MLL371

Q) $\dot{\varepsilon}$ = — $\sigma_{steel} = 240 MPa$

$\sigma_{HSLA} = 420 MPa$

$\sigma = K \dot{\varepsilon}^m$

yield stress:

at same load

$t_2 Y_2 = t_1 Y_1$

$\frac{t_2}{t_1} \propto \frac{w_2}{w_1}$

$\frac{w_2}{w_1} = \frac{Y_1}{Y_2} = \frac{240}{420} = 0.571$

$w_2 = 0.571 w_1$

wt saving: $w_1(1-0.571) =$

$m_{Low\ carbon}$ = — m_{HSLA} = — $\dot{\varepsilon}$ = —

Powder Processing

[Introduction, advantages, types of materials, porosity can be beneficial,

→ strength comparable to casting processed. despite low density.

Design considerations in powder processing

↳ shape of the compact must be simple & uniform

↳ provision must be made for

↳ wide tolerances

↳ avoid sharp edges.

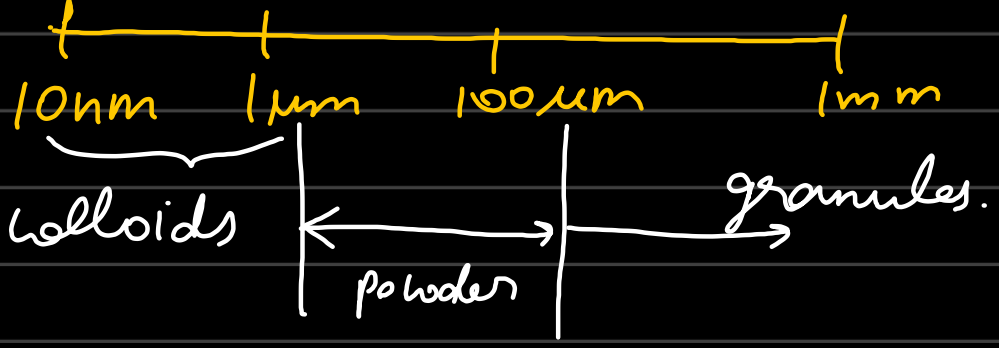
→ avoid sudden change in cross-section,

→ avoid sharp undercuts.

→ cross holes must be machined.

Powder Characterization:

↳ Powder:



↳ particulates in the size range of 1-100 μm.

→ Characterization parameters:

- ↳ Shape & Morphology
- ↳ Chemistry
- ↳ Size & Size distribution.
- ↳ Flowability
- ↳ Surface area
- ↳ Porosity in particle
- ↳ Compactibility
- ↳ Agglomeration.

(spherical)

Q) $d_1 = 1\,\mu m$; Number of powder particles/kg of powder = ?

size of particle

Surface Area = ?

$d_2 = 100\,\mu m$;

↳ Possible shapes of powder:

↳ Spherical: most ideal with least surface energy.

→ Surface energy dictates shape & morphology of powder

Shapes: spherical, cubic, sponge, acicular, polygonal, aggregate, fibrous.

↳ Shape is difficult to quantify.

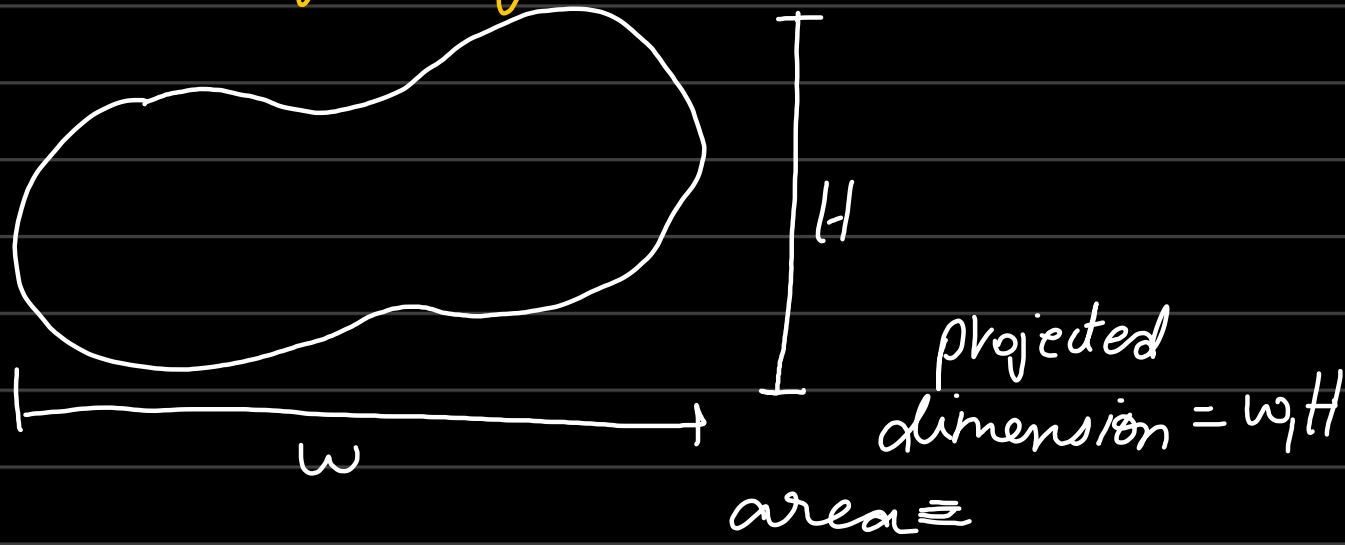
↳ Atomization process → near spherical shape.
Electrolytic process → dendritic particles.

Powder processing techniques.

→ Optical & SEM microscopy to characterize particle shape.

→ SEM micrographs are 2D pictures, how to get 3D idea of irregular shapes?

↳ We are only seeing projected view.

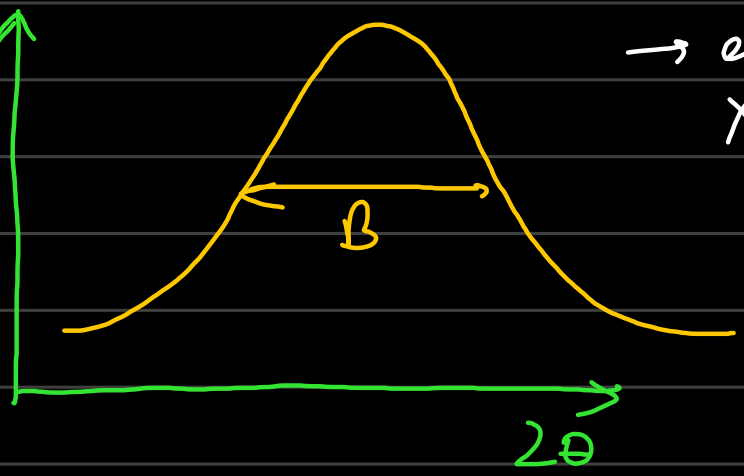


↳ Sphere of equivalent area used to determine size of particle.

Stereology: deals with SEM 2D image processing / post processing
↳ Softwares like Image J.

$D_A = \left(\frac{4A}{\pi}\right)^{1/2}$ ↓ equivalent area / radi

$D_V = \left(\frac{6V}{\pi}\right)^{1/3}$ ↓ equivalent Vol / radius

XRD: 

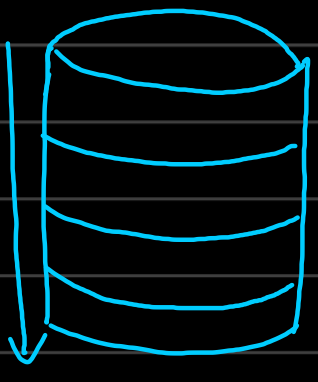
→ estimate "d" using XRD pattern.

Scherrer formula: $d = \frac{K\lambda}{\beta \cos\theta}$

$K = 0.9 - 1$ ↳ Shape factor. λ = wavelength of X-ray.

β = FWHM θ = Bragg's angle.

Seiving / Screening:



↳ Applicable to sizes larger than 38 μm.

Powder fabrication Classification:

↳ Mechanical Methods:

↳ Roll Crushers.

↳ roll gap will decide size powders
↳ coarse powders produced.

↳ Jaw Crusher:

↳ Ball Milling:

↳ Tungsten Carbide (WC) balls

→ material must be brittle, for easy disintegration.

* Hydrogen Embrittlement: convert ductile to brittle material.
{formation of metal hydrides}