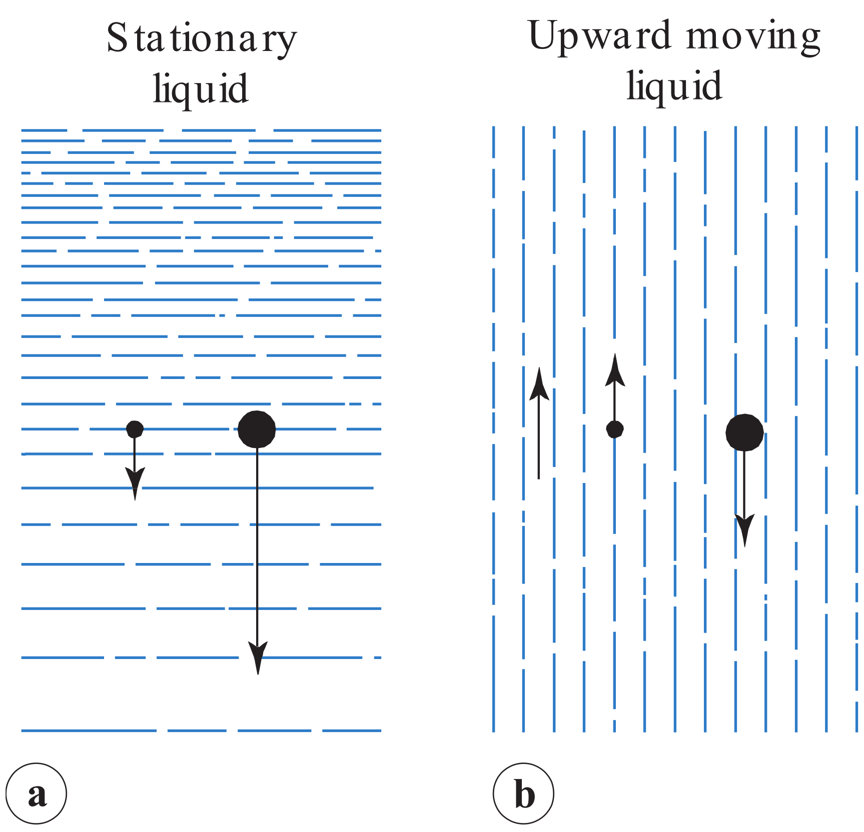

Fig. 10.20 • Comparison of **(a)** sedimentation and **(b)** elutriation.

different size fractions depending on the velocity of the fluid.

Elutriation and sedimentation methods are compared diagrammatically in Figure 10.20, where the arrows are vectors; that is, they show the direction and magnitude of particle movement. This figure may indicate that if particles are suspended in a fluid moving up a column, there will be a clear cut into two fractions of particle size. In practice this does not occur, as there is a distribution of velocities across the tube in which a fluid is flowing – the highest velocity is found in the centre of the tube and the lowest velocity at the tube walls. Therefore, the size of particles that will be separated depends on their position in the tube: the largest particles in the centre, the smallest towards the outside. In practice, particles may rise with the fluid in the centre of the apparatus and then move outwards to the tube wall, where the velocity is lower and they then fall. A separation into two size fraction occurs, but the size cut is not clearly defined. Assessing the sharpness of size cuts is discussed above.

Separation of powders into several size fractions can be achieved by using a number of elutriators connected in series. The suspension is fed into the bottom of the narrowest column, overflowing from the top into the bottom of the next widest column and so on. Because the mass flow remains the same, as the column diameter increases the fluid velocity decreases and therefore particles of decreasing size will be separated.

Adaptations of this technique in which the liquid is replaced by air are available. Air is used as the counterflow fluid in place of water for elutriation of

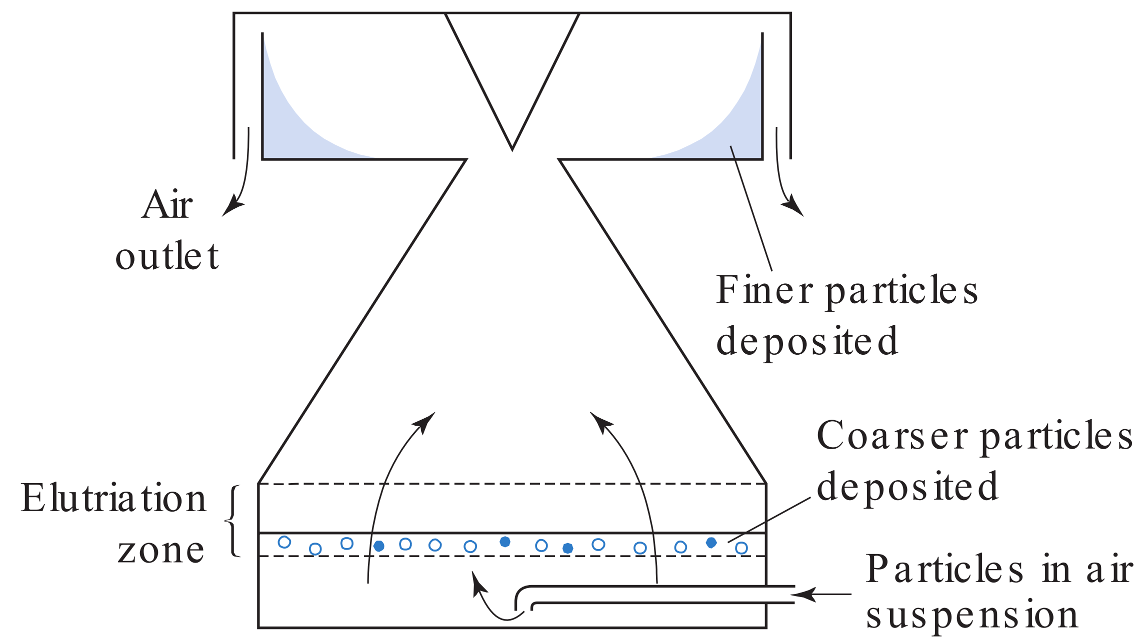

Fig. 10.21 • Upward airflow elutriator.

soluble particles into different size ranges. There are several types of air elutriator, which differ according to the airflow patterns used. An example of an upward airflow elutriator is shown in Figure 10.21. Particles are held on a supporting mesh through which air is drawn. Classification occurs within a very short distance of the mesh and any particles remaining entrained in the air stream are accelerated to a collecting chamber by passage through a conical section of tube. Further separation of any fine particles still entrained in the air flow may be carried out subsequently using different air velocities.

Size separation by cyclone

Separation range

This is shown in Figure 10.22.

Principles of operation

Probably the most common type of cyclone used to separate particles from fluid streams is the reverse-flow cyclone (Fig. 10.23). In this system, particles in air or liquid suspension are often introduced tangentially into the cylindrical upper section of the cyclone, where the relatively high fluid velocity produces a vortex that throws solid particles out on to the walls of the cyclone. The particles are forced down the conical section of the cyclone under the

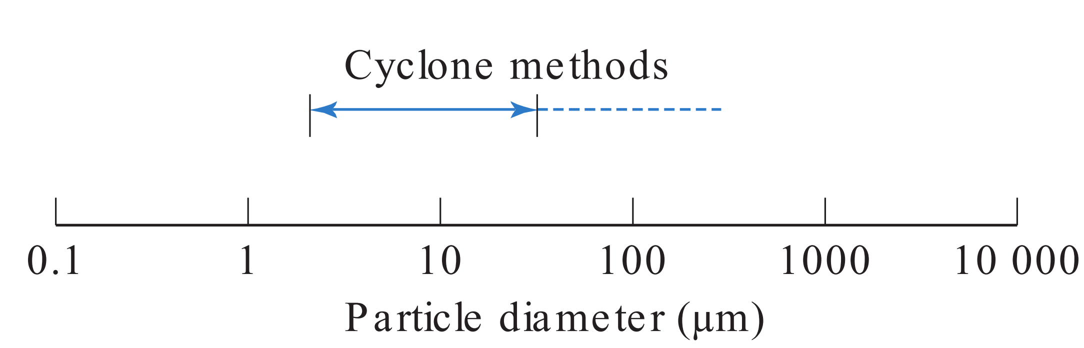

Fig. 10.22 • Separation ranges for cyclone methods.