Molding Sand Composition

The main ingredients of any molding sand are:

- Base sand,
- Binder, and
- Moisture

Base Sand

The major component of a molding sand is the base sand. Silica sand is most commonly used base sand to prepare the green sand. Other base sands that are also used for making mold are zircon sand, Chromites sand, and olivine sand. Silica sand is cheapest among all types of base sand and it is available in abundance. The base sand plays an important role in controlling the surface roughness of the casting. The characteristics of the base sand such as size and its distribution affect the surface roughness of the casting and also affects the permeability i.e ability of the molding sand to escape out the gases from the mould cavity. Also, the base sand must be able to resist the temperature of the molten metal. In other words the fusion temperature of the molding sand should be higher.

Binder

Binders are of many types such as:

1. Clay binders,
2. Organic binders and
3. Inorganic binders
Clay binders are most commonly used binding agents mixed with the molding sands to provide the strength. The most popular clay types are: Kaolinite or fire clay (Al₂O₃·2SiO₂·2 H₂O) and Bentonite (Al₂O₃·4SiO₂·nH₂O). Amongst the two, the Bentonite can absorb more water which increases its bonding power.

**Moisture**

The bonding action of clay activates in the presence of the required amount of moisture. Moisture in the form of water coats the surface of each flake of the clay. The moisture content in the clay should be in a controlled manner. Higher moisture will increase the plasticity and thus reduces the strength of the molding sand. Lower moisture content may result in less flowability of the molding sand resulting into poor packing of the molding aggregate around the pattern. A typical composition of molding sand is given in Table 7.1.1.

<table>
<thead>
<tr>
<th>Molding Sand Constituent</th>
<th>Weight Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica sand</td>
<td>92</td>
</tr>
<tr>
<td>Clay (Sodium Bentonite)</td>
<td>8</td>
</tr>
<tr>
<td>Water</td>
<td>4</td>
</tr>
</tbody>
</table>

**Table 7.1.1 Typical Composition of Molding Sand**

**Molding Material and its Properties**

The molding sand is used for making moulds and cores. Various types of molding sand are used in the metal casting industries. These sands include molding sand, backing sand, facing sand, parting sand, and core sand. These sands posses its own characteristics and properties. The most common type of molding sand properties are:

**Refractoriness**

When liquid metal comes in contact with the sand mould, the sand may fuse. If the fusion temperature of the sand is low, it will fuse and lumps of the sand will be mixed with the metal. It is therefore required that the molding sand should have higher fusion point to avoid its fusion. The molding material must be able to withstand the temperature of the pouring liquid metal. This property of the sand is known as refractoriness. It is the ability of the molding material to resist
the temperature of the liquid metal to be poured so that it does not get fused with the metal. The refractoriness of the silica sand is highest (1700 degree centigrade).

**Permeability**

When liquid metal is poured into the mould cavity, a large amount of gases are generated. These gases are generated because of the reaction of molding material with the liquid metal. The steam in the mold is generated because of the presence of moisture content. In addition, the liquid metal absorbs some gases from the atmosphere and on solidification of metal in the mould, these gases are also released. If these gases, due to reaction, due to moisture, and due to atmospheric gases, could not escape from the mould, it may be entrapped inside the casting and can cause various defects in the casting. Hence the mould must be able to escape these gases or it should be porous. The property of the molding sand which helps to escape the gases, is known as permeability. Higher the permeability of the molding sand better it is. Proper venting of the molding aggregate may also help in escaping the gases which are generated inside the molding aggregate.

**Green Strength or Cohesiveness**

The molding sand constituents must be able to stick together. This property is known as green strength or cohesiveness. Higher the property better will be the strength of the molding aggregate. The higher strength is required in the molding aggregate to retain its shape as the molding aggregate is subject to metallostatic pressure.

**Adhesiveness**

The molding aggregate should have to property of getting cling with the surface of the molding boxes. Otherwise, it will become difficult to transport the molding boxes from one place to the other.

**Dry Strength**

As the hot liquid metal is poured into the mold, the moisture in the mold gets evaporated because of the heat of the liquid metal. The moisture is the source of activating the clay and thus helping
it to achieve the strength. After pouring, the sand becomes the dry strength as it loses the moisture. The dry stand should retain the strength till the first layer, that is the skin of the metal solidifies around the cavity at the same time it must be able to withstand the metallostatic pressure of the liquid material. This strength of the molding sand is called as dry strength.

**Collapsibility**

When metal starts solidifying in the mould, it contracts. The molding sand should not hinder the contraction of the metal, otherwise the cracks in the casting may arise. To avoid the hindrance to the solidifying metal, the molding sand should posses high collapsibility properties.

Besides these specific properties the molding material should be cheap, reusable and should have good thermal conductivity.