# 2 Particle characterisation

An obvious question to ask is, 'what is the particle diameter of my powder?' However, the answer is not so simple. Firstly, most materials are highly irregular in shape, as can be seen in Figure 2.1 – where should one make the measurement? Also, if we turn a particle on its side it is likely that the measurement would be different. When we have to verbally provide this information to someone, who cannot see the particle, it becomes almost impossible to describe the particle simply. In engineering, we wish to perform calculations using the diameter; so, we need some simple basis for describing the irregularly shaped particle that can be used in communication and calculations. This is the origin of the concept of the *equivalent spherical diameter*, in which some physical property of the particle is related to a sphere that would have the same property, e.g. the same volume. Volume is easily measured. If the particle is big enough, water displacement would work and the particle volume can be equated to the volume of a sphere. Note that we shall use diameter rather than radius and the symbol $x$ rather than $d$. Also, it is common practice to talk about particle size, which really means particle diameter.

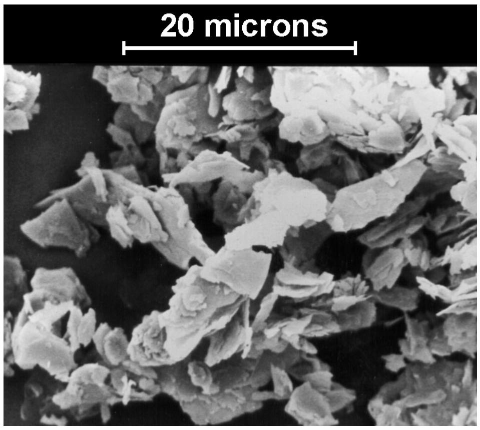
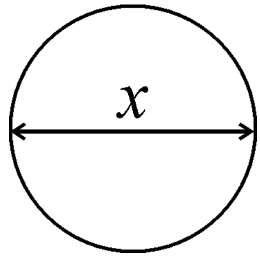


**Fig. 2.1** Talc particles – as in talcum powder

A sphere is a readily understood geometric shape and characterised by a single dimension: its diameter. If you have completed exercise 2.1 you will appreciate that, for the same particle, the equivalent spherical diameter depends upon the property selected for the equivalence. Unless, of course, the particle is spherical in shape. Hence, it is a sphere that all particles are related to and not some other simple geometric shape, e.g. a cube.

Even though we can relate a measured property of our particle to that of a sphere we should still consider particle shape, as it can have an important influence on processing requirements. One simple way to quantify shape is using Wadell's sphericity ($\Psi$) where:

$$\Psi = \frac{\text{surface area of sphere of equal volume to the particle}}{\text{surface area of the particle}} \qquad (2.1)$$




**Equations for spheres**

circumference is $\pi x$

surface area is $\pi x^2$

projected[1] area is $\frac{\pi}{4}x^2$

volume is $\frac{\pi}{6}x^3$

specific surface is $\frac{6}{x}$

**exercise 2.1**

Calculate the equivalent spherical diameter of a 10 μm cube, using equivalence by:
perimeter,
projected area,
surface area,
volume,
specific surface, and
mesh size (i.e. sieve opening size)

e.g. for volume $10^3 = \frac{\pi}{6}x_v^{\,3}$

[1]projected area – what is observed when looking at a particle using a microscope