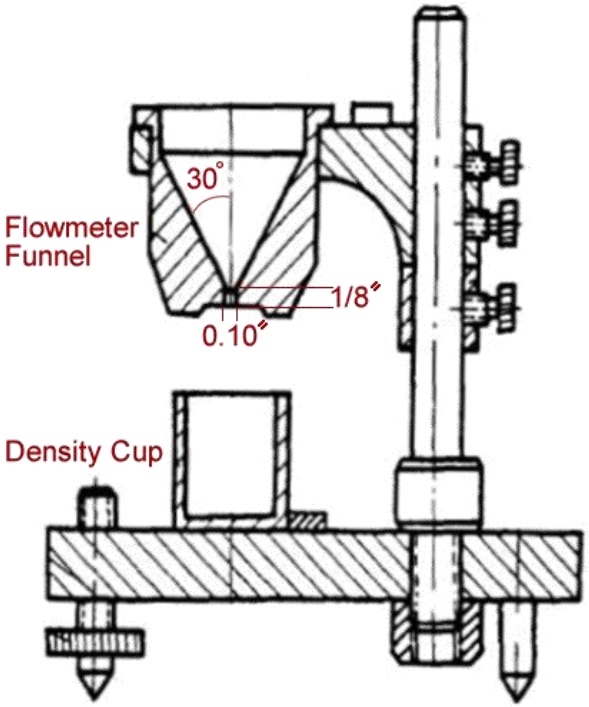
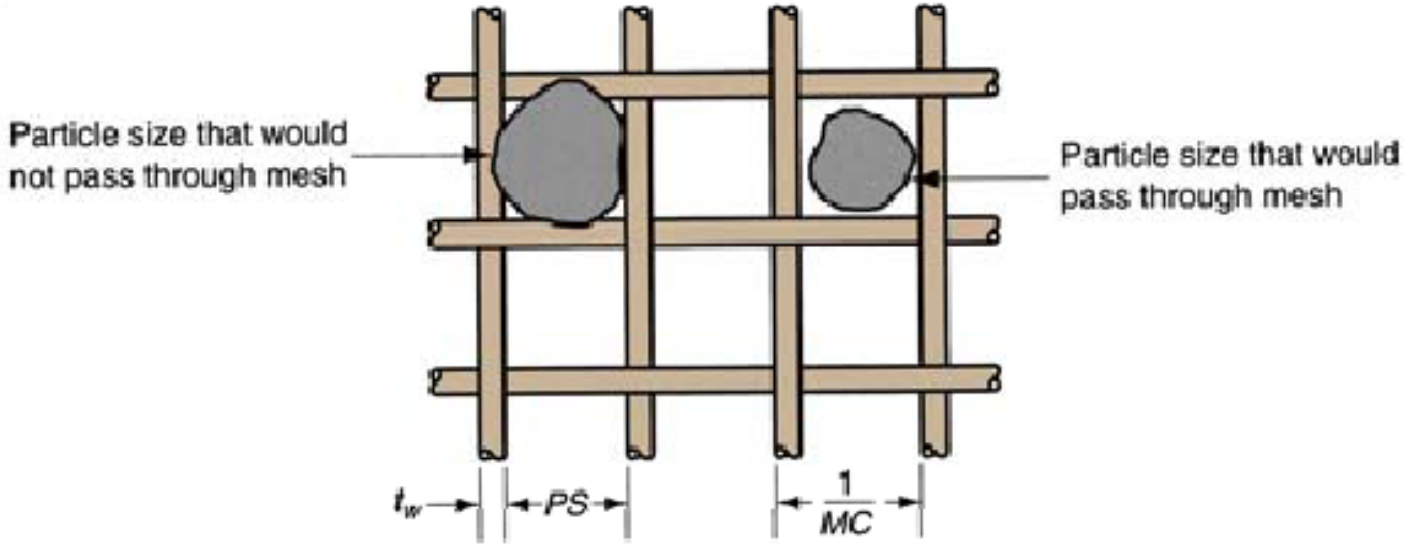
Powder Characteristics

- Analysis
- **A**pparent **D**ensity **A.D**. ….. !!!!g/cc
- **F**low **R**ate **F.R** …. !!!!Sec/50gm
- Average particle size (particle size distribution)
- Particle shape….
- Color
- Oxygen level…..
- Sintering conditions



Hall Flow Meter (Funnel) determines both Flow Rate and Apparent Density.

Measuring Particle Size



- Most common method uses screens of different mesh sizes
- *Mesh count* - refers to the number of openings per linear inch of screen
  - A mesh count of 200 means there are 200 openings per linear inch
  - Since the mesh is square, the count is the same in both directions, and the total number of openings per square inch is $200^2 = 40{,}000$
  - Higher mesh count means .....

Mesh Size
Conversion Table

Mesh Size Conversion Table

A "+" before the mesh size indicates the particles are retained on and are larger than the sieve. A "–" before the mesh size indicates the particles pass through and are smaller than the sieve. For example, –325 mesh indicates the particles pass through and are smaller than the openings of a 325 mesh (44 micron) sieve. Typically 90% or more of the particles will fall within the specified mesh.

MESH SIZE	APPROXIMATE MICRON SIZE	APPROXIMATE MILLIMETERS	INCHES
4	4760	4.76	0.185
6	3360	3.36	0.131
8	2380	2.38	0.093
12	1680	1.68	0.065
16	1190	1.19	0.046
20	840	0.84	0.0328
30	590	0.59	0.0232
40	420	0.42	0.0164
50	297	0.29	0.0116
60	250	0.25	0.0097
70	210	0.21	0.0082
80	177	0.17	0.0069
100	149	0.14	0.0058
140	105	0.10	0.0041
200	74	0.07	0.0029
230	62	0.06	0.0024
270	53	0.05	0.0021
325	44	0.04	0.0017
400	37	0.03	0.0015
625	20	0.02	0.0008
1250	10	0.01	0.0004
2500	5	0.005	0.0002

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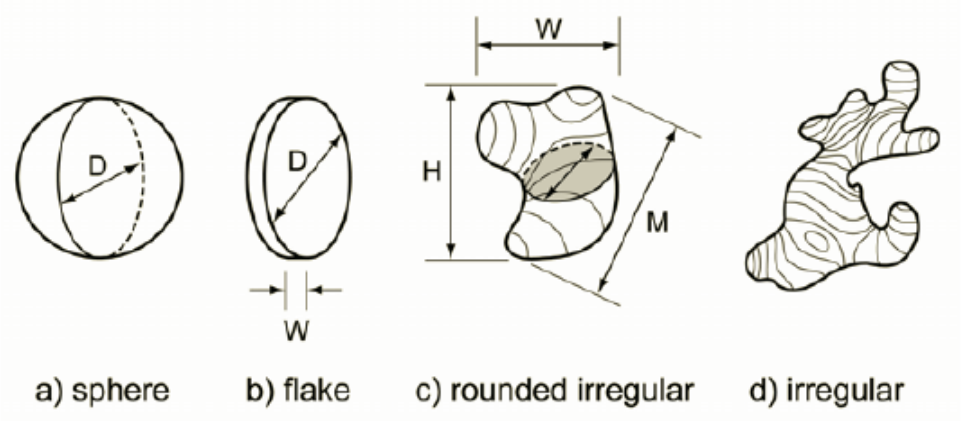
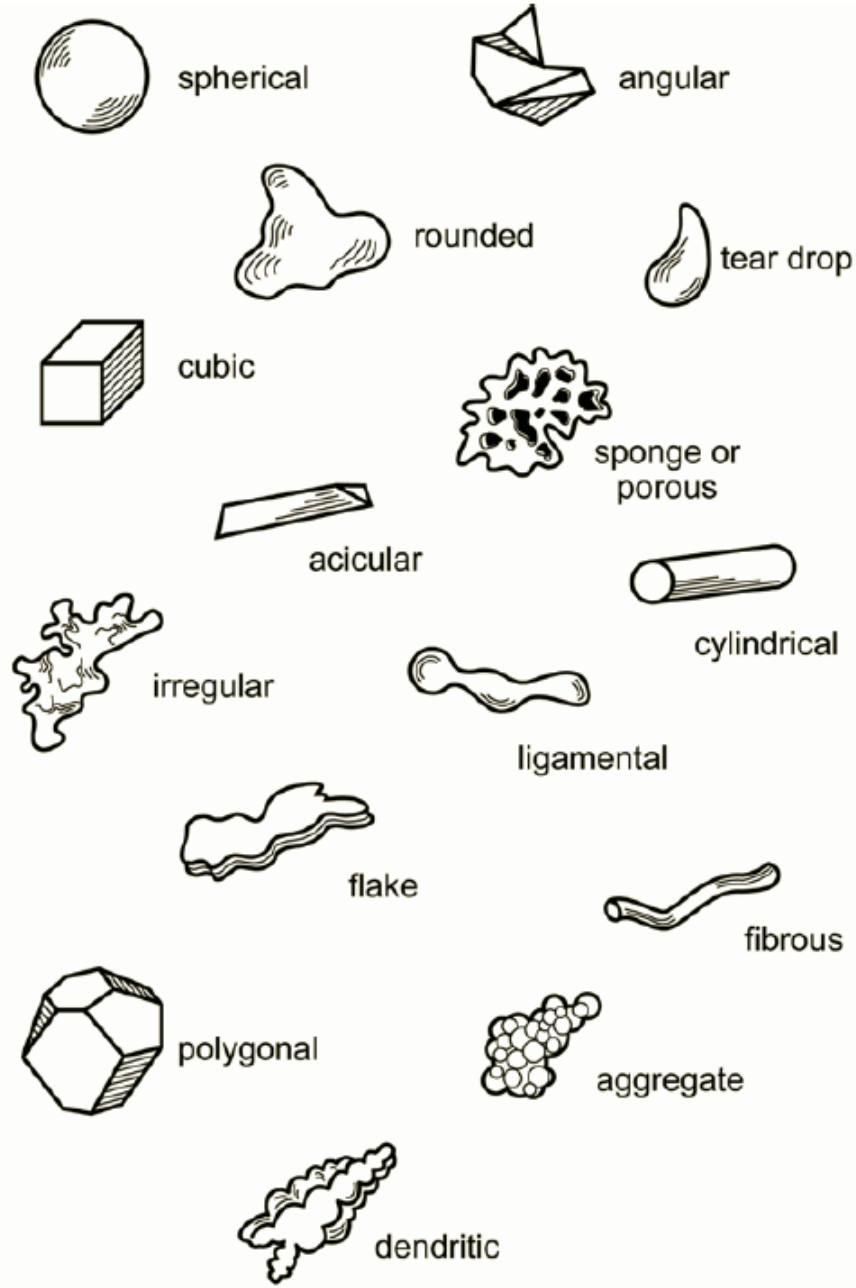
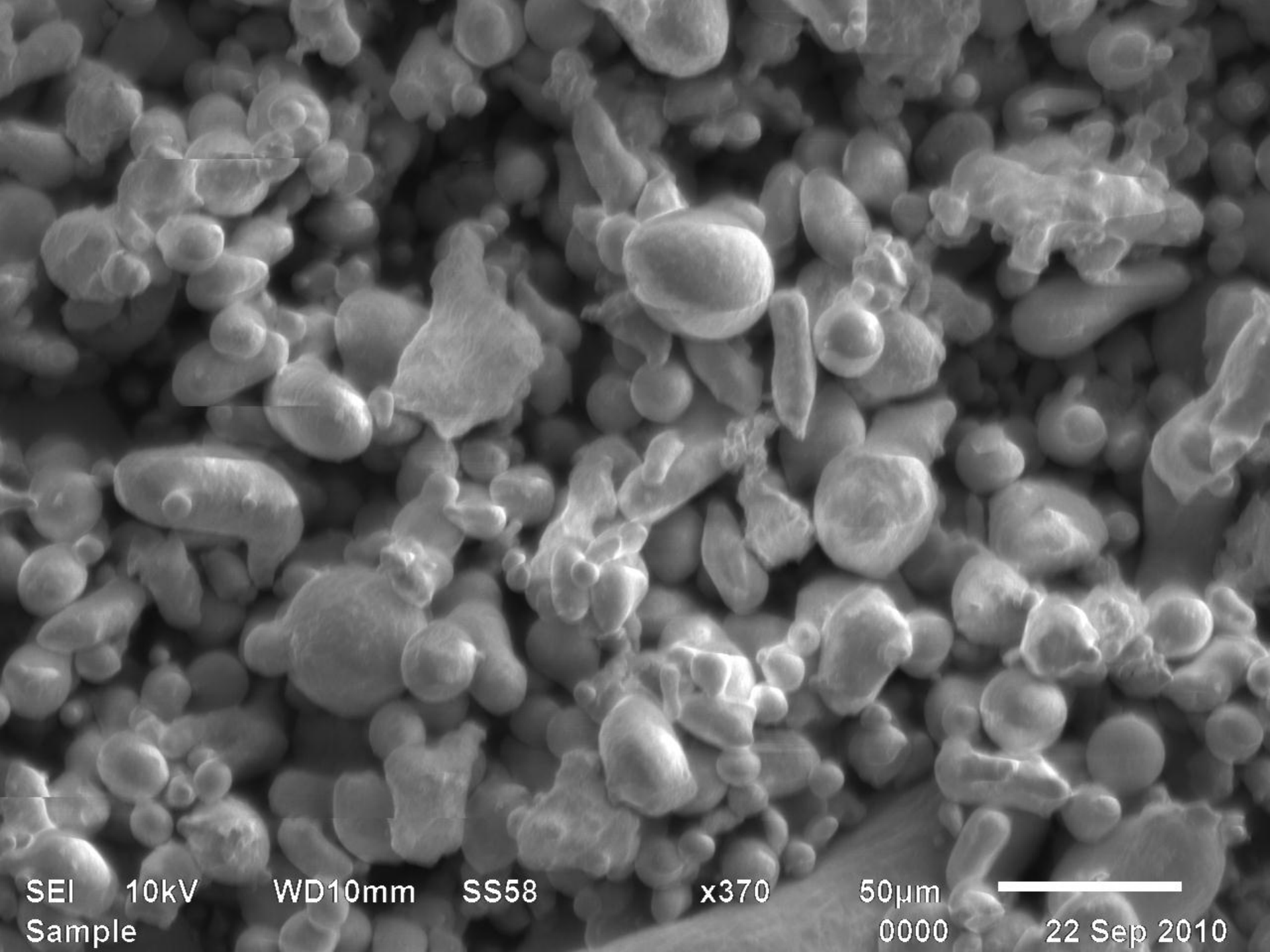
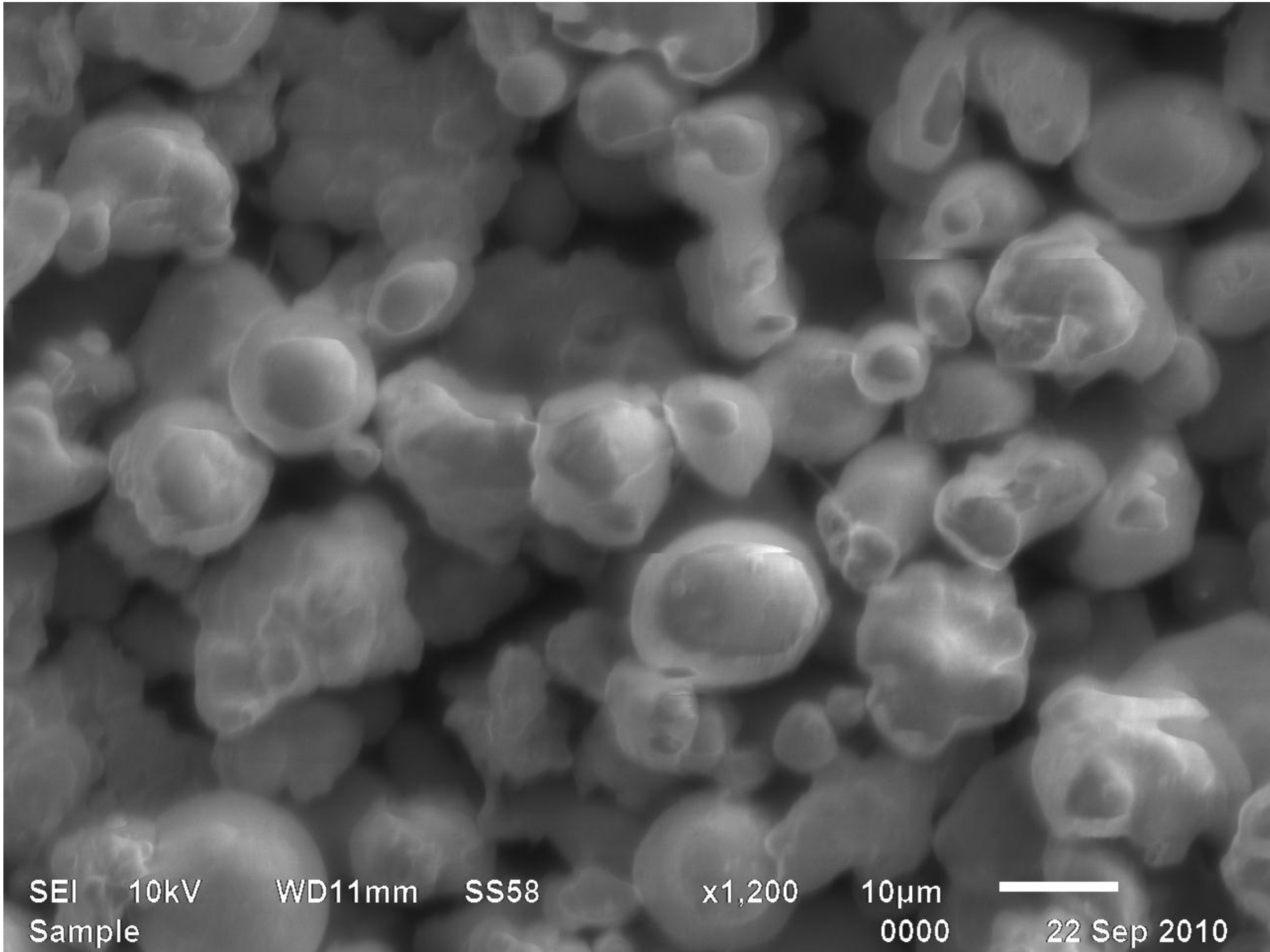
Particle Size and Shape

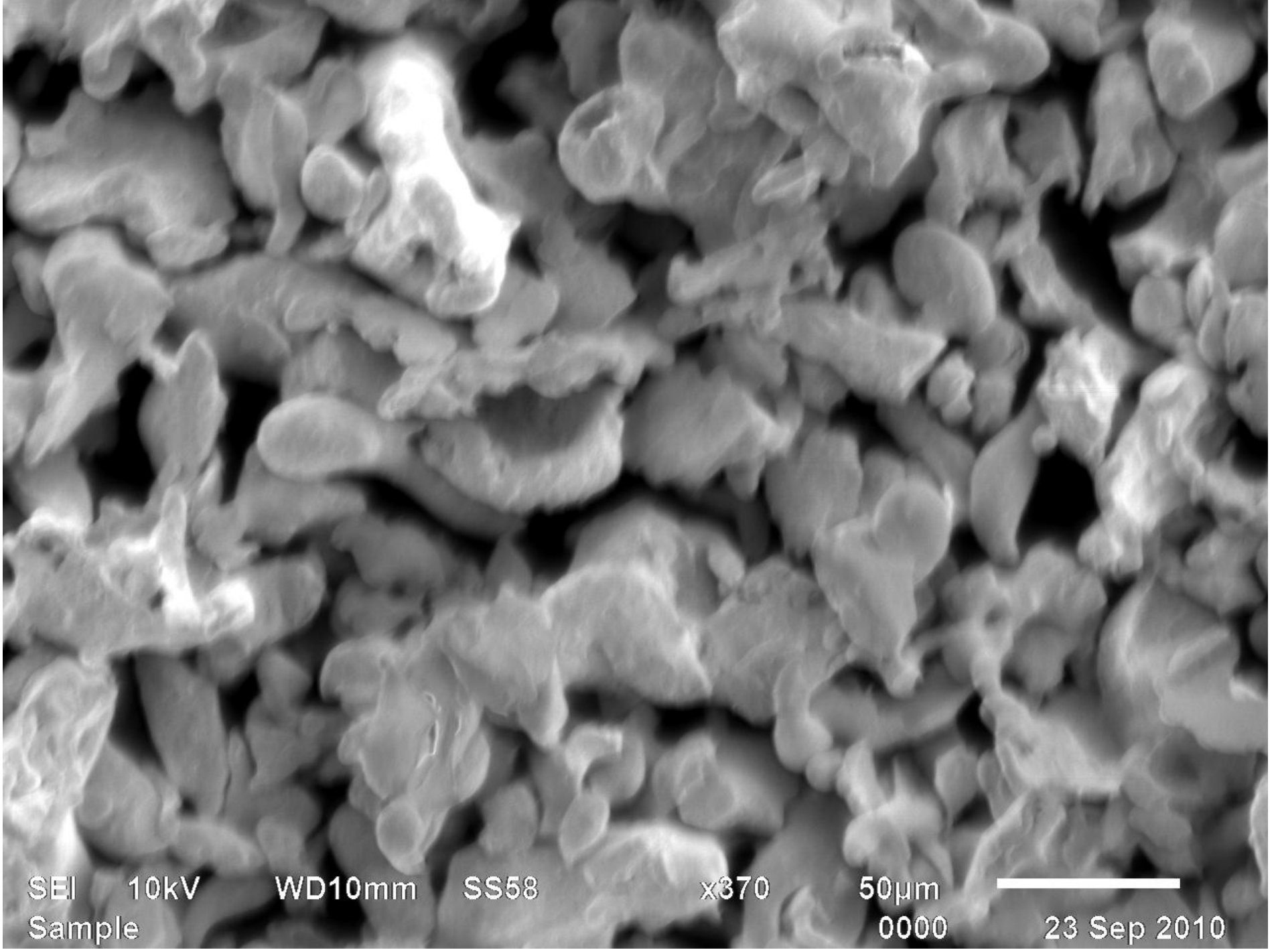
- Most fabricated particles have complex shapes
- Particles size and shape influence packing, flow and compressibility of the powder.
- Characteristic dimensions of the particle depends on the shape of the particle

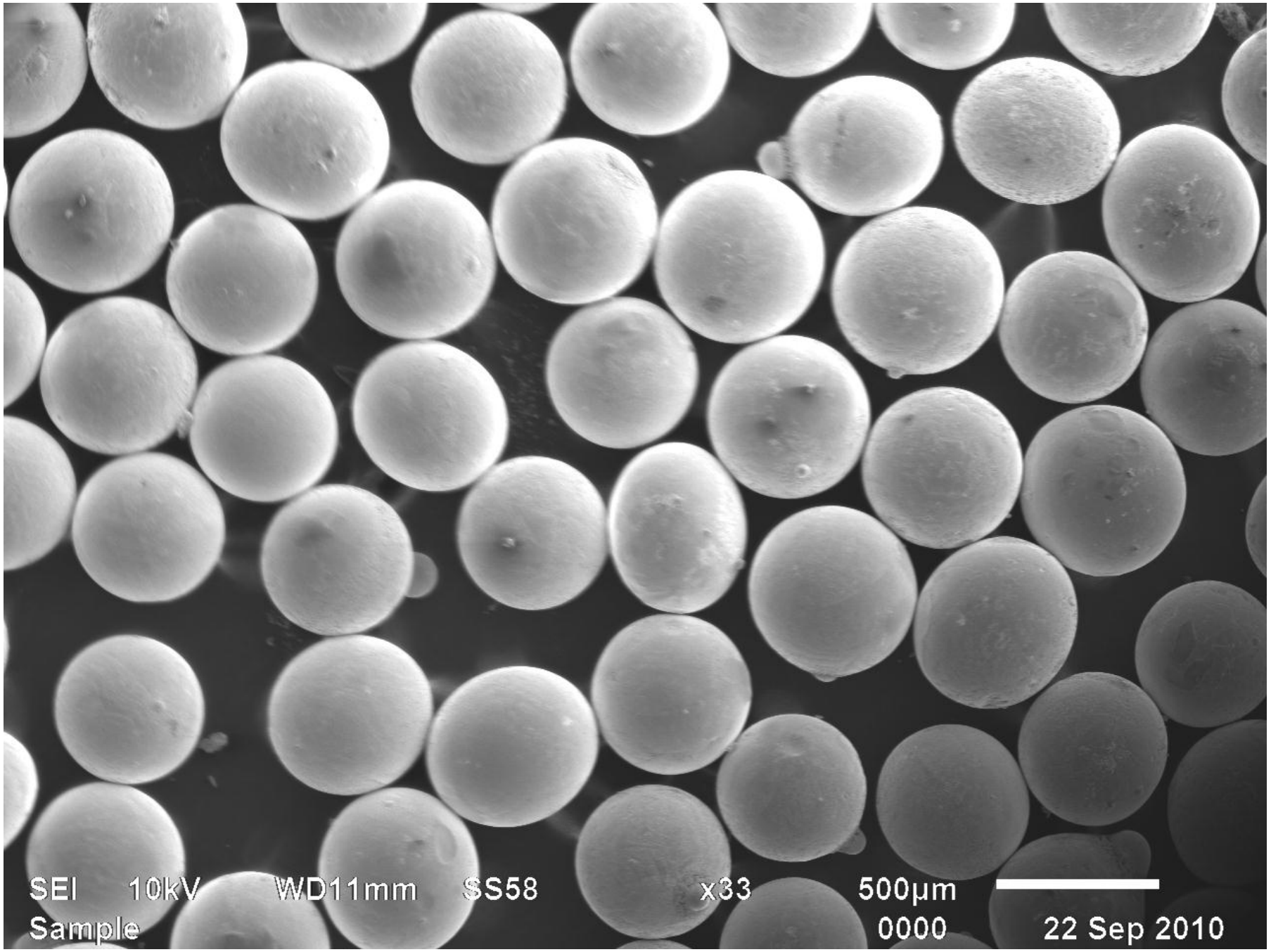





SEI 10kV WD10mm SS58 x370 50µm
Sample
0000 22 Sep 2010


SEI 10kV WD11mm SS58 x1,200 10µm
Sample 0000 22 Sep 2010

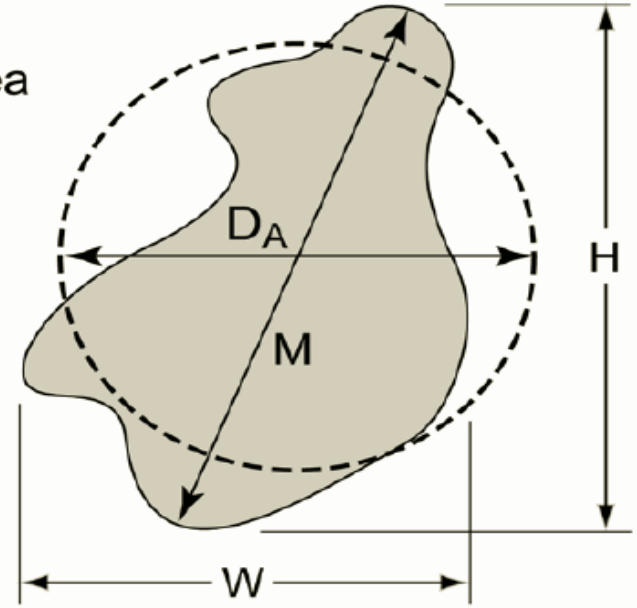

SEI 10kV WD10mm SS58 x370 50µm
Sample 0000 23 Sep 2010


SEI 10kV WD11mm SS58 x33 500µm
Sample 0000 22 Sep 2010

Particle Size

- Several metrics are used to describe particle size. They are based on
  - Characteristic length of projected particle
    - Projected height
    - Projected width
    - Maximum cord length
  - Diameter of an equivalent sphere of the same
    - Projected area (Projected equivalent diameter, D_A)
    - Surface area of actual particle (Surface equivalent diameter, D_S)
    - Volume of actual particle (Volume equivalent diameter, D_V)

A = projected area
S = surface area
V = volume



possible size measures

H = projected height
W = projected width
M = maximum cord length

equivalent spherical diameters:

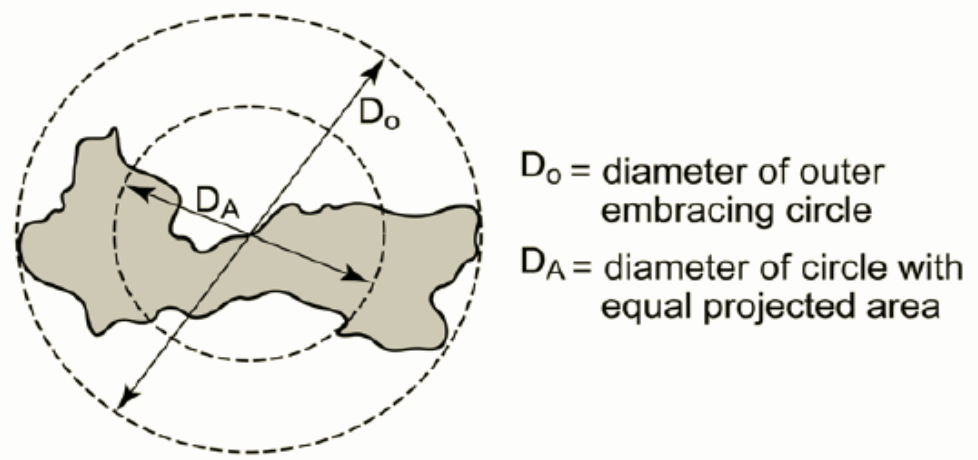
$D_A = (4A / \pi)^{1/2}$
$D_S = (S / \pi)^{1/2}$
$D_V = (6V / \pi)^{1/3}$

Particle Shape

- Most common descriptors of particle shape are main particle features (see figure of particle shapes), shape factor and aspect ratio.
- The shape factor, k, is defined as the particle surface area divided by the surface area of the same volume
  - The shape factor for a spherical particle is unity, and greater than one for other shapes
  - It is used to calculate specific surface area S (area per unit mass m^2/kg)

$$S = 6\,k / (\rho\, D_V)$$

- The aspect ratio is described in terms of
  - Linear dimensions of projected particle (M/W)
  - Equivalent diameters of projected particle (D_O/D_A)



Particle Size Distribution

- The variation of particle size in a powder is described by a distribution function.
- The key parameters in the distribution function are a mean particle size and a standard deviation σ^2
- These two parameters are determined from measured amounts of all particle sizes in the powder