D.PHARM • FIRST YEAR

Pharmaceutics

CHAPTER 4.3

Mixing

ENGLISH CHAPTER NOTES



MIXING

Mixing distributes two or more components to obtain the required uniformity.

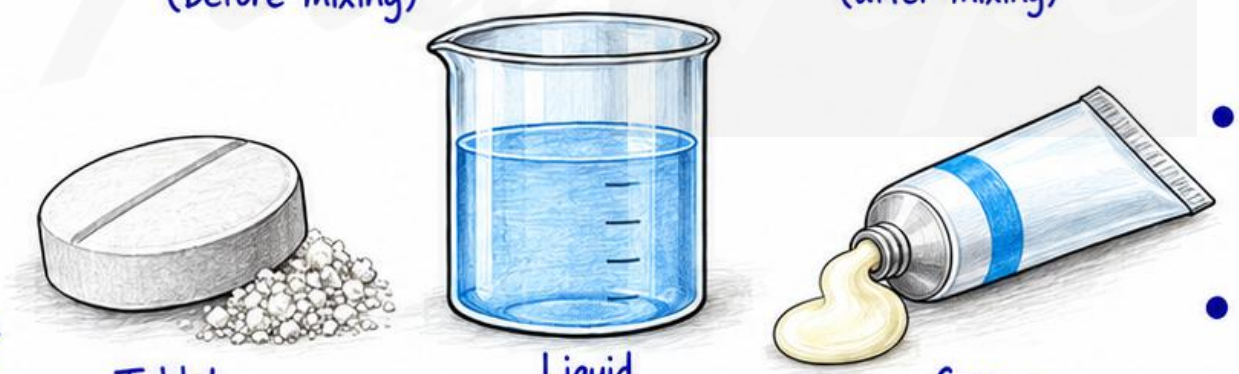
OBJECTIVES

- Give each portion a consistent composition.
- Distribute API and excipients throughout a formulation.
- Improve contact between ingredients and support processing.
- Reduce variation and support product quality.



Segregated powder mixture (before mixing)

Uniformly distributed (after mixing)



Tablet (solid mixture)

Liquid (solution, suspension or emulsion)

Cream (semisolid mixture)

APPLICATIONS

- Solid mixtures: tablet or capsule powders and granules.
- Liquid mixtures: solutions, suspensions and emulsions.
- Semisolid mixtures: creams, ointments and pastes.
- Other industries: food, chemicals, paints and polymers.

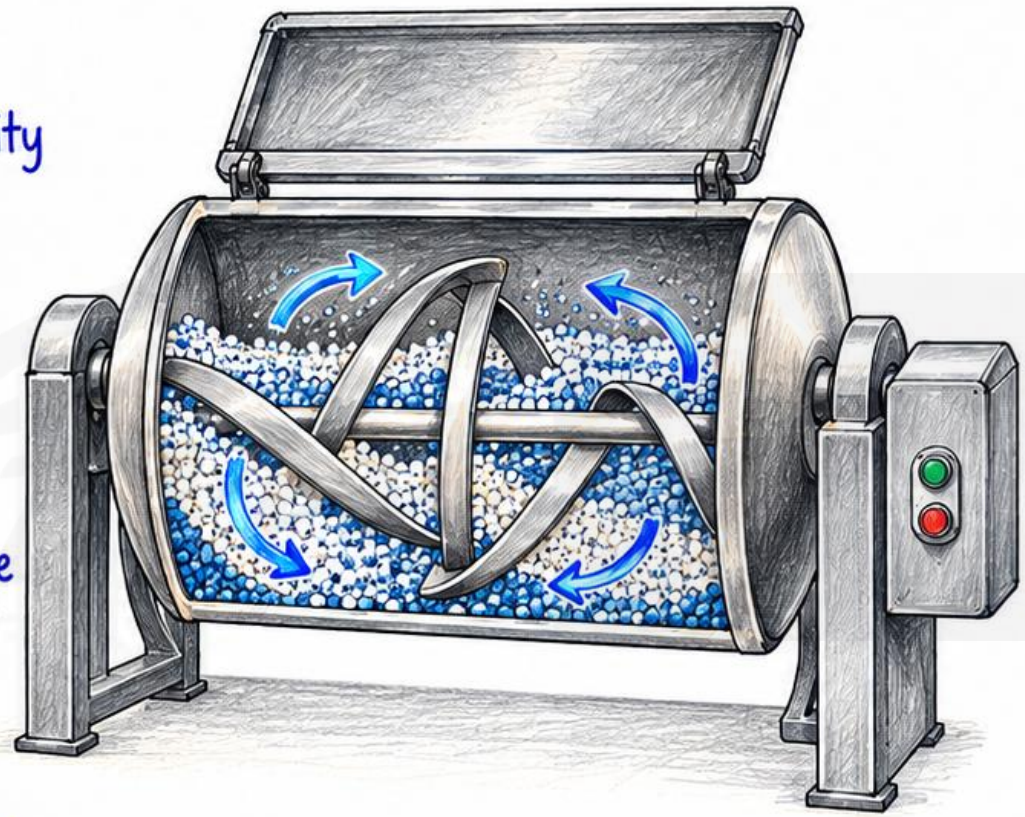
★ Uniform appearance alone does not prove uniform drug content.

FACTORS AFFECTING MIXING

Material properties and operating conditions control mixing efficiency.

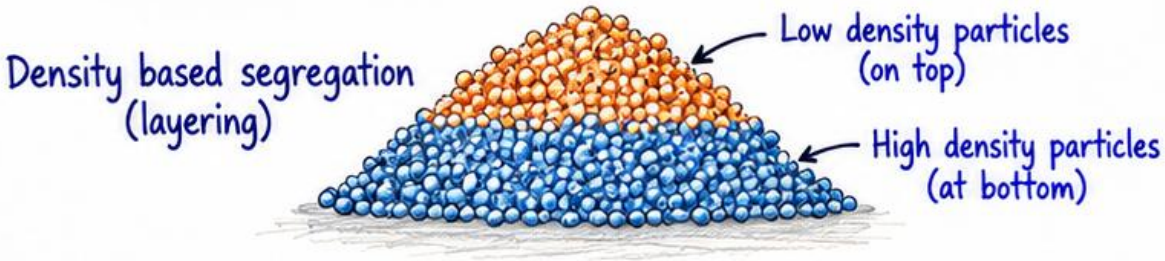
MATERIAL FACTORS

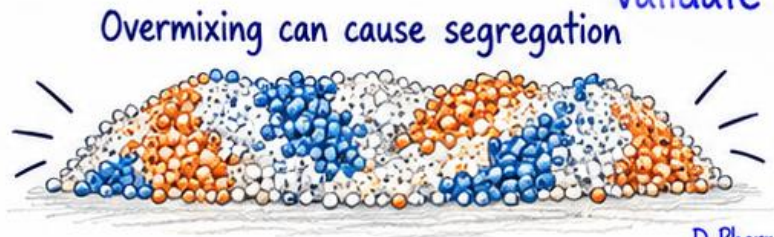
1. Particle size, shape and density influence movement and segregation.
2. Viscosity affects flow and the energy needed for liquid or semisolid mixing.
3. Ingredient proportions influence how easily a minor component is distributed.
4. Moisture and cohesion can form agglomerates in powders.



OPERATING FACTORS

5. Mixer design, fill level and scale determine circulation.
6. Speed and time must be appropriate for the formulation.
7. Temperature changes viscosity and may damage sensitive ingredients.
8. Air entrainment and evaporation can affect liquid products.
9. Excessive mixing can cause heat, degradation or segregation; validate the endpoint.



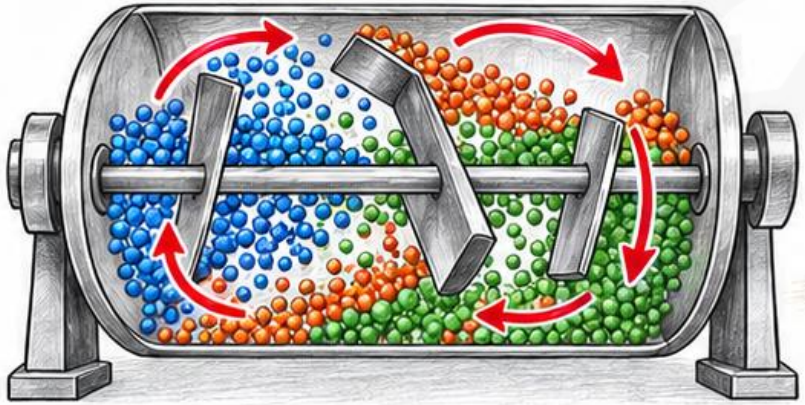


SOLID MIXING MECHANISMS

Powder mixing rearranges particles without dissolving them.

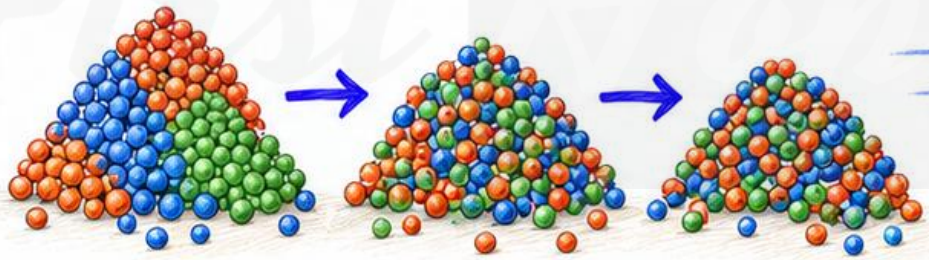
CONVECTIVE MIXING

- Groups of particles move from one region to another.
- Paddles or ribbons create bulk transfer and circulation.



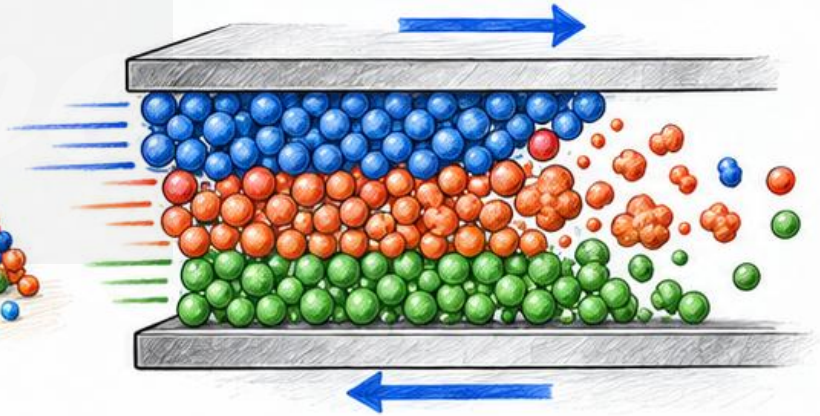
DIFFUSIVE MIXING

- Individual particles randomly change position relative to neighbours.
- This is particle rearrangement, not molecular diffusion.



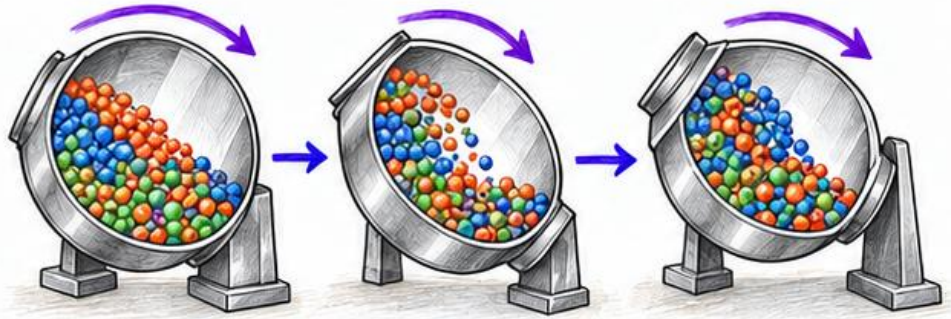
SHEAR MIXING

- Adjacent particle layers move at different speeds.
- Shear breaks some agglomerates and redistributes material.



TUMBLING

- Gravity repeatedly divides and recombines the powder bed.



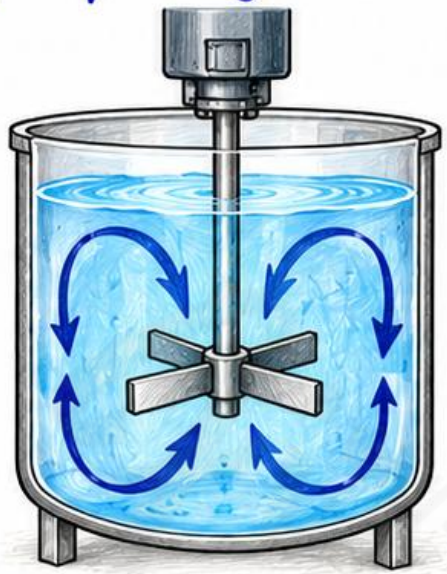
- Different mechanisms often operate together in one mixer.
- Size and density differences may cause the mixture to segregate again.

LIQUID MIXING MECHANISMS

Mixing brings liquid regions into contact and reduces concentration differences.

BULK FLOW

- The impeller circulates liquid through the vessel.
- Large-scale movement transports ingredients between regions.



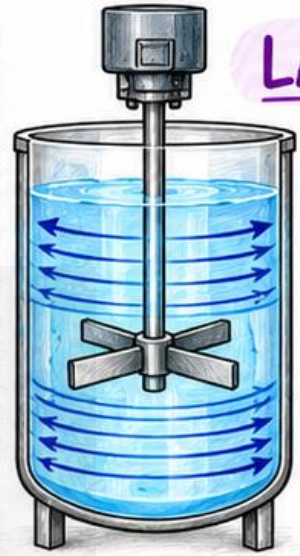
TURBULENT MIXING

- Irregular eddies repeatedly split and intermix liquid.
- More likely with low viscosity and sufficiently high flow velocity.



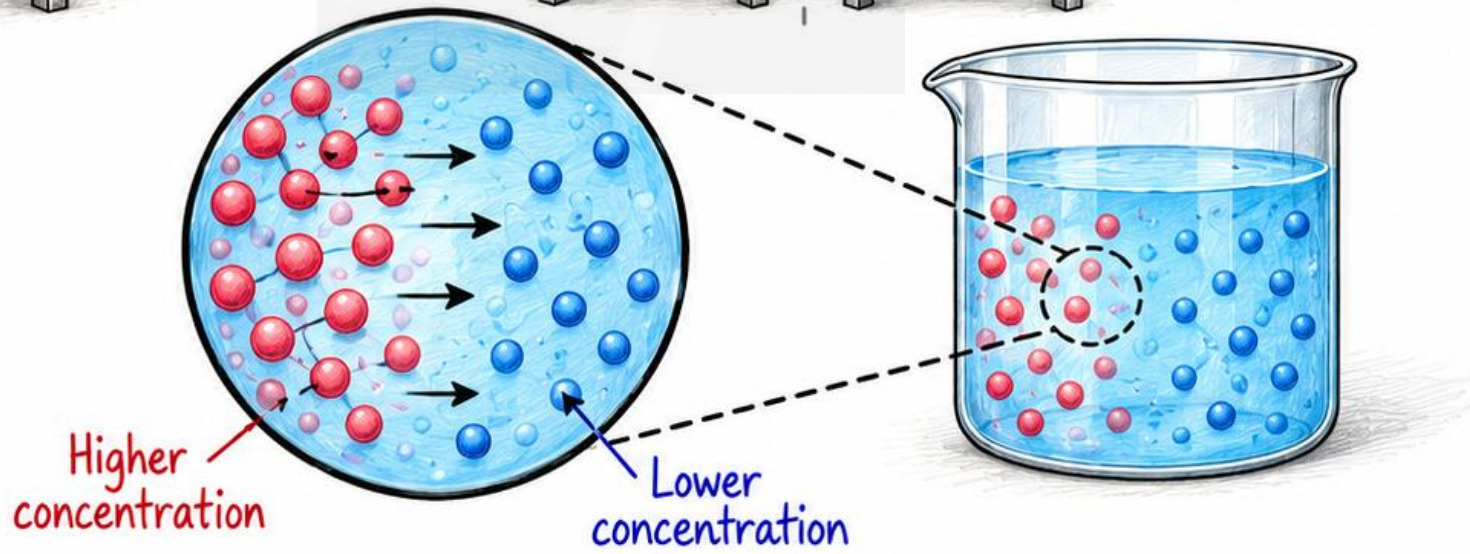
LAMINAR MIXING

- Smooth layers slide and stretch without strong turbulent eddies.
- Common in viscous liquids or at low Reynolds number.



MOLECULAR DIFFUSION

- Molecules move down concentration gradients over small distances.
- Bulk flow and stretching shorten the distance needed for diffusion.
- Equipment and operating speed must match the liquid viscosity.



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