

Characteristics of powder:-

→ powder is a non-homogeneous collection of discrete solid particles of different sizes and shapes
→ as there are different characteristics of powder which to be follows are

- (1) powder size
- (2) surface area
- (3) flow properties
- (4) particle number
- (5) volume
- (6) density

* Powder size :-

→ Fine powder size can be explain by the following expressions like arithmetic mean, geometric mean, harmonic mean etc.

Arithmetic mean:-

→ Arithmetic mean of a powder is defined as the sum of the particle sizes divided by the no of particles.

→ There are different types of arithmetic mean.

(a) length number mean:-

$$d_n = \frac{\sum n d}{\sum n}$$

where d = Diameter of the particle
 n = no of particle

(b) volume surface mean:-

$$d_{vs} = \frac{\sum n d^3}{\sum n d^2}$$

(c) volume weighted mean:-

$$d_{wm} = \frac{\sum n d^4}{\sum n d^3}$$

Geometric mean:-

Geometric mean is calculated by

$$d_g = N / \sqrt{d_1 d_2 d_3 \dots d_n}$$

Particle number:

$$\frac{N}{dn} = \frac{1}{d_1} + \frac{1}{d_2} + \frac{1}{d_3} + \dots + \frac{1}{d_n}$$

where $d_1, d_2, d_3, \dots, d_n$ are diameters of particles in range

d_n = Average diameter of particles

Particle number:

→ The no of particles per unit weight, N , can be expressed in terms of volume number and diameter i.e. " d_m "

→ Assuming that the particles are spheres, the following relationship may be obtained,

volume of a single particle = $\frac{1}{6} \pi d_m^3$

mass of a single particle = volume \times density
= $\frac{1}{6} \pi d_m^3 \rho$

The following relationship may be obtained,

$$\frac{\text{weight of the particle}}{1 \text{ particle}} = \frac{\text{weight of the particles}}{N}$$

$$\frac{\frac{1}{6} \pi d_m^3 \rho}{1 \text{ particle}} = \frac{1g}{N}$$

$$N = \frac{6}{\pi d_m^3 \rho}$$

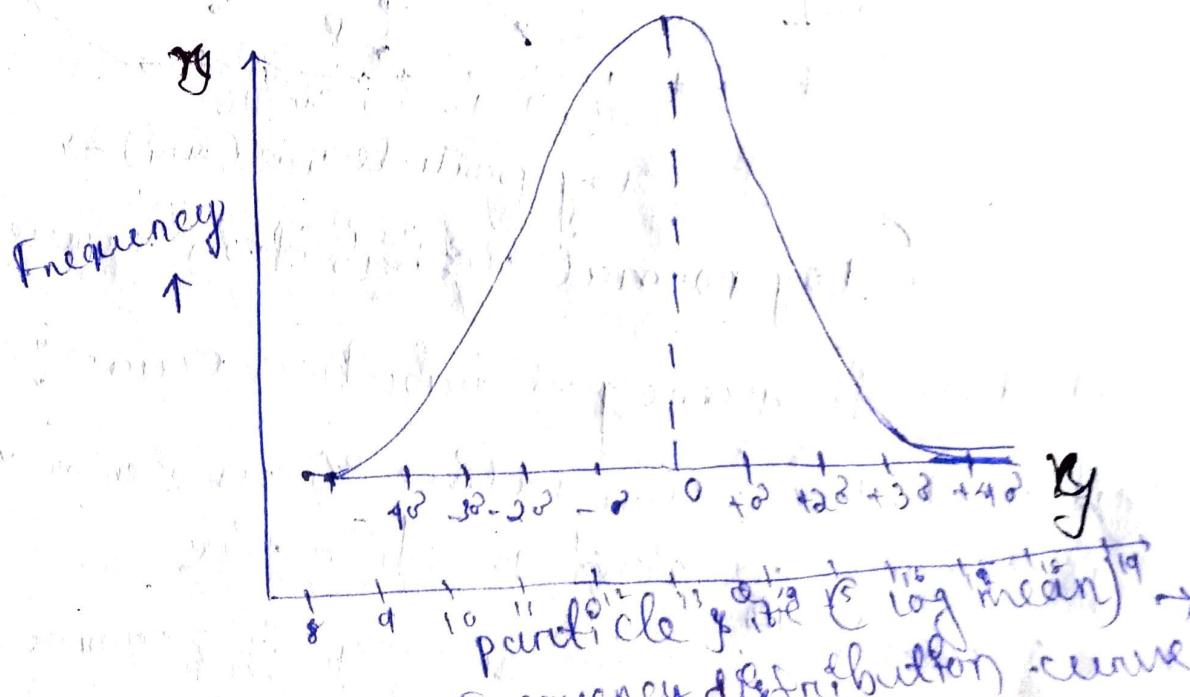
Particle size distribution of powder: —

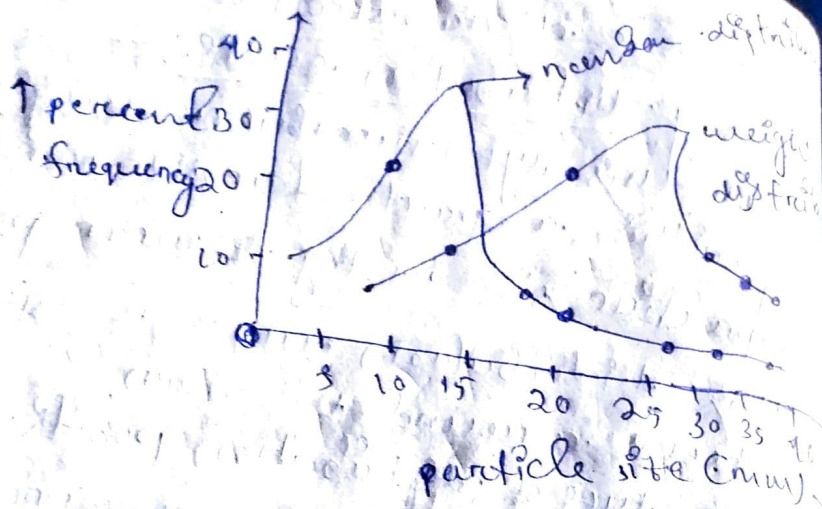
Frequency distribution curve: —

- in this type number or weight of particles lying within a particular size range is plotted against mean particle size or log of mean particle size.
- ⇒ in this distribution curve we get bell shaped structure around the mean.
- in this type of distribution positive & negative deviations from the mean are uniform which is represented by standard deviation.

Normal distribution curve: —

- The normal distribution curve is taken by plotting particle size in y-axis & % frequency in x-axis.
- Here the curve is unsymmetrical or skewed.
- In case of higher size range the particles show positive skewness & in case of lower size range the particles show negative skewness.



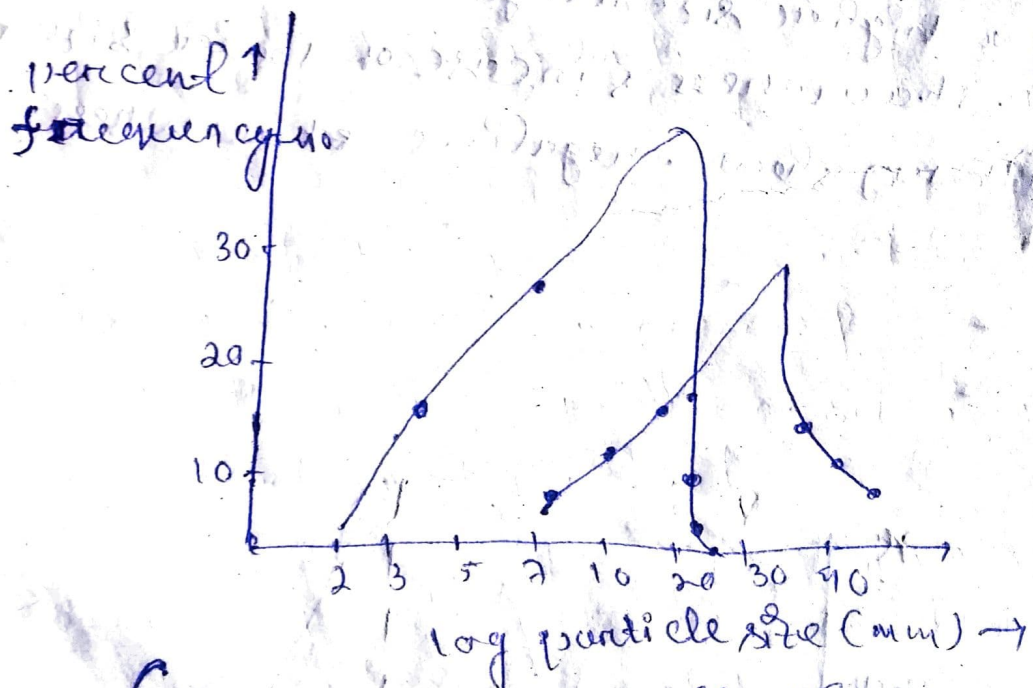


Log normal distribution curve :-

(Normal distribution curve)

→ In this curve the % of frequency is plotted against log particle size or log mean particle size.

→ Here, this curve is somewhat symmetrical in compare to normal distribution curve.



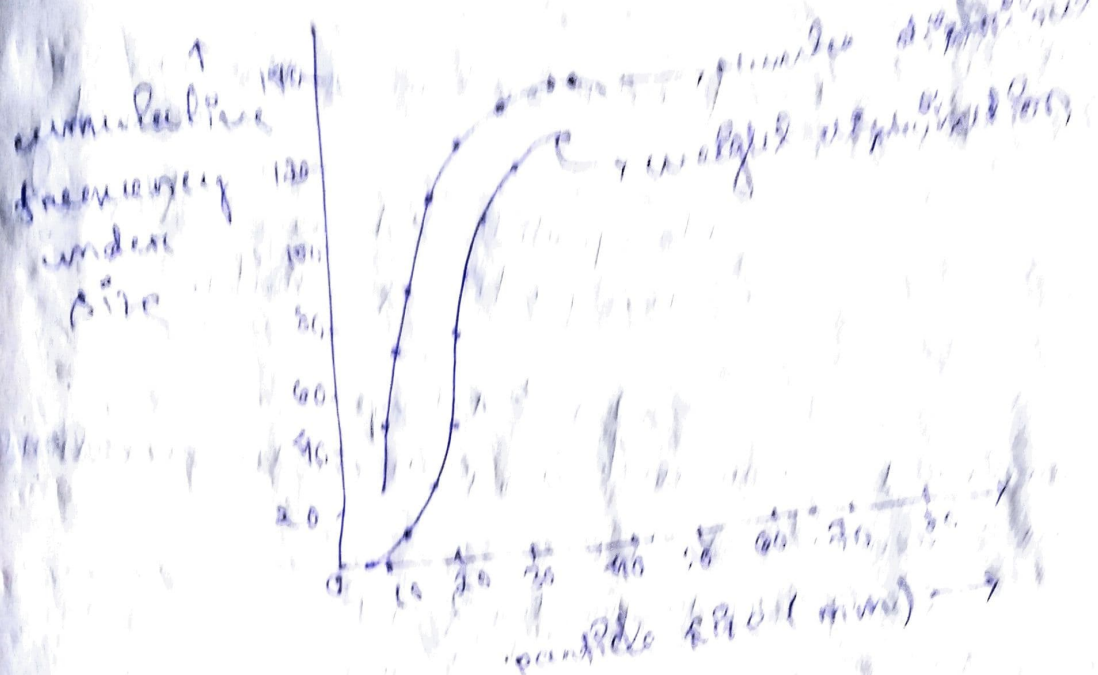
(Log normal distribution curve)

Cumulative frequency distribution curve :-

→ In this plot the cumulative % under or over size is drawn against particle size.

→ If the sum ^{of} frequency is ^{constant} cumulative

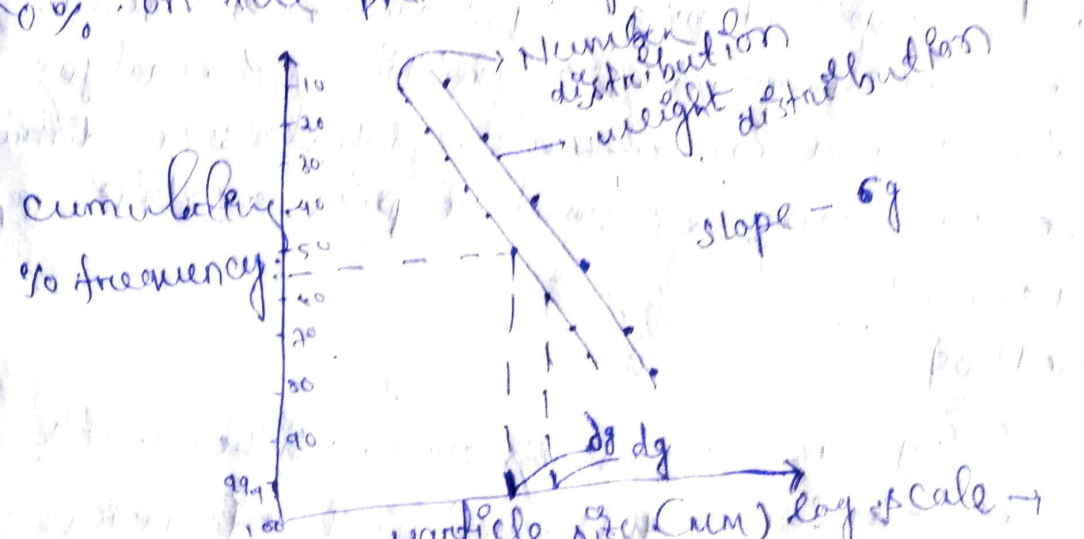
From the graph, we can see that the distribution is not symmetric. The curve is skewed to the right, indicating a long tail of small particles.



Log probability plot:

A plot is drawn by taking log of particle size on x-axis & cumulative % of frequency probability scale on y-axis then straight line graph is obtained.

- At the slope gives symmetrical geometric std (σ_g) deviation
- The reference point gives the geometric mean diameter which is an = median on diameter 50% on the probability scale.



Interconversion of distribution data — Dt =

The weight distribution can be converted to no of distribution and vice-versa by the following expression,

→ weight of the powder = volume of the powder × density

= No of particles × Average volume of the particle × density,

$$= n \times \frac{1}{6} \pi d^3 \times \rho$$

Consider the constant $\pi/6$, then the relation can be rewritten as,

weight of the powder $\propto n d^3$
(directly)