

14 Gas cleaning

In the earlier chapters unit operations that cause particles to become entrained in gas stream were covered; examples include fluidisation, pneumatic conveying and grinding. In the next chapter the effect of dust in the working environment is described. In certain workplaces removal of particles down to very low sizes and concentrations is essential, such as within operating theatres, during fabrication of electronic equipment and production of pharmaceutical grade materials. Hence, a critically important subject is the removal of particles from gas streams. The subject is significantly different from solid-liquid separation because the fluid medium is much less viscous than a liquid and this influences the forces that are most relevant to the trajectory analysis.

In many industrial processes sedimentation is the primary mechanism for particle removal from a gas stream. Thus, gas fluidised beds have the characteristic shape illustrated in Figure 7.2: the increase in the bed diameter leads to a decrease in the gas velocity above the bed and particles will fall back into the fluidised bed. However, finer particles may still be *carried over* with the gas, i.e. *entrained* in the gas flow, and additional particle/gas separation equipment is required. The material presented in Chapter 5 is appropriate to calculate the sedimentation rates of particles in gases, this chapter covers other relevant mechanisms.

14.1 Target; grade and overall efficiencies

To remove a particle from a gas stream it must be encouraged to hit a target and then to stick to it. The gas then passes on leaving the particle removed from it. Targets can be made from many objects including: liquid drops, fibres, larger particles, plates and walls. There is an enormous range of equipment based on one, or more, of these targets. Clearly, for the particle to be removed the target needs to have the property of retaining the particle from the flow but, if the targets are reused it must then be encouraged to release the particle when required during a cleaning cycle. There is often confusion between the different types of efficiencies used to describe the process. The simplest is the *single target efficiency*, which can be represented by Figure 14.1. The single target (e.g. a fibre) efficiency is (η_s)

$$\eta_s = \frac{r_c}{r_t} \quad (14.1)$$

where the particle is collected by inertial separation: the gas can easily change direction and does so round the fibre, but the particle has much greater inertia and will continue moving towards the fibre,

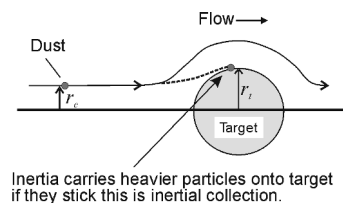


Fig. 14.1 Particle collected on a target from a gas streamline and single target efficiency