binders*** and ***chlorinated*** substances.
The use of these agents should be reviewed against less harmful alternatives
Green sand moulding methods ***release dust*** during mixing.
This should be extracted and collected and then treated in a suitable air-cleaning unit.

- ✓ Resin bonded processes use a variety of resins and catalysts.
- ✓ The cold box method uses a gaseous catalyst, such as ***amine*** or ***sulphur dioxide***, which must be collected in a suitable scrubbing unit.

### 2.2. Method of disposal

- Recommended prevention and control of sand waste includes the following.

  - ✓ External ***re-use*** of sand waste should be considered, (e.g. as ***concrete and paving materials, and for brick*** manufacturing, concrete backfill, and construction fill)
  - ✓ Green foundry sand should be reused once it is removed from the metal piece and regenerated.
  - ✓ Sand recovery methods consist of primary (e.g. vibration, rotating drum or shot blasting) and secondary regeneration (e.g. processing of the sand to remove residual binders, as well as cold mechanical and themal treatments, or wet scrubbing.
  - ✓ ***Thermal*** treatment units are used to reclaim chemically bonded sand.

- **Releases into water**

Aqueous waste may contain:

- ✓ inorganic metal compounds
- ✓ organic compounds
- ✓ Particulate matter.

Process waters, emergency fire water and chemically contaminated water should be contained and discharged to the sewer after gaining approval from SA Water.
If sewer disposal is not possible then these waste streams should be kept separate for easier management and may have to be removed from the premises by a contractor licensed to carry this waste.
The amount of process water used in foundries is small, comprising principally:

- ✓ discharge and blow down from wet scrubbers
- ✓ cooling water, often containing biocides and anti-oxidants
- ✓ Leach ate from slag and waste tips.
- ✓ Process water is not suitable for discharge to the storm water system.
- ✓ Minimising the use of water and the level of pollutants in each wastewater stream are the primary aims, followed by the recycling of wastewater streams whenever possible.
- ✓ Runoff from open areas, but in particular from raw material stocking areas, will contain suspended solids that will have to be removed by settlement or other techniques prior to disposal to any off-site storm water system.
- ✓ Oil interceptors may be necessary in drainage from scrap handling areas.
- ✓ Drainage sumps should be of sufficient capacity to handle storm water and should be designed to handle storm surge in order to prevent carryover of unsettled material to storm water systems.
- ✓ Bunding is a sensible precaution in most cases. It is essential in many cases where there is a risk to controlled waters, sewers and drains and on-site effluent treatment plants.
- ✓ Shared bunds are possible in cases where the materials stored are not incompatible..
- ✓ Areas where spillage is most likely to occur, such as storage tanks and sampling points, should be bounded and drain to sumps.
- ✓ Wastes collected in bunds should generally be considered contaminated and not suitable for discharge to the storm water system.
- ✓ The composition of any wastes collected should be determined prior to treatment or disposal.
- ✓ Bunds not frequently inspected should be fitted with a high level probe and an alarm where appropriate.
- ✓ The integrity of storage tanks and bunds should be checked and documented regularly, particularly where corrosive substances are involved.
- ✓ Procedures for preventing unauthorised discharges or leakage from bunds should be in place.
- ✓ Where it is considered inappropriate to bund a particular storage tank or process vessel, the foundry must justify this approach.

- **Wastes to landfill**

  - ✓ The foundry should identify the key pollutants likely to be present in wastes to landfill, using knowledge of the materials used in production and plant maintenance. All of the dust and slags arising from the process should be identified, and should be validated as necessary by appropriate analytical techniques and material safety data sheets.

- ✓ The presence of materials created by abnormal operation should also be identified, since process abnormalities can carry substances normally not present through into solid waste.

- ***Used foundry sand (UFS)***

  - ✓ Sand is the primary constituent of moulds and cores used in the production of both ferrous and non-ferrous castings. In most foundries the majority of UFS is disposed to landfill.
  - ✓ Depending on the binding agents used to make the moulds and cores, a number of sand reclamation and internal recycling options exist.
  - ✓ These options should be considered where feasible.
  - ✓ Similarly, options for the recycling of used foundry sand for external applications, such as a component of road base or other suitable means of reuse, should also be considered.
  - ✓ Foundry operators need to show they are aware of their discharges and have the necessary documented evidence in place to show these are monitored on a regular basis.
  - ✓ The management of environmental information can be greatly assisted by the implementation of an environmental management system (EMS).
  - ✓ An EMS provides a structured means of managing environmental impacts and is the first step towards environmental improvement—an EMS benchmarks environmental performance and then continually evaluates improvement.

- **Sand Waste**

  - ✓ Sand waste from foundries using sand moulds is a significant waste by volume.
  - ✓ Moulding and core sand make up 65 to 80 percent of the total waste from ferrous foundries.
  - ✓ Sand that is chemically bound to make cores or shell moulds is more difficult to reuse effectively and may be removed as waste after a single use.
  - ✓ Sand wastes from brass and bronze foundries are often hazardous and should be disposed of accordingly.

| Self-Check -2 | True false item |
|---|---|

**Directions: write true if the statement is correct and false if the statement is not correct on the separated answer sheet (6%)**:

1. ______In most foundries the majority of used foundry sand is disposed to landfill
2. ______Sand that is chemically bound to make cores or shell moulds is more difficult to reuse effectively and may be removed as waste after a single use.
3. ______Process water is not suitable for discharge to the storm water system.
4. ______Wastes collected in bunds should generally be considered contaminated and not suitable for discharge to the storm water system.
5. _____Sand waste from foundries using sand moulds is a significant waste by volume.

**Matching: match the word or phrase under column A with words or phrase under column B (8%)**

| Column'' A" | Column ''B" |
|---|---|
| 1. _____Environmental management system | A. vibration, rotating drum or shot blasting |
| 2. _____Mould released agent | B. brick manufacturing, concrete back fill |
| 3. _____external re-use of sand waste | C. contain organic solvent and binder chlorate substance |
| 4. _____Sand recovering method | |
| | D. provide structural means of managing environmental impact |

***Note:* Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-3 | Completing appropriate documentation. |
|---|---|

## 3.1 Introduction

- *In sand preparation handling Sands* are required to be conveyed from one part of the production foundry to another for various purposes.
- For example, sand is taken from the shake-out station to the riddle for screening; from the screen to the magnetic separator; from the magnetic separator to the reconditioning plant, i.e., Muller and aerator or to the hoppers for storage; and from the storage to the mixing or conditioning plant.
- Reconditioned sand has to be sent to distribution mains and then to workstations all these processes should be recorded and documented.
- Foundry industry owing to its complex character of producing operations has specific place in proposals of management systems.
- Foundry production process consists of preparation of moulds and moulding mixtures, preparation of liquid metal, casting, cleaning of castings, thermal and surface treatment of castings each step has its marked response to problems of environment and to problems of safety and risk.
- Because the organizations use different ways of management systems, applications and each organization has its own history of introduction and development of the systems, its unique environment, workers, culture of the organization, different forms of the management systems exist in different Organizations.
- It is the reason why no “the best method” of combination or integration exists.
- Integration rate will depend on complexity of present management level also on will to integrate. In following text fully integrated model is discussed.
- Close ties exist among three management systems, though each of them is focused on different aim:
  - ✓ Quality management system - fulfilment of customer needs.
  - ✓ Environment management system -protection of environment and public.
  - ✓ Management of safety and health protection system - protection of employee

3.2 Procedure to recorded work done under sand preparation foundry shop

- Amount of sand and other additive required for the specific project .
- Safety procedure while sand preparation
- Faulty in sand preparation
- Method of screening sand
- Method of conditioning
- Mixing procedures

- Method of sand test required
- Result of each test done on sand and remedy
- Test result and comparisons with standard
- record when un wanted sand disposed
    - ✓ Place of deposal
    - ✓ Amount disposed sand
    - ✓ Method of disposal

**Quality Performance in Production.**

The challenge is increasing production while maintaining high quality. This process can be difficult to measure, but best way to gauge quality is to first measure it. Use key performance indicators (KPIs) to improve quality. KPIs help management to manage and measure both production and quality. Financial analysts and mangers also use KPIs as a measure of productivity.

**Instructions:**

1. Identify the three most important processes in production. Examples include inventory purchases, assembly, distribution and accounts payable.
2. Map out each process on a flow chart diagram. Start with first step in each process and end with the last step. This helps all parties involved in the process to visualize the process as well as where possible errors in production may occur.
3. Identify the best way to manage production for each process. For instance, assembly can be managed with the number of items produced and distribution can be managed by the total number of items delivered.
4. Define what an error or issue is within the process. For instance, for assembly, measure the number of errors or mistakes by determining how many of the total device being produced did not work or were permanent. For distribution, you could determine the number of errors by monitoring on-time delivery. The error depends on the process and your firm's definition of quality.

| Self-Check -4 | Matching |
|---|---|

**Directions: Matching words or phrase under column "A ''with the word or phrase which have similar meaning under column ''B''. (8%)**

| **Column A** | **Column B** |
|---|---|
| **1.** _____best way to gauge quality | A. safety and health protection system |
| 2. ______Environment management system | B. fulfilment of customer needs |
| 3. ______protection of employee | C. protection of environment and public |
| 4. ______Quality management system | D. measuring |

***Note:*** **Satisfactory rating – 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

| Operation Sheet-1 | Charging the Muller |
|---|---|

**Charging of machine**

**Procedure**

**Step** 1- prepare the sand by measuring required amount of quantity

**Step 2**- get ready the necessary additives and water.

**Step 3 -** load machine using proper loading tools

**Step 4-**discharged the mixed sand

**Step 5-** takes the mixed sand to mold shape using appropriate mechanism

| Operation Sheet-2 | Disposing unwanted treated sand and complete documentations |
|---|---|

**Dispose waste sand and complete necessary documentation**

**Procedure**

**Step** 1-collect the waste sand from stored container.

**Step 2**- dispose to predetermined location or place following safety procedure.

**Step 3 –** complete documentations on task performed.

| LAP Test 1 | Practical Demonstration |
| --- | --- |

Name: ______________________________ Date: ________________

Time started: ________________________ Time finished: ________________

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

**Task 1**- charging load to the machine following correct procedure.

**Task 2.** Discharge mixed sand and deliver to mould shop.

| LAP Test 1 | Practical Demonstration |
| --- | --- |

Name: ______________________________ Date: ________________

Time started: ________________________ Time finished: ________________

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

**Task 1**- disposes waste sand following safe work procedure.

**Task 2.** Prepare necessary documentations.

## List of Reference Materials


1. The ASM Handbook Committee, casting volume 15 9th Edition'
2. H.N Gupta , manufacturing processes second edition, newdelhi, 2009.
3. Stephen D.chastain, metal casting :a sand casting manual for small foundry vol.1,USA 2004

# FOUNDRY WORK

## LEVEL-II

# Learning Guide-21

| | |
|---|---|
| **Unit of Competence** | **Prepare and Mix Sand for molding and Core Making** |
| **Module Title** | **Preparing and Mixing Sand for molding and Core Making** |
| **LG Code** | **IND FDW2 M6 0919 LO5-LG-21** |
| **TTLM Code** | **IND FDW2 M6 0919 TTLM 0919v1** |
| **LO 5** | **Clean mixer** |

| Instruction Sheet | Learning Guide 21 |
|---|---|

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Performing housekeeping.
- Cleaning mixer.
- Shutting down mixer.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Perform housekeeping is per workplace standard
- Clean Mixer is according to workplace standard operating procedures.
- Shut down Mixer is following standard safety and operating procedures.

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1”, ’’2’’and ’’3’’
4. Accomplish the “Self-check1,2,3,
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 ” **in page -82**
6. Do the “LAP test” **in page – 82** (if you are ready).

| Information Sheet-1 | Performing housekeeping |
|---|---|

### 1.1 Housekeeping

When sand preparation is finished, a number of tasks should be done to ensure the foundry is safe for the next casting process.

- ✓ Clean unobstructed aisles and gangways, well defined working area, and adequate storage areas contribute to safe and healthful working condition.
- ✓ Ignoring these factors may undermine the safety and health program.
- ✓ Housekeeping can also have a marked effect on production efficiency.

- Special attention should be given to:
  - ✓ Storing raw materials scraps in pins, compartments, or other appropriate forms of containment or separation
  - ✓ Provide constantly maintained means of access for operations such as metal pouring
  - ✓ Removing items not required for immediate use from the foundry working area.
  - ✓ Providing and encouraging the use of specified areas for tools, lubricants, and other equipment
  - ✓ To help reduce the incidence of injuries, floors should be made of concrete, brick, steel, iron plate, or other suitable materials except in areas where the nature of the work requires refractor floors.
  - ✓ Foundry work area should be cleaned as required to prevent accumulation of hazardous and nuisance dust.
  - ✓ The preferred cleaning method is vacuum system that delivers the dust to a collector system with an outlet pipe leading to the opening air.
  - ✓ It is important to clean overhead plant fixtures, roof trusses, and hoists.
  - ✓ The amount of cleaning that must be done can often be reduced if the spillage of sand and other dusty materials is reduced.

## 1.2 CLEANING UP DUSTS

Compressed air should not be used for cleaning unless the task cannot be done other ways.

- If compressed air is used, control measures, for example reducing air pressure and providing protective equipment should be in place.
- Compressed air should never be used to clean clothing or the body.
- Control measures include:
  - ✓ Ensuring work practices and equipment produce a minimal residue.
  - ✓ Cleaning plant, fixtures and structures regularly.
  - ✓ Managing sand or earth floors in foundries to stop dust rising. If this involves using moisture, the sand or earth floors should not be wet enough to trigger a steam explosion
  - ✓ Using exhaust ventilation to extract dust.
  - ✓ Considering other technologies, for example fogging to minimise dust.
  - ✓ Considering the impact of fogging on the work environment, for example humidity and heat stress and other risks associated with increases in atmospheric moisture.
  - ✓ Carrying out wet cleaning where it creates no extra risk.
  - ✓ Ensuring workers use vacuum cleaners with high efficiency particulate air (HEPA) filters.
  - ✓ Ensuring cleaning is a regular part of preventative maintenance programs.

| Self-Check -1 | Matching |
|---|---|

**Directions:** match word or phrase under column'' A'' with word or phrase having similar meaning under column'' B''. (8%)

| **Column A** | **column B** |
|---|---|
| 1. ___House keeping | A. never be used to clean clothing or the body |
| 2. ___Items not required for immediate use | B. preferred cleaning method of dust |
| 3. ___Vacuum cleaner | C. a marked effect on production efficiency |
| 4. ___Compressed air | D. Remove from the foundry working area |

***Note:*** **Satisfactory rating – 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet-2 | Shutting down the machine. |
| --- | --- |

## 2.1 Shutting down the machine

- ✓ For your safety and the safety of others, use the shutdown procedure before working on the machine for any reason, including servicing, inspecting, or maintaining the machine.
- ✓

- **Mixer Shutdown Procedure**

  - ✓ Drum rotation must continue at all times when material is in the drum. Mixer shutdown occurs only after final mixing is completed.
  - ✓ Empty all material from drum.
  - ✓ Push and hold *Drum Stop Switch* to clear set speed.

- **Maintenance**

  - ✓ Do not make any change to the mixer (installed power, rotation speed, shaft length, impellers etc.) without consulting.
  - ✓ Unplug the motor from the power supply before performing any maintenance.
  - ✓ When repairing the mixer or replacing parts, use only procedures and ***manual*** of the machine
  - ✓ Do not touch the mixer motor or the top of the mixing shaft unless they have been left to cool for at least an hour.
  - ✓ To perform maintenance in areas that are not easily accessible or hazardous, ensure adequate safety for those performing maintenance and others in compliance with applicable laws regarding safety in the workplace.
  - ✓ Maintenance, inspection and repairs may only be performed by experienced maintenance technicians, aware of dangerous conditions.
  - ✓ It is therefore necessary to provide operating procedures for the complete machine aimed at managing the dangerous situations that could arise and methods for preventing them. The experienced maintenance technician should always work very carefully, paying close attention and carefully following the safety rules.
  - ✓ During operation wear only clothes and/or individual safety equipment indicated in the instructions for use provided by the Manufacturer and by applicable laws on safety at work.
  - ✓ Replace worn components using original spare parts. Use oils and greases recommended by the Manufacturer.
  - ✓ Do not dispose of polluting materials into the environment. Dispose of these materials in compliance with applicable laws on this matter

- ✓ Always check that lubricant is present in the gearbox, bearings and mechanical seal where necessary according to the manual.
- ✓ Assemble all protections that ensure that it is not possible to touch moving parts of the mixer (shaft, motor, impellers, seal, gaskets etc.) with hands or any part of the body.
- ✓ Do not use the mixer for purposes other than those envisaged. Do not operate the sealing system at temperatures or pressures higher than those specified
- ✓ The mixer should be handled with care using appropriate lifting systems.
- ✓ Place the machine in position following these rules for moving:
- ✓ Secure all parts that could come loose or fall out of the machine.
- ✓ Remove any accessories affixed to the machine.
- ✓ Make sure there is enough space for moving the machine and the lifting system.
- ✓ Lift the machine carefully
- ✓ The transport operation must be performed by specialised personnel.
- ✓ Clean any packaging residues and any protective products from the gearbox. Pay particular attention to the coupling surfaces.
- ✓ Check correct shaft/shaft or shaft/hole alignment.
- ✓ Provide adequate safety protections devices for the rotating parts outside the gearbox.

- **Preliminary checks**

- ✓ Check that the data on the identification plate matches that in the technical specification
- ✓ Check the oil level in the gearbox and that there are no visible leaks
- ✓ Position any safety guards
- ✓ Check for and remove any moisture on the motors after prolonged storage
- ✓ Check to see if the mixer is designed to operate at constant or variable level,
- ✓ Ensure that the mixer cannot start up accidentally.

| Self-Check -2 | True false |
|---|---|

**Directions: write true if the statement is correct and false if the statement is not correct on the separated answer sheet (10%)**

1. _____Make any change to the mixer (installed power, rotation speed, shaft length, impellers etc.) without consulting.
2. _____Maintenance, inspection and repairs may be performed by any of the trainees.
3. _____Using the mixer for any purposes which is similar with foundry sand mixing is possible.
4. ____ while the machine running we can maintain, inspect and change replaceable parts.
5. _____Do not touch the mixer motor or the top of the mixing shaft unless they have been left to cool for at least an hour

***Note:*** **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

| Information Sheet- 3 | cleaning mixer |
|---|---|

### 3.1 Cleaning mixer.

- **Cleaning And storing equipment**
  - ✓ After finishing sand mixing process the mixer should be cleaned using proper clean tools
  - ✓ Emptying , cleaning and inspecting the mixer regularly
  - ✓ Inspecting mixer for cracks or damage
  - ✓ Removing spills
  - ✓ Examining materials for dryness and lack of contamination.
  - ✓ Equipment should be stored in areas readily accessible to the task it is required for, and should be stored in a clean and well-maintained condition.
  - ✓ Markings should be provided to identify the task and location where the equipment is to be used.
  - ✓ Equipment removed from storage should be returned to the correct storage area in a clean and usable condition
  - ✓ Adjustment and replacement of V-Belts & scrapping blades
  - ✓ Equipment failures due to inadequate inspection and maintenance in foundries are often the cause of fatal and non fatal injuries and exposures to hazardous airborne contaminates.
  - ✓ Constant vigilance to ensure that all equipment is in safety condition and that operation is proceeding normally is critical to safety and to accident prevention.
  - ✓ Adequate maintenance and immediate replacement and repair of worn or suspicious equipment or component parts are essential.
  - ✓ Inadequate training and experience in how to cope with emergency maintenance situation is often a major contributing factor in foundry accidents.
  - ✓ Equipment design ,construction ,use inspection and maintenance are key goals for foundry safety
  - ✓ Regular inspection can detect abnormal conditions, and maintenance can then be performed.

- ✓ All maintenance work should include an examination of the local exhaust ventilating system at the emission source.

| Self-Check -3 | True false item |
|---|---|

**Directions: write true if the statement is correct and false if the statement is not correct on the separated answer sheet 10%)**

1. ________ Equipment removed from storage should be returned to the correct storage area in a clean and usable condition.
2. _______Regular inspection can detect abnormal conditions of the machine.
3. ________ Equipment failures due to inadequate inspection cause of fatal and non fatal injuries and exposures to hazardous.
4. ______ Adequate maintenance and immediate replacement and repair of worn or suspicious equipment decrease the life of the machine
5. _____Cleaning and inspecting mixing Muller machine is part of preventive maintenance.

***Note:*** **Satisfactory rating – 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

| 0peration Sheet 1 | Perform hose keeping |
|---|---|

**House keeping**

**Procedures**

**Step 1**. Prepare cleaning materials.
**Step 2**. Store raw materials tools on their proper place.
**Step 3.** Clean benches, ceilings floor of the shop.
**Step 4**. Store waste sand, scraps on its proper place.

| 0peration Sheet 2 | Shutting and cleaning of Muller machine |
|---|---|

**Shutting and cleaning machine**

**Procedure**

**Step. 1**. Empty all material from mixer
**Step 2.** Shut down Unplug the motor from the power supply.
**Step 3.** Clean any packaging residues and any protective products from the gearbox.
**Step 4**. Clean the machine using proper cleaning tools.
**Step 5.** Inspect condition of the machine

| LAP Test 1 | Practical Demonstration |
|---|---|

Name: ______________________________ Date: ________________

Time started: ________________________ Time finished: ________________

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

**Task 1**- performs work shop cleaning following proper procedures.

**Task 2.** Shut down the machine and clean followed standard operation procedure

**List of Reference Materials**


1. U.S department of health and human services public Health service, Recommendation for control of occupational safety and health hazards foundries, U.S 1985.
2. Baylor university, ( January 6, 2016),shop safety manual , *Published by the Department of Environmental Health & Safety*
3. The ministry of education and industrial relation , Queensland (2004),Foundry code of practice

4. jss mahavidyapeetha jss science & technology university , Foundry and Forging Laboratory Manual

5. Instruction manual industrial mixers. info@grec.it; www.grec.it. GREC S.r.l. Via Copernico, 3 - 20082 Binasco (Mi) – ITALY 2014

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