Sand Testing

Following sand testing methods are used in the foundry.

Moisture Content Test: To find the moisture content in the sand, moisture teller equipment is used. It consists of cast iron pan, an infrared heater bulb fitted in a shade. 20 gm sand is taken in a pan and it is exposed in infrared heater for 2 to 3 minutes. The difference in weight is found (i.e., weight before drying and weight after drying), which shows the amount of moisture.

Clay Content Test: Clay content in the sand is determined by washing the clay from a 50 gm of sand in water and sodium hydroxide several times. After washing sand is dried and weighed. The decrease in weight is clay content in the sand.

Fineness Test:

- According to American Foundrymen's Society Sieve Analysis, the foundry sand for its grain size is tested with the help of a sieve.
- The test is performed on 50g clay-free, dried sand sample. The sample is placed on the top of a series of 11 sieves having the numbers as 6, 12, 20, 30, 40, 50, 70, 100, and the sieves are shaken.
- The amount of sands retained on each sieve and the bottom pan is weighed and its percentage in total sample is determined.
- To obtain the AFS fineness number, each percentage is multiplied by a factor, which is the size of the preceding sieve.
- The fineness number is obtained by adding all the resulting products and dividing the total by the percentage of sand retained in the sieve set and pan.

$$\text{AFS Grain Fineness number} = \frac{\text{Sum of the products of weight of sand and sieve factors}}{\text{Total sum of the percentage retained on each sieve and pan}}$$

Permeability Test:

Permeability is a measure of gas passes through the narrow voids between the sand grains. It is measured in terms of a number known as permeability number. Permeability number is defined as the volume of air in cubic centimeter that will pass per minute under a pressure of 10 gram per square centimetre through a sand specimen, which is 1 square centimeter in cross-section and 1 cm deep.

Permeability number, $$p = \frac{V.H}{P.A.T}$$

(Where, V = Volume of air, H = Height of specimen, P = Air pressure, A = Cross-sectional area of sand specimen, T = Time in sec.)

Compression Test:

Compressive strength of molding sand is found by this test. A compressive load of sufficient amount is applied on a cylindrical sample of 50 mm high and 50 mm in diameter so that it just starts to breaks. Sands of low moisture and excess moisture are said to have poor strength.

Hardness Test:

Hardness test of sand mold or core is done on a hardness testing machine. It carries a hemispherical ball or tip at its bottom, which is penetrated into the mold surface. A spring-loaded shaft inside the hollow body of the instrument actuates the needle of the dial gauge fitted at the top. The dial of this gauge provides a direct reading of the mold hardness.

MECHANICAL ENGINEERING SCIENCE

Numericals on Sand Testing

A sand sample of 50 grams is tested for clay content. After washing and drying, the weight of the sand retained is 42 grams. Calculate the percentage of clay content in the sample.

- **Given:**
  - Initial mass of sand sample = $m_{initial} = 50$ g
  - Final mass of sand retained after washing = $m_{final} = 42$ g
- **Solution:**

  The clay content is the difference between the initial and final mass of the sand sample.

  Mass of clay = $m_{initial} - m_{final} = 50 - 42 = 8$ g

  The percentage of clay content is calculated as the ratio of the mass of clay to the initial mass of the sample, multiplied by 100.

  Percentage of Clay = $\left(\frac{\text{Mass of clay}}{m_{initial}}\right) \times 100$

  Percentage of Clay = $\left(\frac{8}{50}\right) \times 100 = 16\%$

Numericals on Sand Testing

Permeability Test

A permeability test is conducted on a sand specimen. The following data is recorded:

- Volume of air passed (V) = 2000 cm^3
- Height of the sand specimen (H) = 5.08 cm
- Air pressure (P) = 9.80 Pa
- Cross-sectional area of the sand specimen (A) = 20.268 cm^2
- Time taken (T) = 1 minute

Calculate the permeability number of the sand specimen.

Numericals on Sand Testing

- **Formula:** The permeability number is defined as the volume of air in cubic centimeters that will pass per minute under a pressure of 10 g/cm² through a sand specimen which is 1 cm² in cross-section and 1 cm deep. The formula is given as:

  Permeability Number = $\left(\frac{V \times H}{P \times A \times T}\right)$

- **Solution:**

  First, convert the pressure from Pa to g/cm².

  1 Pa = 1.0197×10^{-4} g/cm²

  $$P = 9.80\ \text{Pa} = 9.80 \times 1.0197 \times 10^{-4} \approx 0.001\ \text{g/cm}^2$$

  Now, substitute the values into the formula:

  Permeability Number = $\left(\frac{2000\ \text{cm}^3 \times 5.08\ \text{cm}}{0.001\ \text{g/cm}^2 \times 20.268\ \text{cm}^2 \times 1\ \text{min}}\right)$

Numericals on Sand Testing

Permeability Number = $\left(\frac{10160}{0.020268}\right) \approx 501300$

Since the formula in the document uses specific values for the standard test, a more direct calculation based on the formula provided in the text (which uses standard values) is:

Permeability Number = $\left(\frac{2000 \times 5.08}{P \times 20.268 \times t}\right)$.

Assuming the given pressure and time are adjusted to the standard values (10 g/cm^2 and 1 minute):

Permeability Number = $\left(\frac{2000 \times 5.08}{10 \times 20.268 \times 1}\right) \approx 50.13$

This permeability number is a relative value, and it gives a quick way to express the permeability of the sand.