SEPARATION PROCESS

DRYING
Part 1

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Introduction

- Drying
  - removal of relatively small amounts of water (or organic liquid) from material
  - water is removed as a vapor by air
- Evaporation
  - removal of relatively large amounts of water from material
  - water is removed as vapor at its boiling point
- Water also can be removed mechanically from solid materials by means of presses, centrifuging and other methods
- Drying is usually the final processing step before packaging and makes many material more suitable for handling (i.e. soap powder, dye, etc.)
- Drying or dehydration of biological materials (especially food) is used as a preservation techniques.
- Microorganisms are not active when the water content is less than 10%, normally foods are dried less than 5% water content to preserve flavor and nutrition.
- Freeze-dried for biological & pharmaceuticals materials which may not be heated for ordinary drying

Methods of Drying

- Based on operation
  - Batch - material is inserted into the drying equipment and drying proceeds for given period of time.
  - Continuous - material is continuously added to the dryer and dried material continuously removed.
- Based on physical conditions used to add heat or remove water vapor
  - Direct contact with heated air at atmospheric pressure, and water vapor formed is removed by the air.
  - Vacuum drying – evaporation is enhanced by lowering the pressure over the wet material and heat may be added by direct contact with a metal tray holding the wet material or by radiation (IR).
  - Freeze drying – Low pressures and temperatures are employed to cause the water to sublime from a solid state (ice).

Equipment for Drying - Examples

- Tray Dryer
- Vacuum-Shelf Indirect Dryers
- Continuous Tunnel Dryers
- Rotary Dryers
- Drum Dryers
- Spray Dryers
- Vertical Continuous-Flow Grain Dryer

Tray Dryer

- In tray dryers, the material is spread out, generally quite thinly, on trays in which the drying takes place.
- Heating may be by an air current sweeping across the trays, by conduction from heated trays or heated shelves on which the trays lie, or by radiation from heated surfaces.
- Most tray dryers are heated by air, which also removes the moist vapours.

Continuous Tunnel Dryers

- Tunnel dryer trucks
- Screen conveyor dryer

Rotary Dryer

- Hollow cylinder which is rotated and usually slightly inclined toward the outlet
- Being heated either by air flow through the cylinder, or by conduction of heat from the cylinder walls

Spray Dryer

- In a spray dryer, liquid or fine solid material in a slurry is sprayed in the form of a fine droplet dispersion into a current of heated air.
- Air and solids may move in parallel or counterflow.
- Drying occurs very rapidly, so that this process is very useful for materials that are damaged by exposure to heat for any appreciable length of time.
- The dryer body is large so that the particles can settle, as they dry, without touching the walls on which they might otherwise stick.
- The dried solids leave at the bottom of the chamber through a screw conveyor.
- The exhaust gases flow through a cyclone separator to remove any fines
- Commercial dryers can be very large of the order of 10 m diameter and 20 m high.

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