

SPRAY DRIER

WHAT DOES A SPRAY DRYER DO?

A spray dryer is a drying machine used to process solutions, suspensions, or materials in a slurry state. A spray dryer is a kind of continuous atmospheric dryer which can be used to dry materials such as fuel, intermediates, soap powder, or inorganic salts, etc.

HOW DOES IT WORK?

A spray dryer uses the spray method to transform the material into fog droplets in order to be dispersed into the hot gas stream. The material connects with the hot air in a cocurrent, countercurrent, or mixed flow manner so that the water can evaporate quickly to achieve the drying effect.

INDUSTRIES USING SPRAY DRYERS

- i. Chemical Industry
- ii. Petroleum Industry
- iii. Mining Industry

ADVANTAGES OF SPRAY DRYING

- The droplets are small, giving a large surface area for heat and mass transfer so that evaporation is very rapid
- It can be used for drying heat sensitive or oxidized materials without degradation
- It can be designed for drying under sterile conditions
- The dried powder will have a uniform particle size and shape
- Because of good flow properties, the spray-dried powder can be easily compressed into the form of tablets

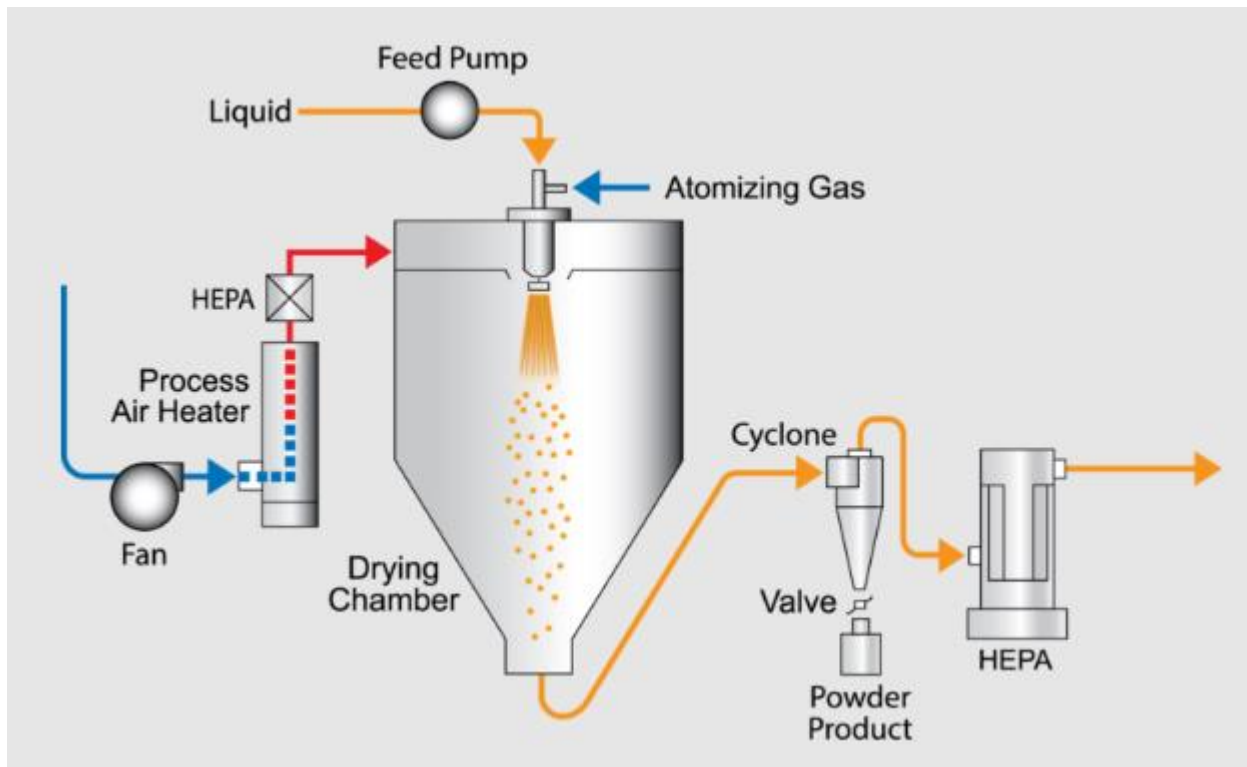
- It is useful in the coating and encapsulation of both solids and liquids
- Labor cost is low since the material is dried in a single operation with no handling

DISADVANTAGES

- Solid materials cannot be dried
- The equipment is very costly and bulky
- Since the equipment is bulky, cleaning is time consuming
- There is a lot of heat wasted

APPLICATIONS

- Spray dryers are used for the drying of liquid materials like emulsion, suspension, solution, slurries, thin pastes, etc.
- Spray drying can be used to dry materials that are sensitive to heat or oxidation without degrading them, even when high temperature air is employed
- The liquid feed is dispersed into droplets, which are dried in seconds because of their high surface area and intimate contact with the drying gas
- The product is kept cool by the vaporization of the enveloping liquid, and the dried product is kept from overheating by rapid removal from the drying zone
- The improvement in flow and reduction of air entrapment make the spray-dried material suitable for use in the manufacturing of tablets and capsules



PRINCIPLE OF SPRAY DRYER

In a spray dryer, the fluid to be dried is atomized into fine droplets, which are thrown radially into a moving stream of hot gas. The temperature of the droplets is immediately increased and fine droplets get dried instantaneously in the form of spherical particles. This process completes in a few seconds before the droplets reach the wall of the dryer.

CONSTRUCTION OF SPRAY DRYER

The construction of a spray dryer is shown in Figure 1.1. It consists of a large cylindrical drying chamber with a short conical bottom, made up of stainless steel (the diameter of the drying chamber ranges between 2.5 to 9.0 meters, and the height is 25.0 meters or more). An inlet for hot air is placed on the roof of the chamber. Another inlet carrying a spray-disk atomizer is set on the roof (shown in Figure 1.1). The spray disk atomizer is about 300 millimeters in diameter and

rotates at a speed of 3,000 to 50,000 revolutions per minute. The bottom of the dryer is connected to a cyclone separator.

WORKING OF SPRAY DRYER

Drying of the material in the spray dryer involves 3 stages.

- Atomization of the liquid
- Drying of the liquid droplets
- Recovery of the dried product

Atomization of the liquid to form liquid droplets: The feed is introduced through the atomizer either by gravity or by using a suitable pump to form fine droplets. The properties of the final product depend on the droplet form, hence, the selection of the type of atomizer is important. An atomizer of any type: the pneumatic atomizer, pressure nozzle, and spinning disc atomizer may be used.

The rate of feed is adjusted in such a way that the droplets should be completely dried before reaching the walls of the drying chamber. At the same time, the product should not be overheated.

Drying of the liquid droplets: Fine droplets are dried in the drying chamber by supplying hot air through the inlet.

The surface of the liquid drop is dried immediately to form a tough shell. Further, the liquid inside must escape by diffusing through the shell at a rate. At the same time, heat transfer from outside to inside takes place at a rate greater than the liquid diffusion rate. As a result, the heat inside mounts up which allows the liquid to evaporate at a faster rate. This tendency of a liquid lead causes the droplets to swell. to rise in the internal pressure The shell's thickness decreases whereas permeability for vapor increases. If the shell is neither elastic nor permeable, it ruptures and the internal pressure escapes.

The temperature of the air is adjusted in such a way that the droplets should be completely dried before reaching the walls of the drying

chamber. At the same time, the product should not be overheated. Recovery of the dried product: Centrifugal force of the atomizer drives the droplets to follow a helical path. Particles are dried during their journey and finally fall at the conical bottom.

All these processes are completed in a few seconds. The particle size of the final product ranges from 2 to 500 μm . Particle size depends on solid content in the feed, liquid viscosity, feed rate, and disc speed. Spray dryers of maximum size have got evaporating capacity of up to 2000 kg per hour.