

Fig. 11.8 • Diagrammatic representation of a high-speed mixer-granulator.

expansion in bed volume which allows diffusive mixing. Once mixed, granulating agent can be added and granules formed in situ using a slower impeller speed and the action of the side-mounted chopper blade. Further details of granule production using this method can be found in [Chapter 28](#).

Because of the high-speed movement within a mixer-granulator, care needs to be taken if the material being mixed fractures easily. This, and the problems associated with overmixing of lubricants, means that this type of mixer is not normally used for blending lubricants.

Fluidized-bed mixers

The main use of fluidized-bed equipment is in the drying of granules ([Chapter 29](#)) or the coating of multiparticulates ([Chapter 32](#)). Fluidized-bed equipment can, however, be used to mix powders prior to granulation in the same bowl. This is discussed in [Chapter 28](#).

Agitator mixers

This type of mixer depends on the motion of a blade or paddle through the product, and hence the main mixing mechanism is convection. Examples include the ribbon mixer and the planetary mixer.

In the *ribbon mixer* ([Fig. 11.9](#)), mixing is achieved by the rotation of helical blades in a hemispherical trough. ‘Dead spots’ are difficult to eliminate in this type of mixer and the shearing action caused by the movement of the blades may be insufficient to break up drug aggregates. The mixer does, however, mix poorly flowing material and is less likely to cause segregation than a tumbling mixer.

A drawing of an industrial *planetary mixer* is shown in [Figure 11.10](#). Similar designs are used for both powder and semi-solid mixing. The mixing bowl is shown in the lowered position for filling and

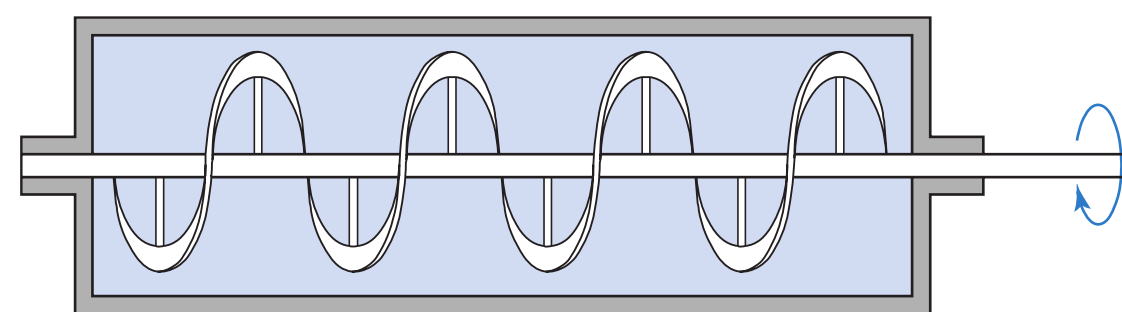


Fig. 11.9 • Ribbon agitator powder mixer.

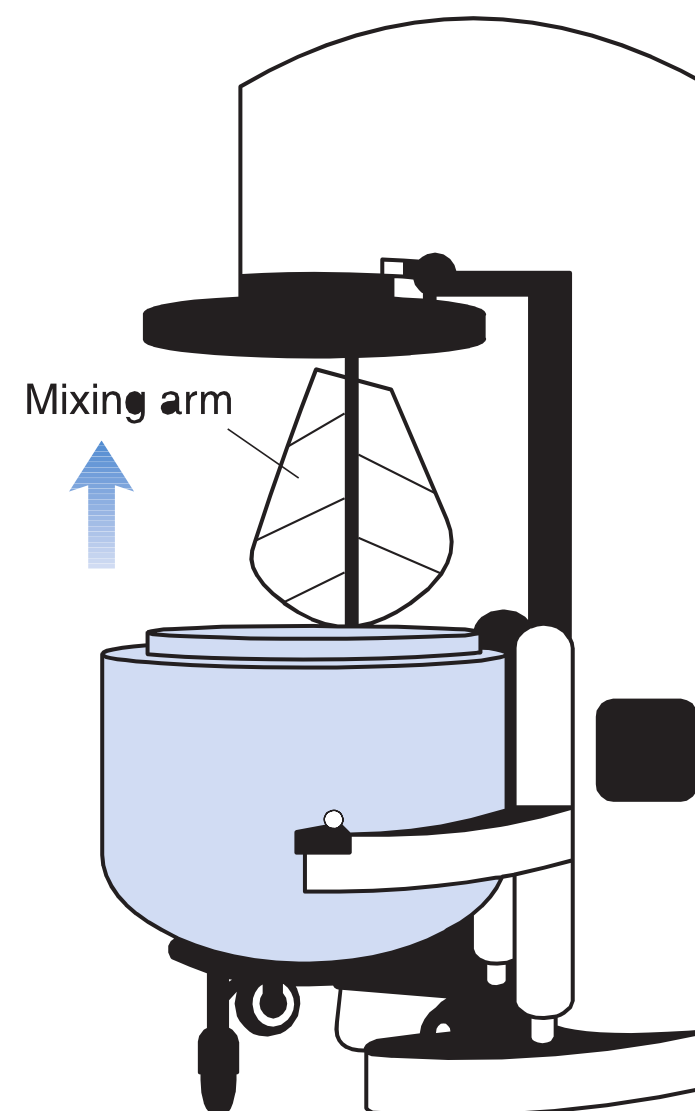


Fig. 11.10 • Planetary mixer for powders and semi-solids.

emptying. The bowl is raised up to the mixing blade for the mixing process. The mixing blade is set off centre and is carried on a rotating arm. It therefore travels round the circumference of the mixing bowl while simultaneously rotating around its own axis ([Fig. 11.11](#)). This is therefore a double rotation similar to that of a spinning planet around the sun – hence the name – and is designed so that the blade covers all the volume of the mixer.

Scale-up of powder mixing

The extent of mixing achieved at a small laboratory scale during development work may not necessarily be mirrored when the same formulation is mixed at a full production scale, even if the same mixer design is used for both. Often, mixing efficiency and the extent of mixing are improved on scale-up owing to increased shear forces. This is likely to be beneficial in most cases, although when blending