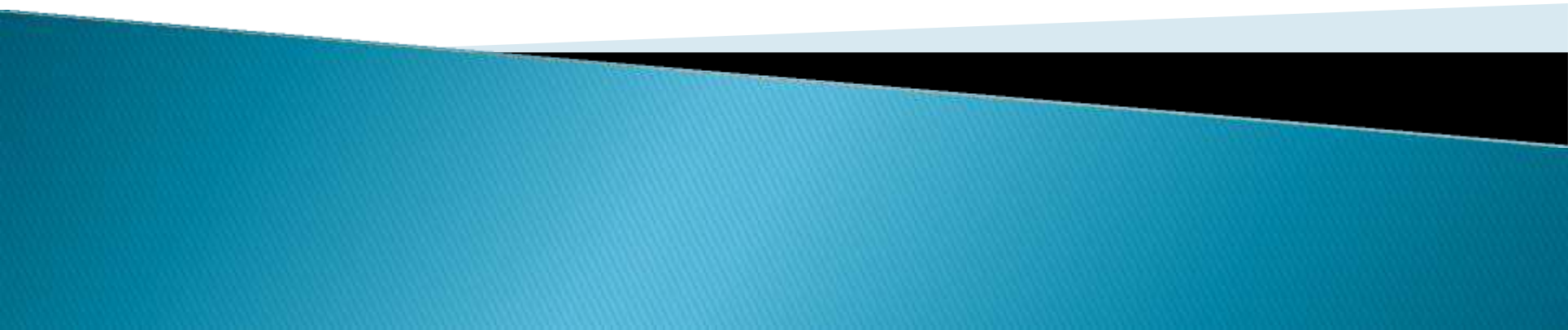


Spray dryer & Fluidised Bed dryer

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Spray dryer:

▶ Principle:

- ✓ In spray dryer the fluid to be dried is atomized into fine droplets which are thrown radially into moving stream of hot gas.
- ✓ The temperature of the droplets is immediately increased and fine droplets get dried instantly in the form of spherical particles.

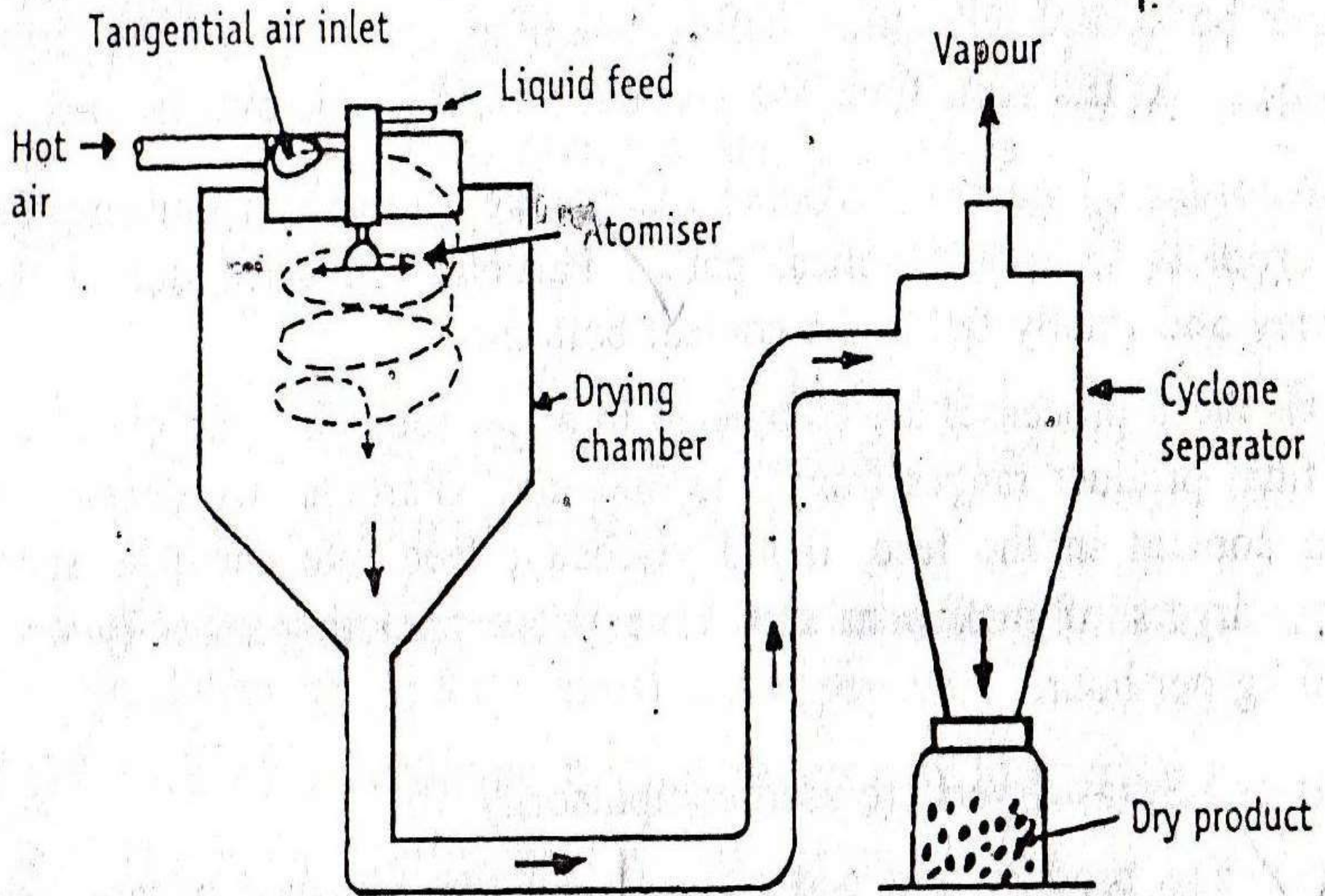


Figure 14-5. Spray dryer.

▶ Construction:

- ✓ It consists of a large cylindrical drying chamber with a short conical bottom made up of stainless steel. (diameter 2.5 to 9.0 m and height 25 m or more)
- ✓ An inlet for hot air is placed in the roof and another inlet carrying a spray disk atomizer is also set in the roof.
- ✓ The spray disk atomizer is about 300 mm in diameter and rotates at a speed of 3000 to 50,000 rpm.
- ✓ The bottom of the dryer is connected to a cyclone separator.

▶ Working:

- ✓ Drying of material in spray dryer involves 3 stages;
 1. **Atomization of liquids:** The feed is introduced through the atomizer either by gravity or using suitable pump.
 2. **Drying of the liquid droplets:** Fine droplets are dried in the drying chamber by supplying hot air through the inlet.
 3. **Recovery of the dried product:** Centrifugal force of atomizer drives the droplets to follow helical path. Particles are dried and collected at the conical bottom.
- ✓ All these processes are completed in few seconds. Particle size obtained is ranging from 2 to 500 nm. maximum size of spray dryer has capacity of 2000 kg per hour.

Uses : Spray dryers are used compulsorily, if:

- (1) The product is a better form than that obtained by any other dryer.
- (2) The quantity of the material to be dried is large.
- (3) The product is thermolabile, hygroscopic, or undergoes chemical decomposition.

Advantages : (1) Spray drying is a continuous process and drying is very rapid. Drying completes within 3 to 30 seconds.

(2) Labour costs are low as it combines the function of an evaporator, a crystallizer, a dryer, a size reduction unit and a classifier.

- (3) By using suitable atomizer, the product of uniform and controllable size can be obtained. Free flowing product of uniform spheres is formed which is very convenient for tableting process.
- (4) Fine droplets formed provide large surface area for heat and mass transfer. Product shows excellent solubility.
- (5) Either the solution or suspension or thin paste can be dried in one step to get the final product ready for package.
- (6) It is suitable for the drying of sterile products.
- (7) Reconstituted product appears more or less similar to the fresh material.
- (8) Globules of an emulsion can be dried with the dispersed phase inside and layer of the continuous phase outside. On reconstitution, the emulsion will be formed.

Disadvantages : (1) Spray dryer is very bulky (height of 25.0 metres and diameter of 9.0 metres) and expensive.

- (2) Such a huge equipment is not always easy to operate.
- (3) The thermal efficiency is low, as much heat is lost in the discharged gases.

Fluidised bed dryer:

- ▶ Principle:
- ✓ In fluidised bed dryer hot air is passed at high pressure through a perforated bottom of the container.
- ✓ The granules are lifted from the bottom and suspended in the stream of air, this condition is called as fluidized state.
- ✓ The hot gas surrounding every granule to completely dry them.

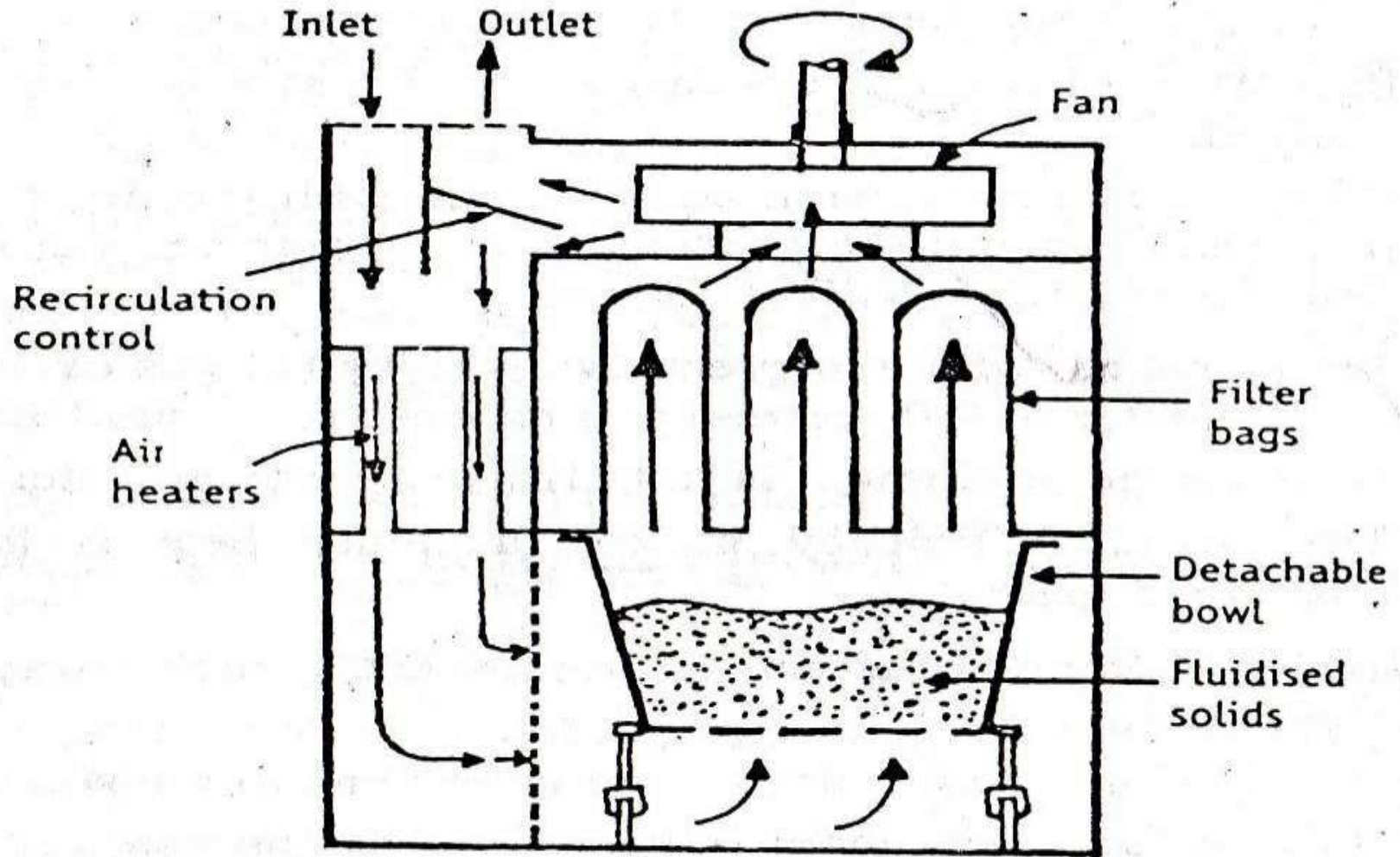


Figure 14-6. Fluidised bed dryer.

Construction:

- ✓ Fluidised bed dryer is available in two forms;
- ✓ i) Horizontal FBD ii) **Vertical FBD**
- ✓ The dryer is made up of **SS** or **plastic**.
- ✓ A **detachable perforated bowl** is placed at the bottom of the dryer which is used for charging and discharging of material.
- ✓ A **fan** is mounted in the upper part for circulating hot air.
- ✓ **Fresh air inlet, pre-filter and heat exchanger** are connected serially to the required temperature.
- ✓ **Bag filters** are placed over bowl for recovery of fines.

Working:

- ✓ The wet granules to be dried are placed in detachable bowl and bowl is placed into the dryer.
- ✓ Fresh air is allowed to pass through pre-filter which subsequently gets heated by passing through heat exchanger.
- ✓ Hot air passed through bottom of bowl and fan is allowed to rotate.
- ✓ The granules rise in the container because of high velocity gas and later fall back in random motion.

- ✓ The gas surrounds every granule to completely dry them. The air leaves the dryer by passing through bag filter.
- ✓ The entrained particles remain adhere to the inside surface of bags. Periodically the bags are shaken to remove the particles.
- ✓ The material is collected after some time so as to reach the ambient temperature.

Uses:

- ✓ For drying granules.
- ✓ It can be used for drying, mixing and granulation process.
- ✓ It is modified for coating of granules.

~~✓~~ **Advantages** ✓ (1) Fluidised bed dryer requires less time to complete drying, i.e., 20 to 40 minutes compared to 24 hours of tray dryer. Handling time is also short. It is 15 times faster than the tray dryer.

- ✓ (2) It is available in different sizes with the drying capacity ranging from 5 to 200 kg per hour.
- (3) The drying containers are mobile, making handling simple and reducing labour costs.
- ✓ (4) The thermal efficiency is 2 to 6 times than tray dryer.
- ✓ (5) It is also used for mixing the ingredients and its mixing efficiency is also high.
- (6) Hot spots are not observed in the dryer, because of its excellent mixing and drying capacities.
- (7) Higher drying temperatures can be used that are not possible in tray dryer and truck dryer.
- (8) It facilitates the drying of thermolabile substances, since the contact time for drying is short.
- (9) It can be used either as batch type or continuous type.
- (10) It has a high output from a small floor space.
- (11) The free movement of individual particles eliminates the risk of soluble material migrating as may occur in static beds.

Disadvantages:

- ✓ Some organic material may develop electrostatic charge so requires earthing.
- ✓ Due to attrition fines are observed in large quantity.

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