Size separation methods

Some of the types of size separation equipment are discussed briefly below. These have been chosen to illustrate the basic principles of size separation. The actual equipment in use in pharmaceutical processing continues to develop, yet remains based on the principles illustrated.

Size separation by sieving

Separation ranges

These are shown in Figure 10.17.

Principles of operation

The principles of sieving in order to achieve particle size analysis are described in Chapter 9. There are some differences in the methods used to achieve size separation rather than size analysis. The use of sieving in size separation usually requires processing of larger volumes of powder than are commonly found in size analysis operations. For this reason, the sieves used for size separation are often larger in area and of more robust construction than those used for size analysis.

There are several techniques for encouraging particles to separate into their appropriate size fractions efficiently. In dry sieving processes these are based on mechanical disturbances of the powder bed and include the following.

Agitation methods. Size separation is achieved by electrically induced oscillation, mechanically induced vibration of the sieve meshes or by gyration in which sieves are fitted to a flexible mounting which is connected to an out-of-balance flywheel. In the latter case, the eccentric rotation of the flywheel imparts a rotary movement of small amplitude and high intensity to the sieve and causes the particles to spin, thereby continuously changing their orientation and increasing their potential to pass through a given sieve aperture. The output efficiency of gyratory sieves is usually greater than that of oscillation or vibration methods.

Agitation methods can be made continuous by inclination of the sieve and the use of separate outlets for the undersize and oversize powder streams.

Brushing methods. A brush is used to reorientate particles on the surface of a sieve and prevent apertures becoming blocked. A single brush can be rotated about the midpoint of a circular sieve or, for large-scale processing, a horizontal cylindrical sieve is employed with a spiral brush rotating about its longitudinal axis. It is important, however, that the brush does not force the particles through the sieve by distorting either the particles or the sieve mesh.

Centrifugal methods. In this type of equipment, particles are thrown outwards on to a vertical cylindrical sieve under the action of a high-speed rotor inside the cylinder. The current of air created by the rotor movement also assists the sieving process, especially where very fine powders are being processed.

Wet sieving can also be used to effect size separation and is generally more efficient than dry sieving methods.

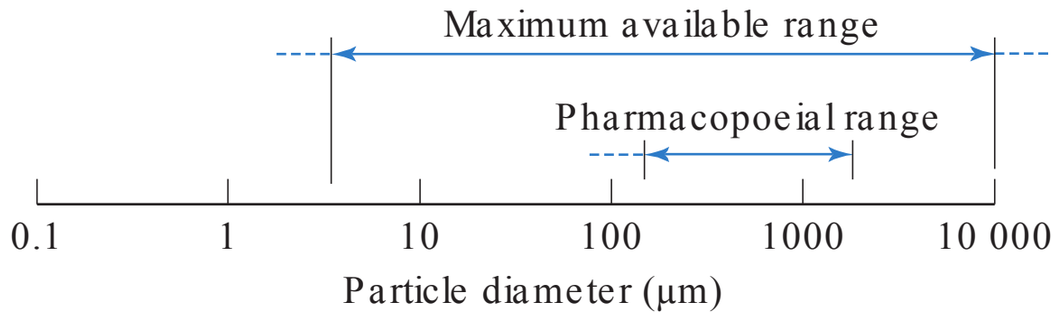

Fig. 10.17 • Separation range for sieving.

Standards for powders based on sieving

Standards for the size of powders used pharmaceutically are sometimes provided in pharmacopoeias. These may indicate how the degree of coarseness or fineness of a powder is differentiated and expressed by reference to the nominal mesh aperture size of the sieves used. Grades of powder are specified and defined in general terms by most pharmacopoeias. An example is shown in Table 10.2.

It should be noted that the term 'sieve number' has been used as a method of quantifying particle size in pharmacopoeias and is still favoured in some parts of the world. However, various monographs use the term differently and in order to avoid confusion it is strongly recommended to always refer to particle sizes according to the appropriate equivalent diameters expressed in millimetres, micrometres or nanometres, as appropriate.