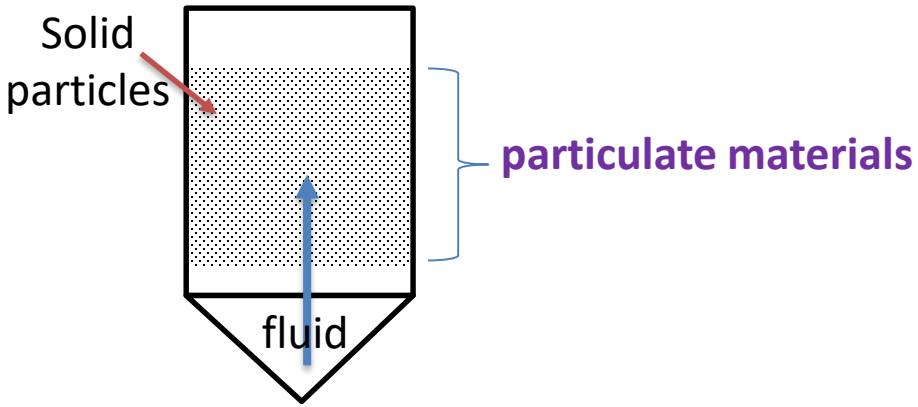
UNIT OPERATIONS OF PARTICULATE SOLIDS

Some Definitions & applications in chemical industries

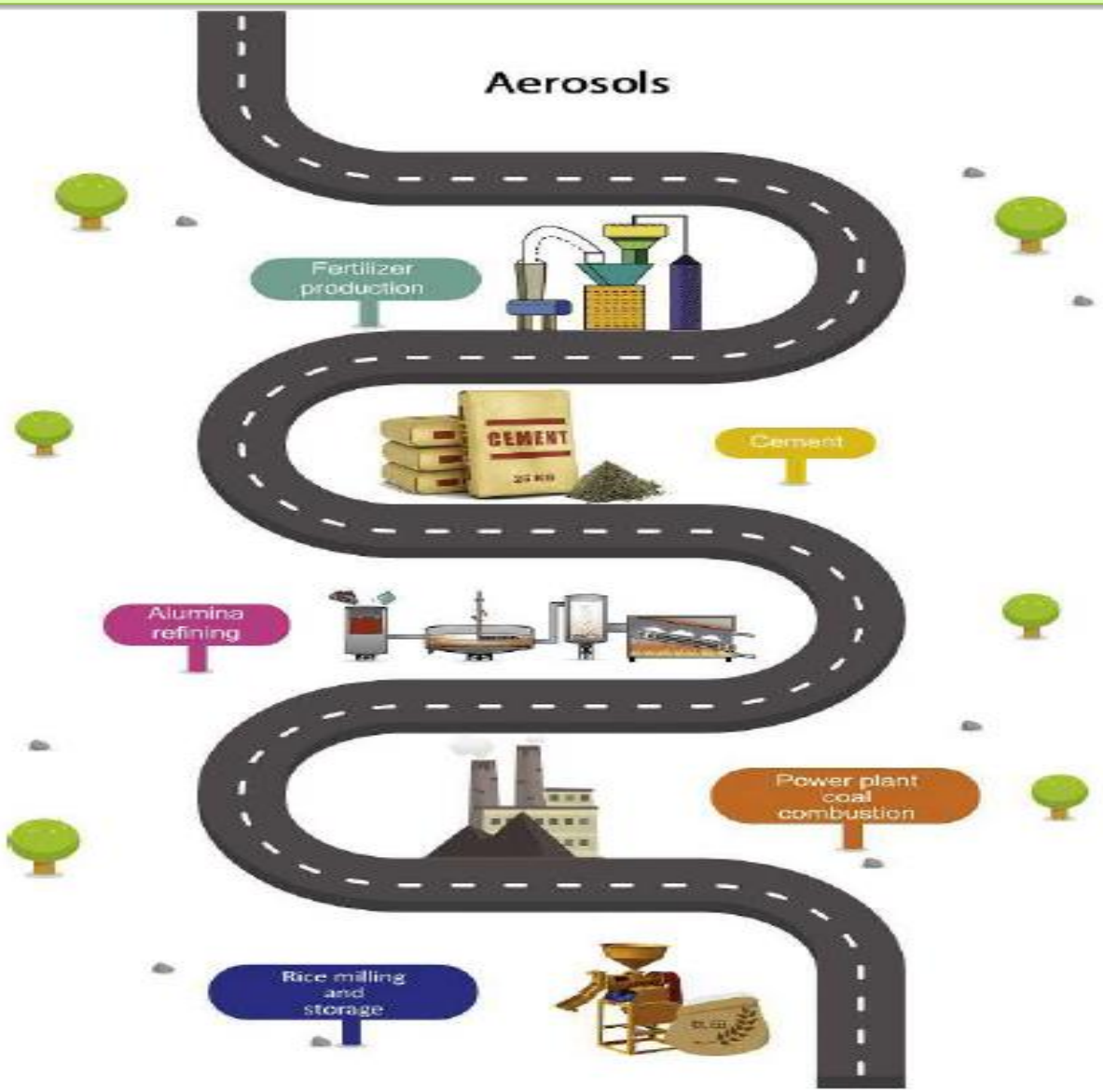
Introduction

- Solid materials and their dispersion in fluids are the subject matter of this course.
- Individual unit of dispersed solid material is referred to as a **particle.**
- Solid-fluid material systems are referred to as particulate systems, **particulate materials** or **particulates**.

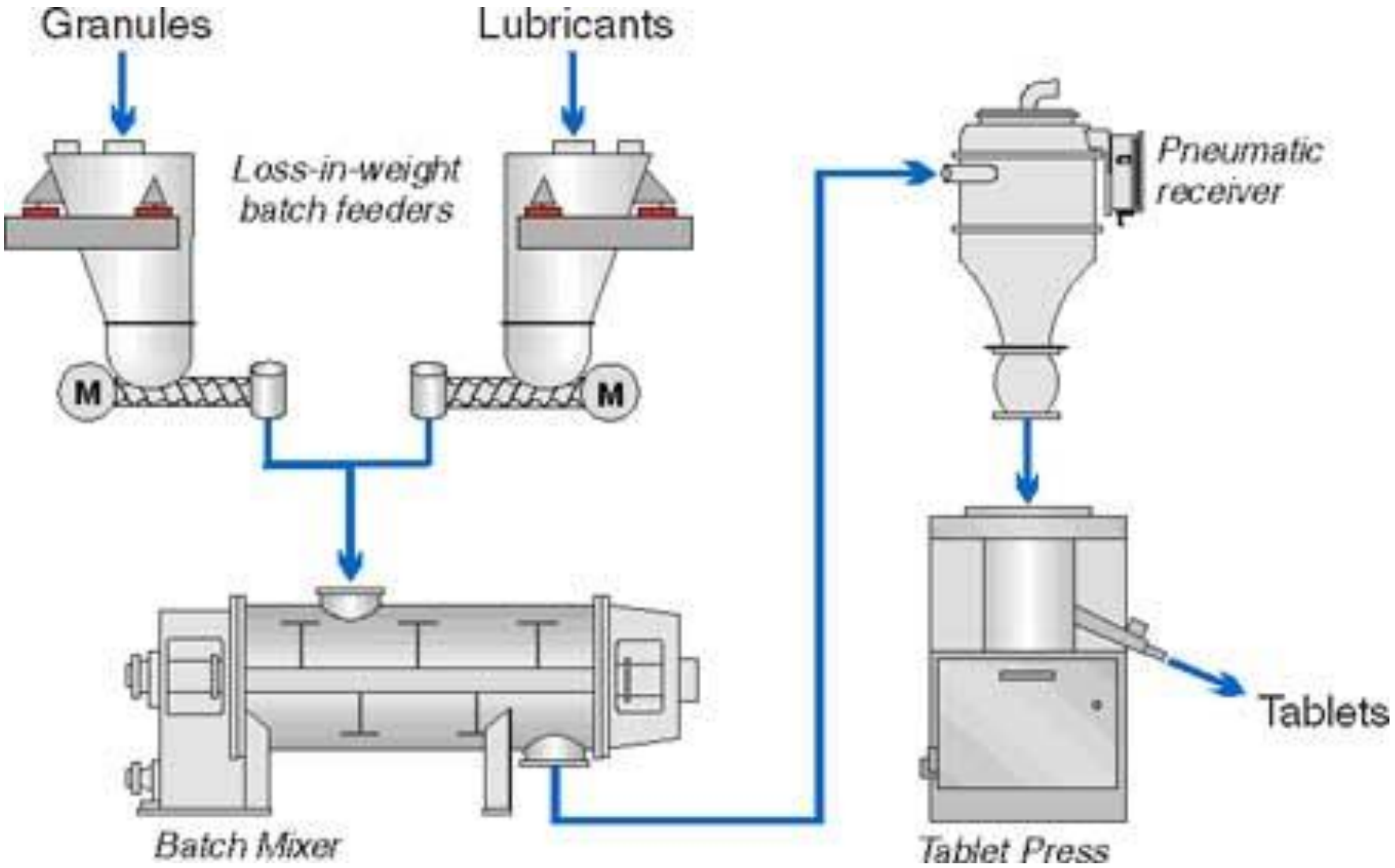
Solid particle



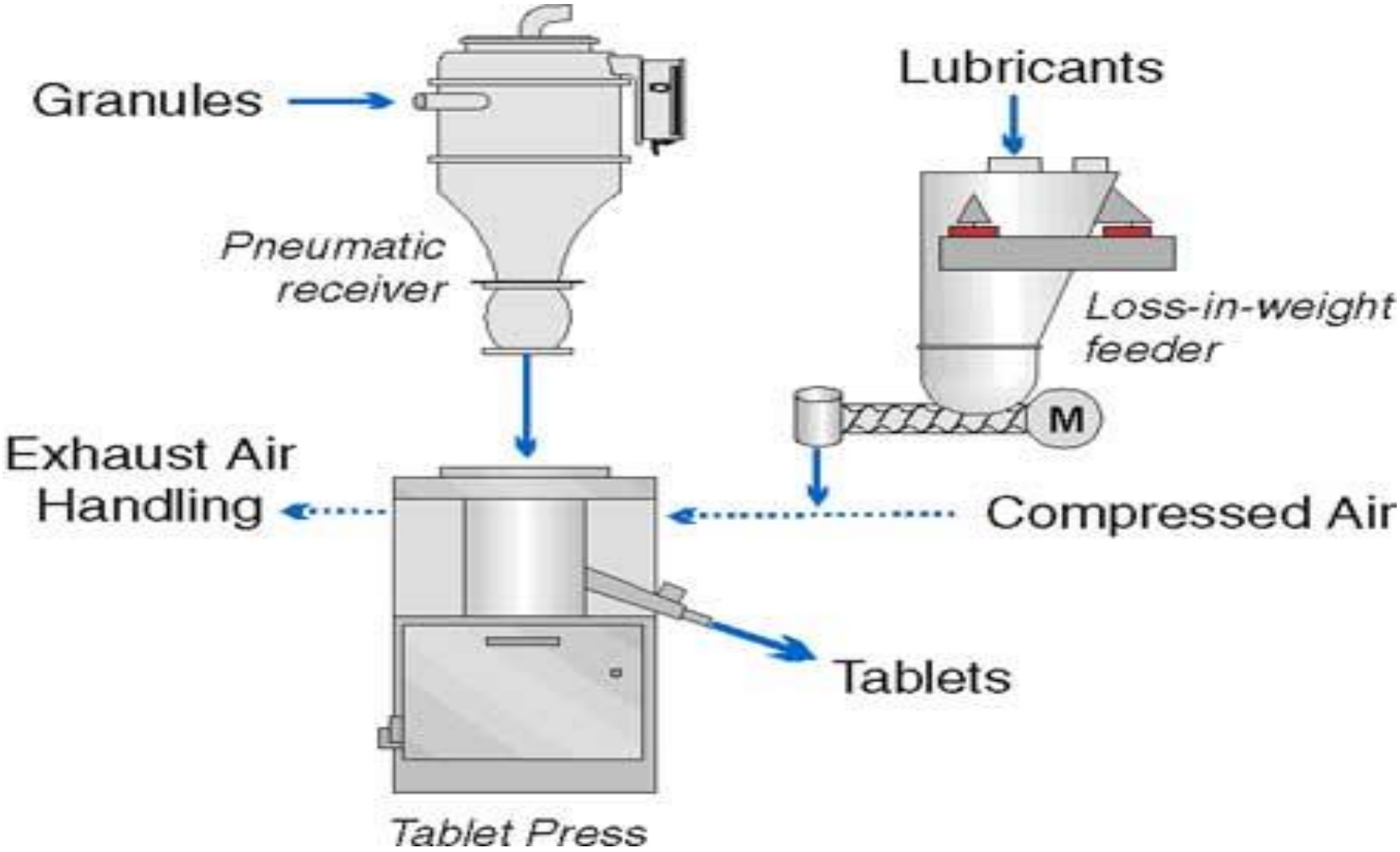
Examples of particulate systems in industrial applications.



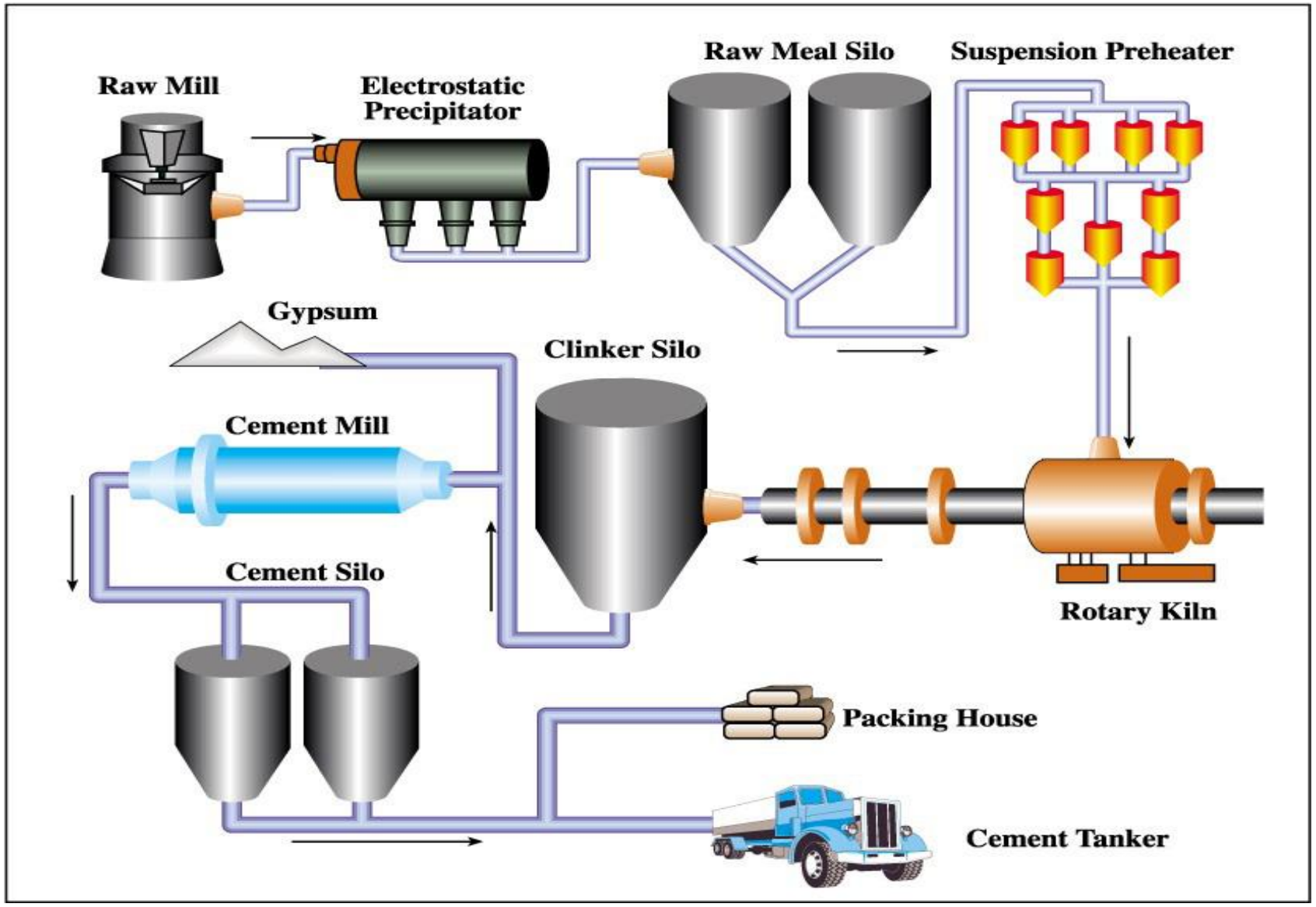
Application Example: Twin Screw Feeders in Pharmaceutical Tablet Press Lubrication Applications



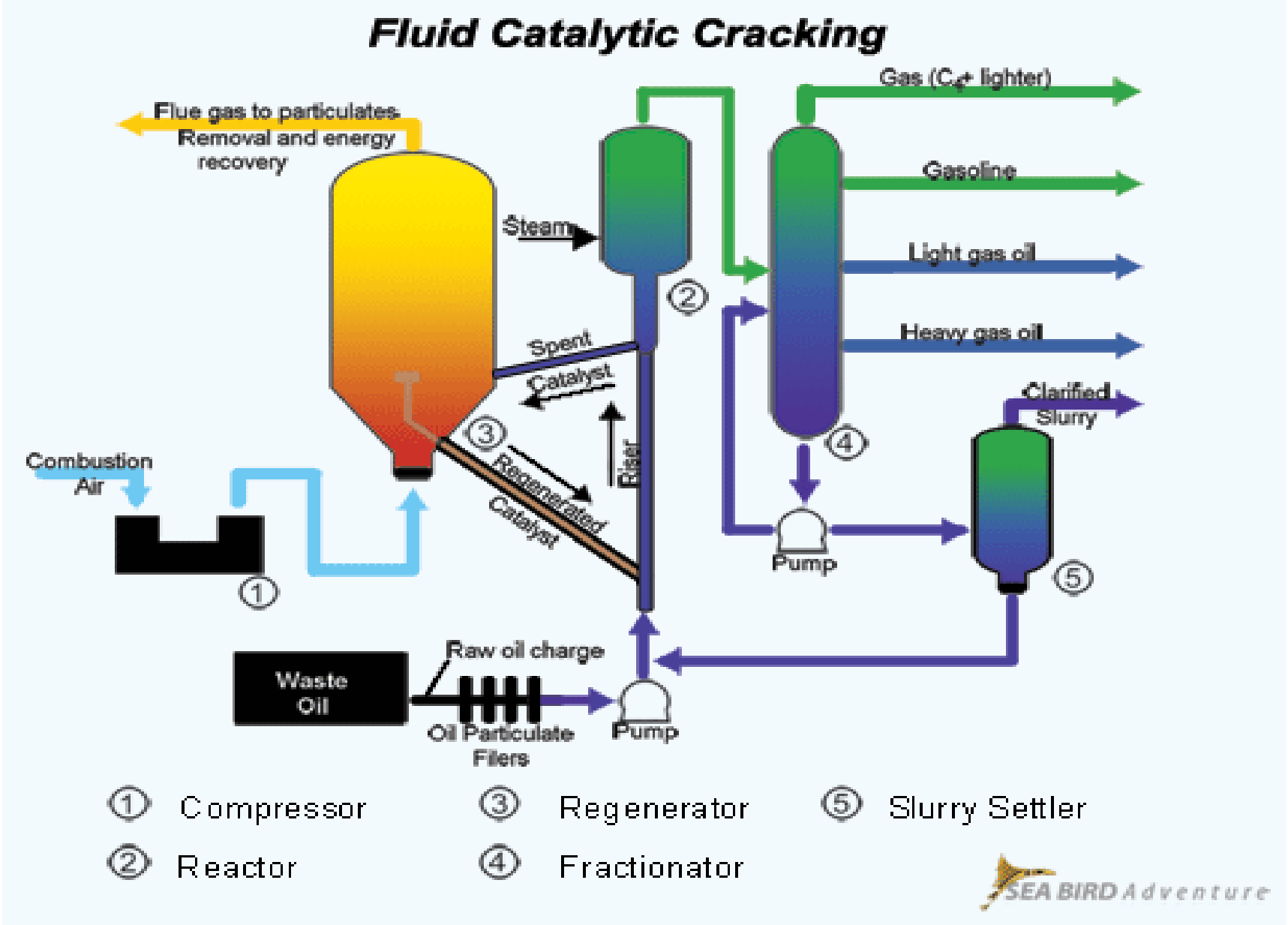
Pharmaceutical application tablet Press



Cement Production Process



FCC process


Fluid Catalytic Cracking
Flue gas to particulates Removal and energy recovery
Steam
Gas (C_4- lighter)
Gasoline
Light gas oil
Heavy gas oil
Clarified Slurry
Spent Catalyst
Regenerated Catalyst
Riser
Combustion Air
Pump
Pump
Waste Oil
Raw oil charge
Oil Particulate Filers
① Compressor
② Reactor
③ Regenerator
④ Fractionator
⑤ Slurry Settler
SEA BIRD Adventure

Examples of particulate systems in consumer applications.

Absorption column “lab experiment”

Solid particles
‘Packing bed’

Absorption column

Laboratory absorber

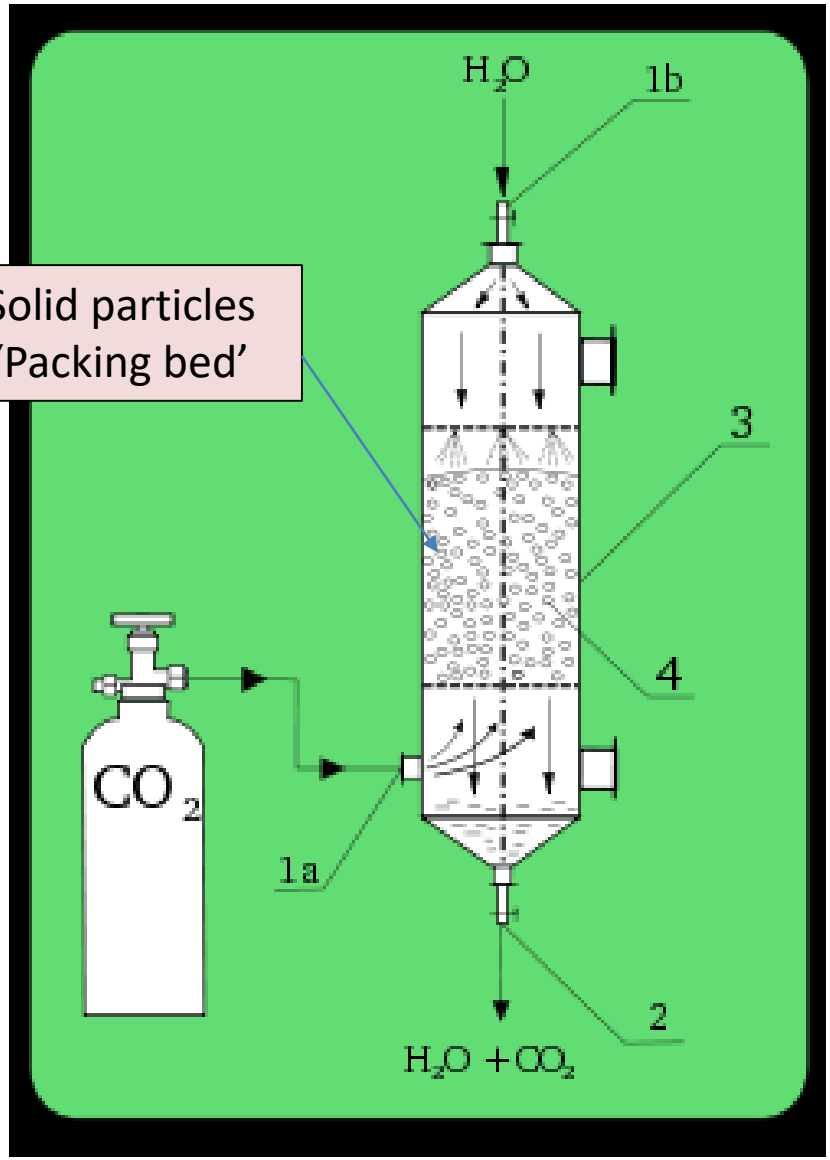
(1a): CO_2 inlet;

(1b): H_2O inlet;

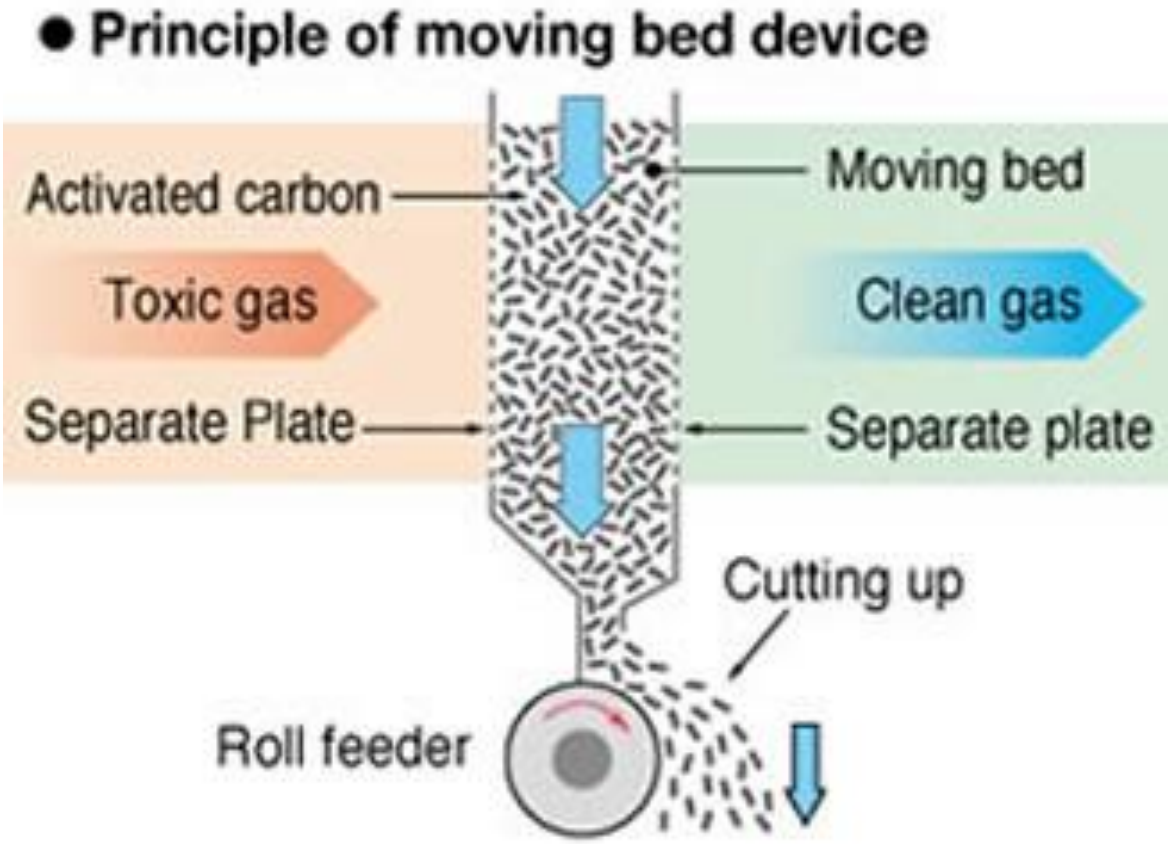
(2):outlet;

(3): absorption column;

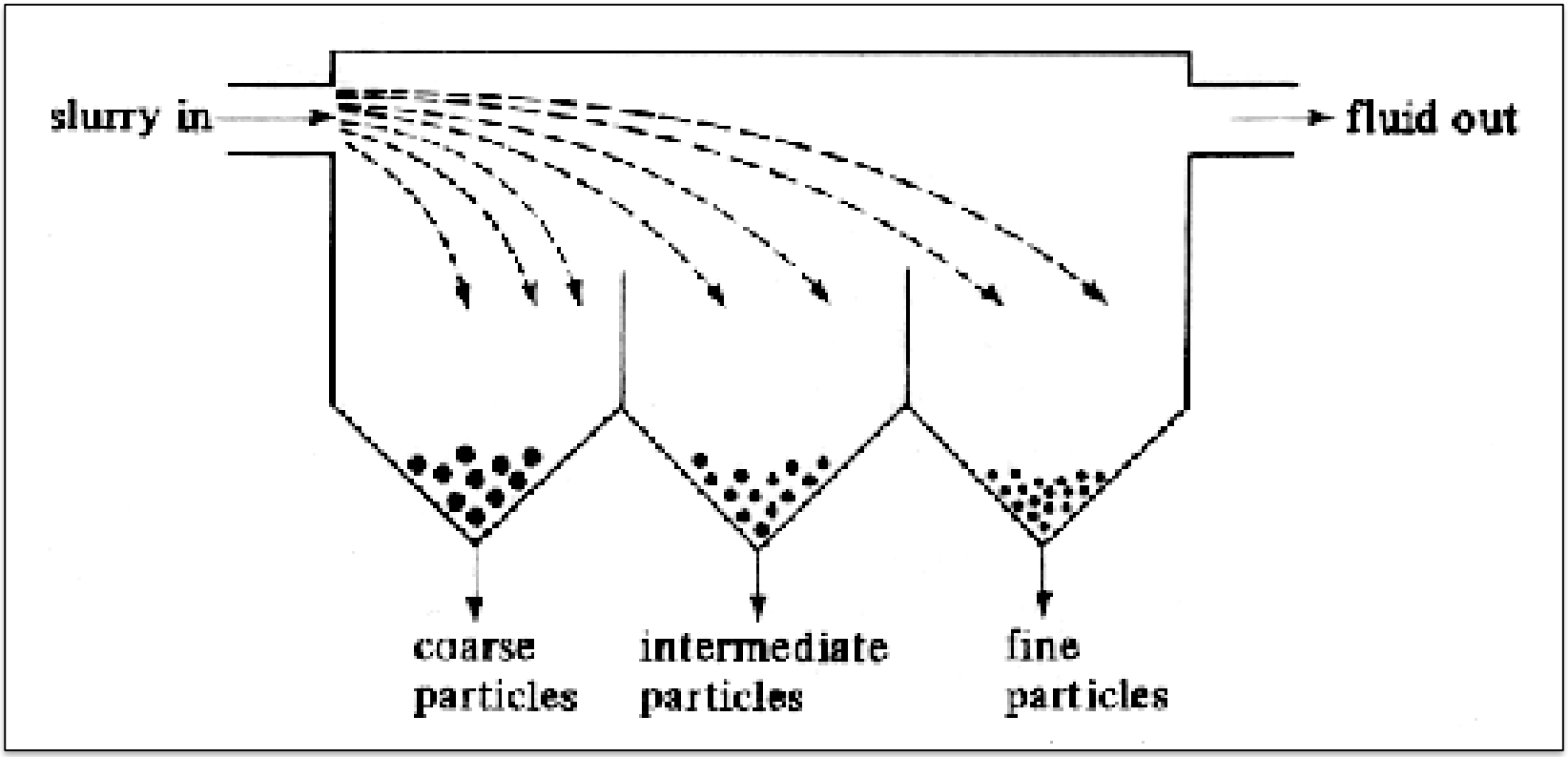
(4): **packing**.



Moving Bed of solid particles



Sedimentation

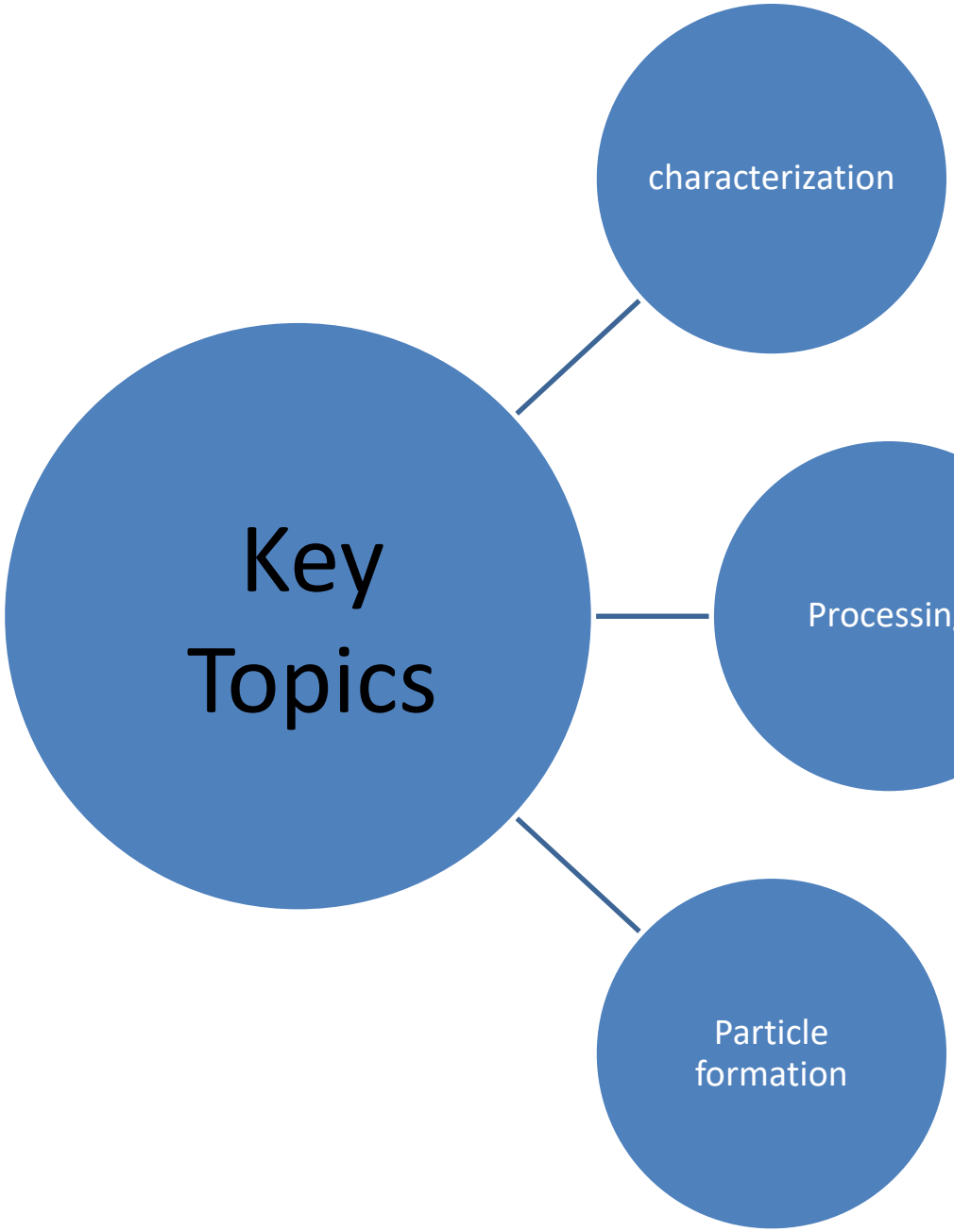


Solid Particulate

Introduction, Definitions, particle size analysis, size distribution, mean particle size, and measuring techniques

Topics of Particle Technology

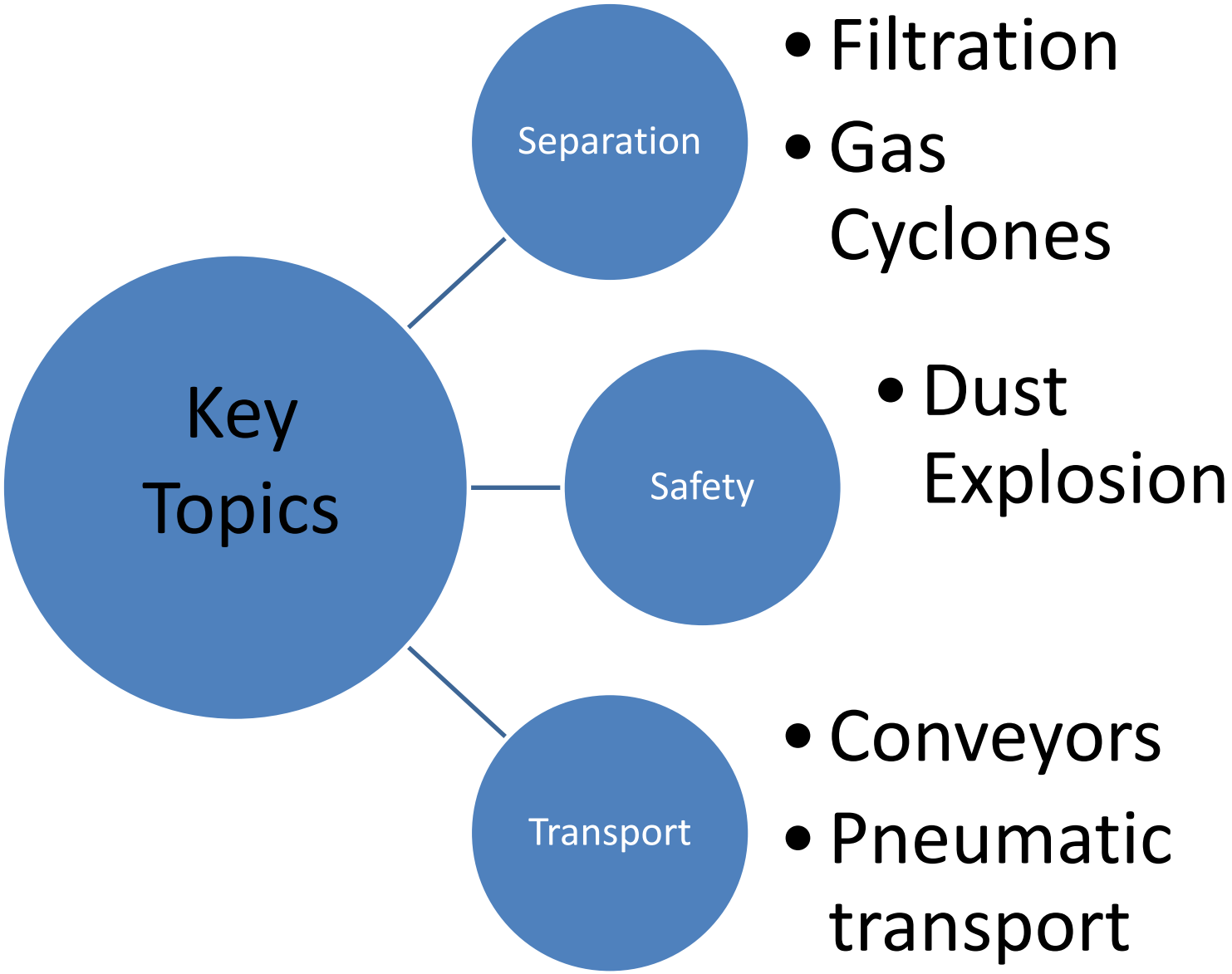
- Characterization of solids
- Motion of Particles through fluids
- Size Reduction
- Mechanical Separations

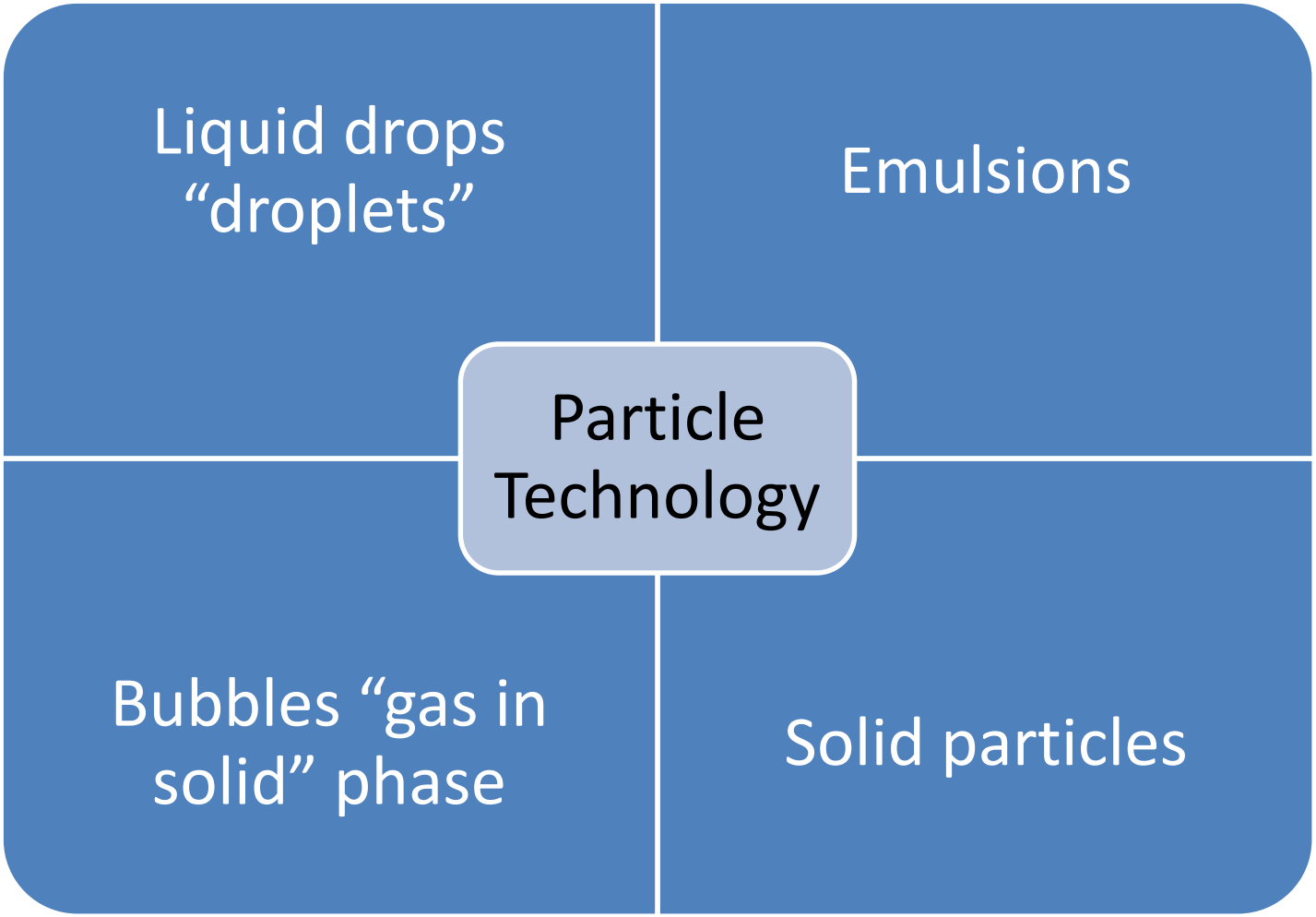


- Size analysis
- Size measurement

- F.B
- Granulation

- Size reduction
- granulation


Key Topics
Separation
Safety
Transport
• Filtration
• Gas Cyclones
• Dust Explosion
• Conveyors
• Pneumatic transport


Liquid drops "droplets"
Emulsions
Particle Technology
Bubbles "gas in solid" phase
Solid particles

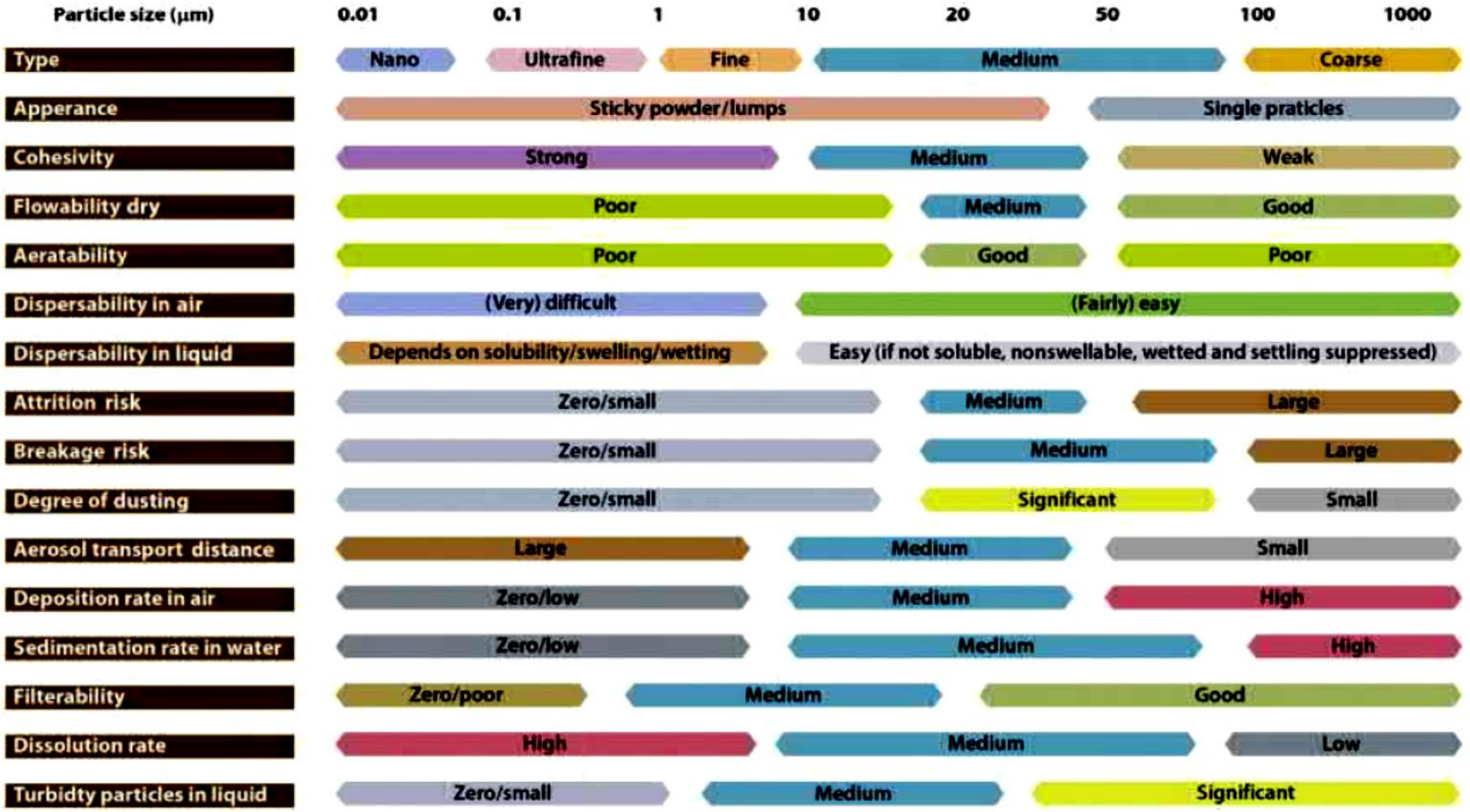
What is particle technology?

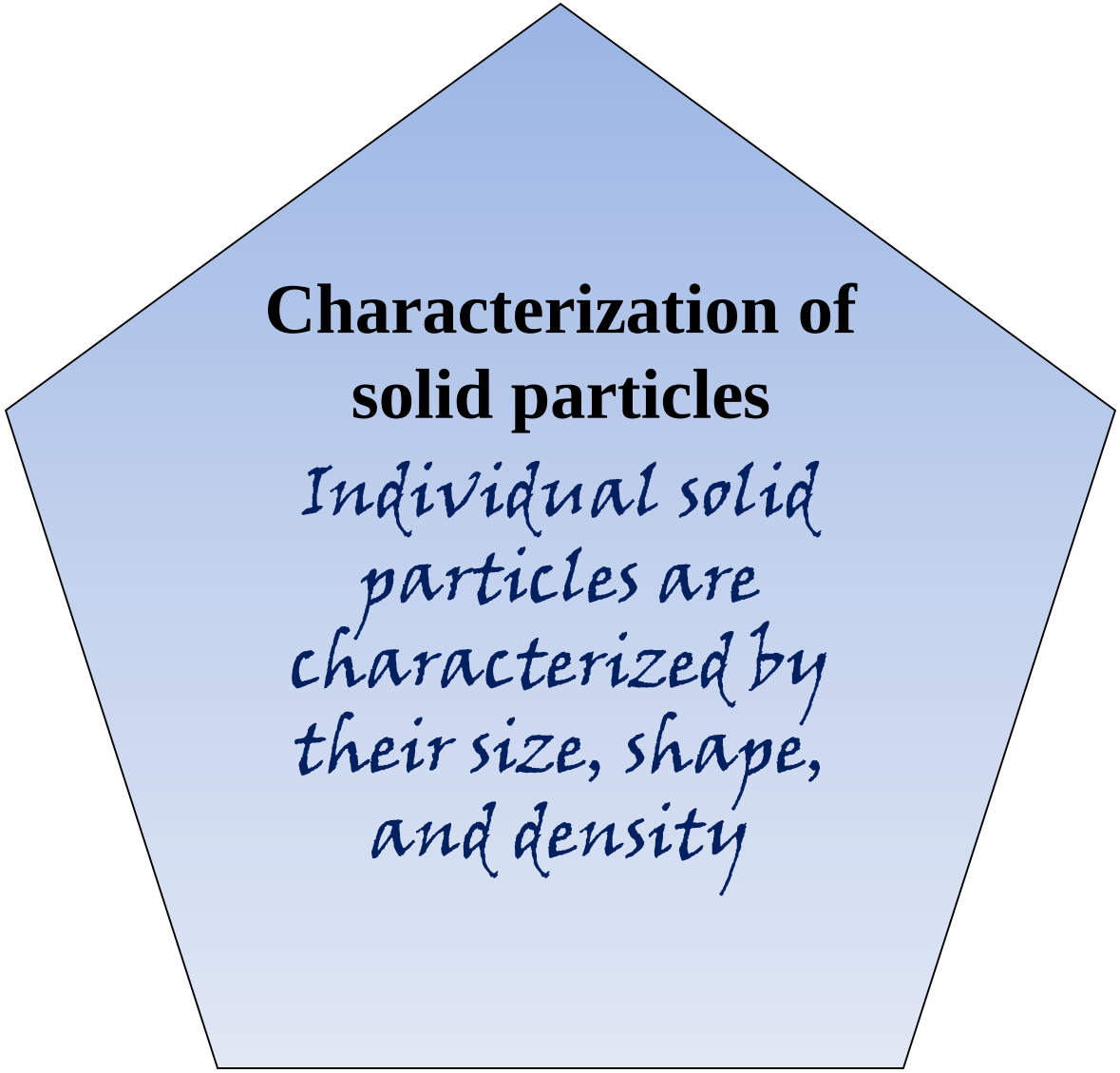
Techniques for processing and handling particulate solids. It plays a major role in the production of materials in industry.

Units used for particle size depend on the size of particles.

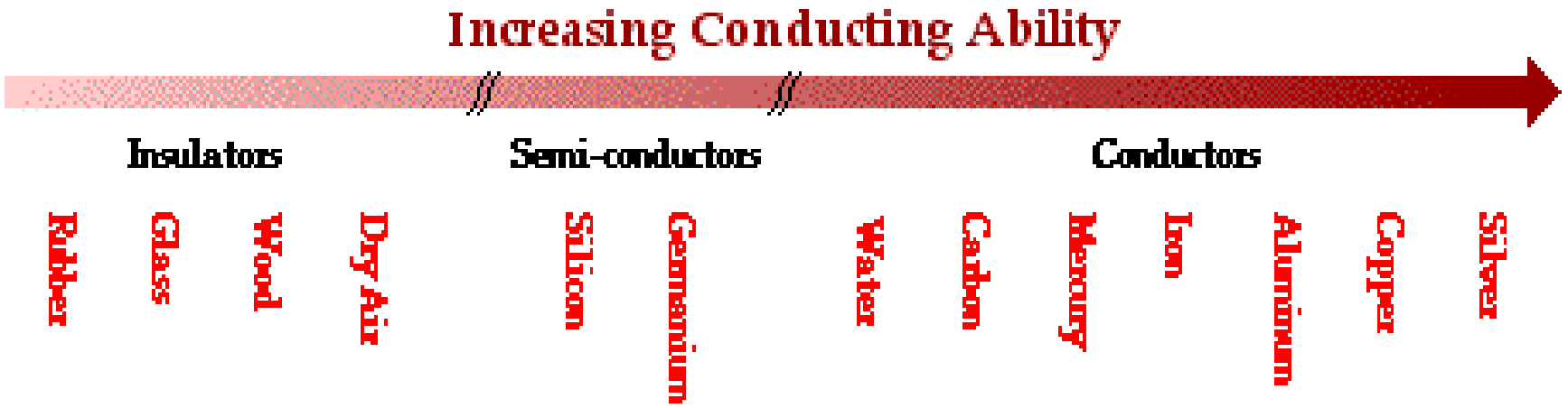
Particles	Size
Coarse particles	inches or millimeters
Fine particles:	screen size
Very fine particles	micrometers or nanometers
Ultra fine particles	surface area per unit mass, m^2/g

Influence of particle size on example characteristics of particulate solids




Characterization of solid particles
Individual solid particles are characterized by their size, shape, and density

Types of Material



CHARACTERIZATION OF SOLID MATERIAL

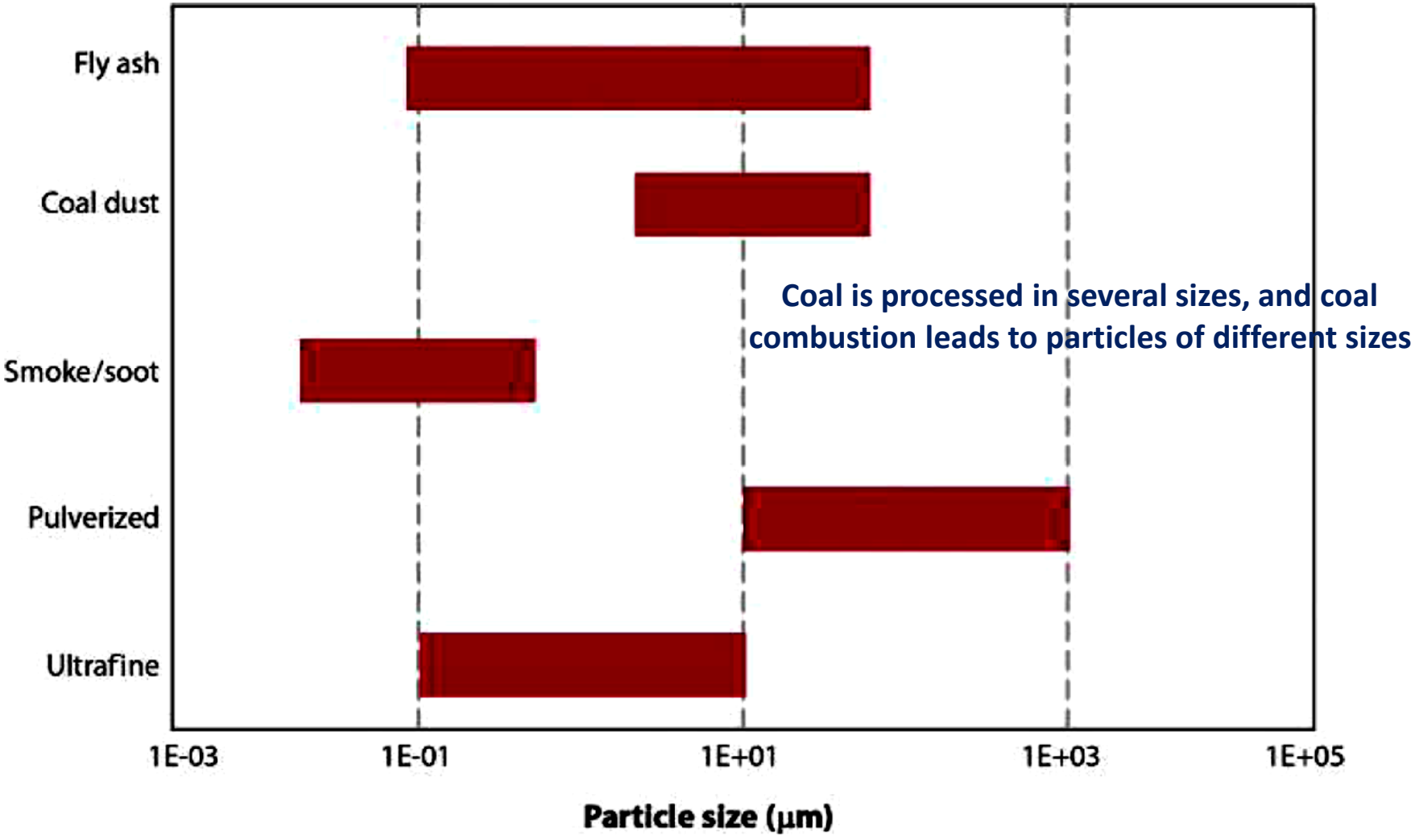
- Density and porosity
- Composition
- Thermal conductivity
- Particle size and shape
- Mechanical properties ‘Strength and hardness’

Definitions

- A particle
- Particulate material

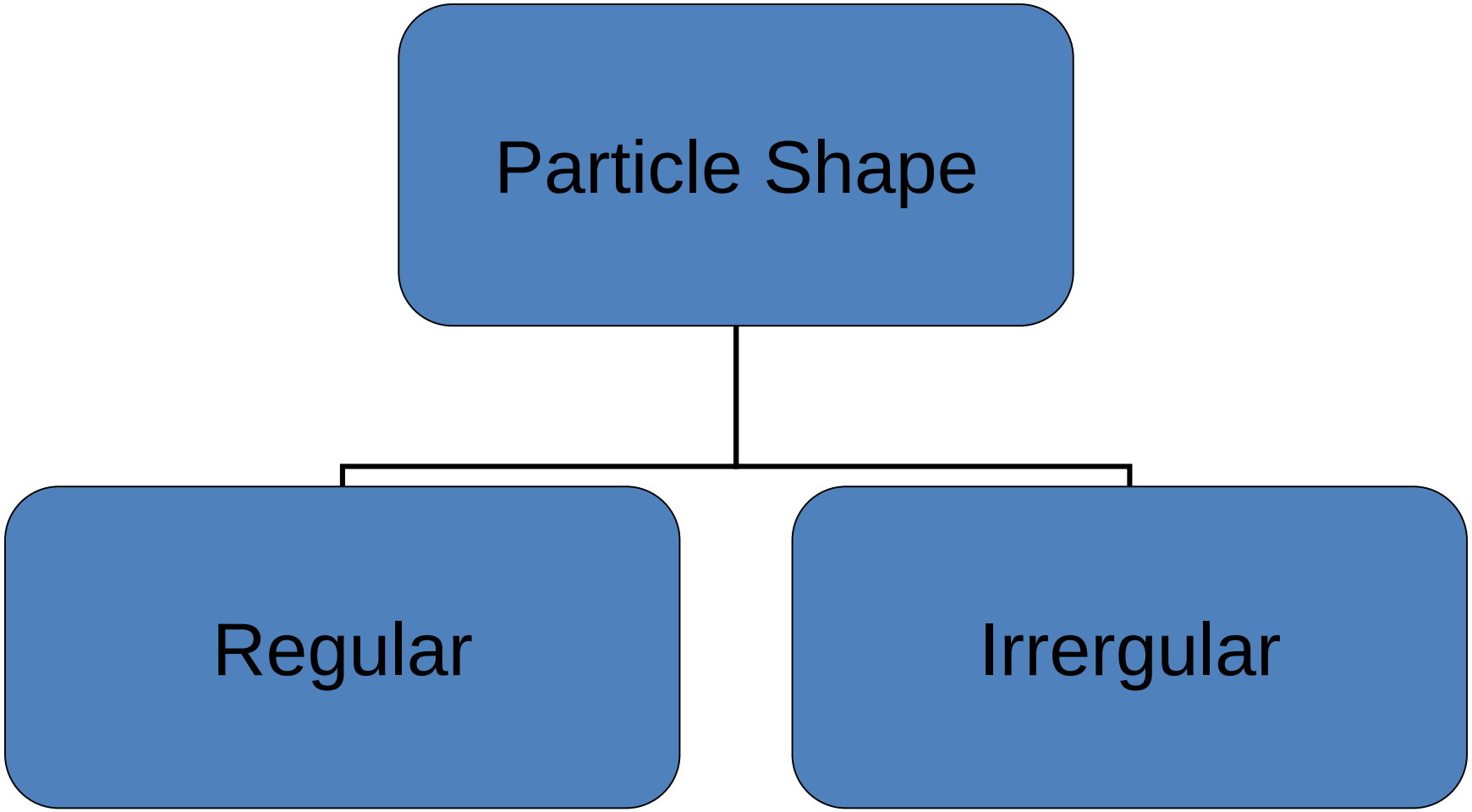
Dust	Shape is not visible by eye
Powder	Produced by comminution Shape is not visible by eye
Granules or Fibers	Shapes are visible to eye rounded or elongated
Lump	Manipulated by hand

Example of material systems with the relevant particle size

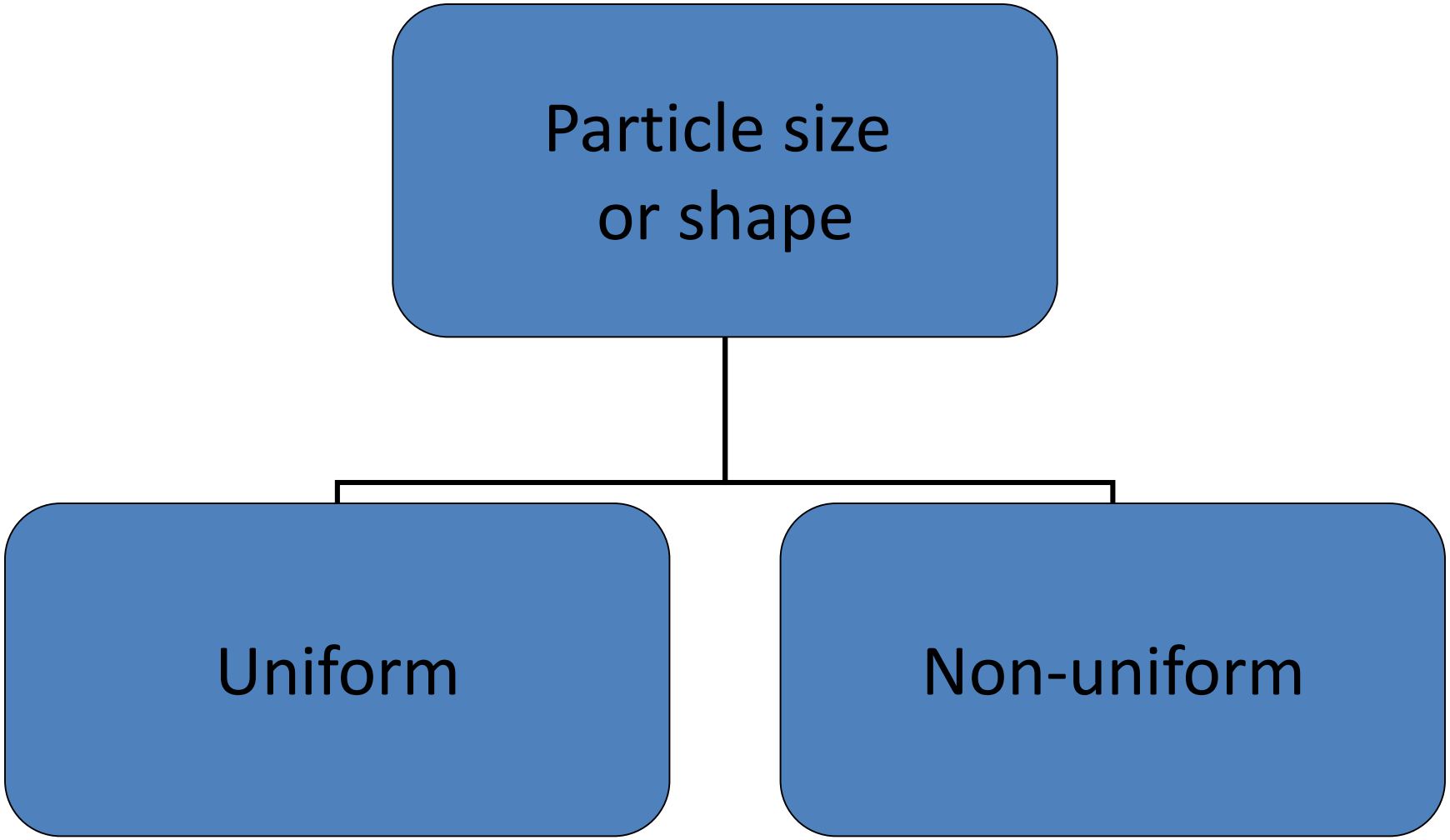


Coal is processed in several sizes, and coal combustion leads to particles of different sizes

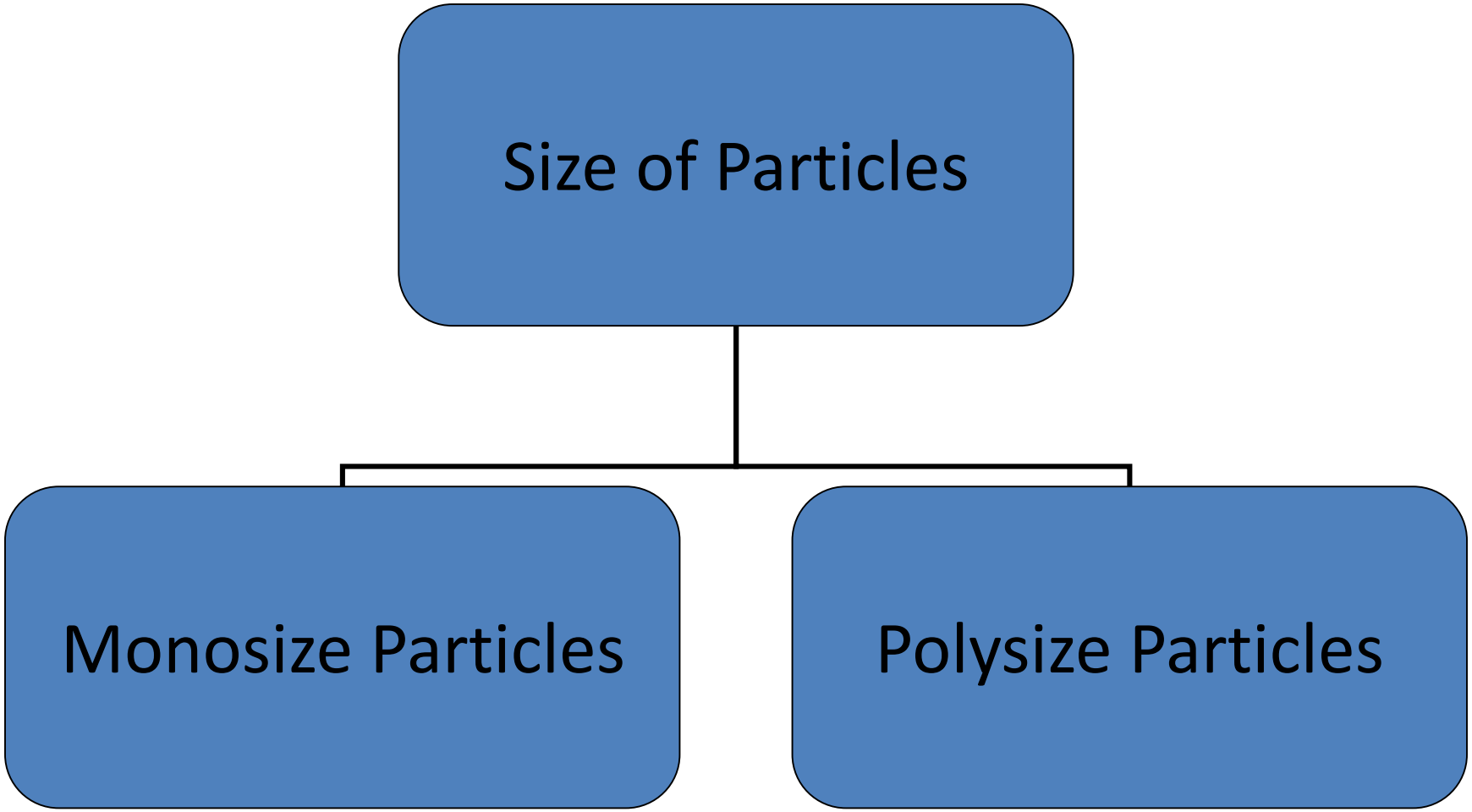
Definitions



Definitions



Definitions



Typical shapes of particles

ONE DIMENSIONAL

TWO DIMENSIONAL

THREE DIMENSIONAL

Definitions

- A particulate system
- Porosity
- Specific surface area of particle
- Specific surface area of particulate system
- Fixed bed of solids
- Porous mass of solids
- Moving bed
- Fluidized bed