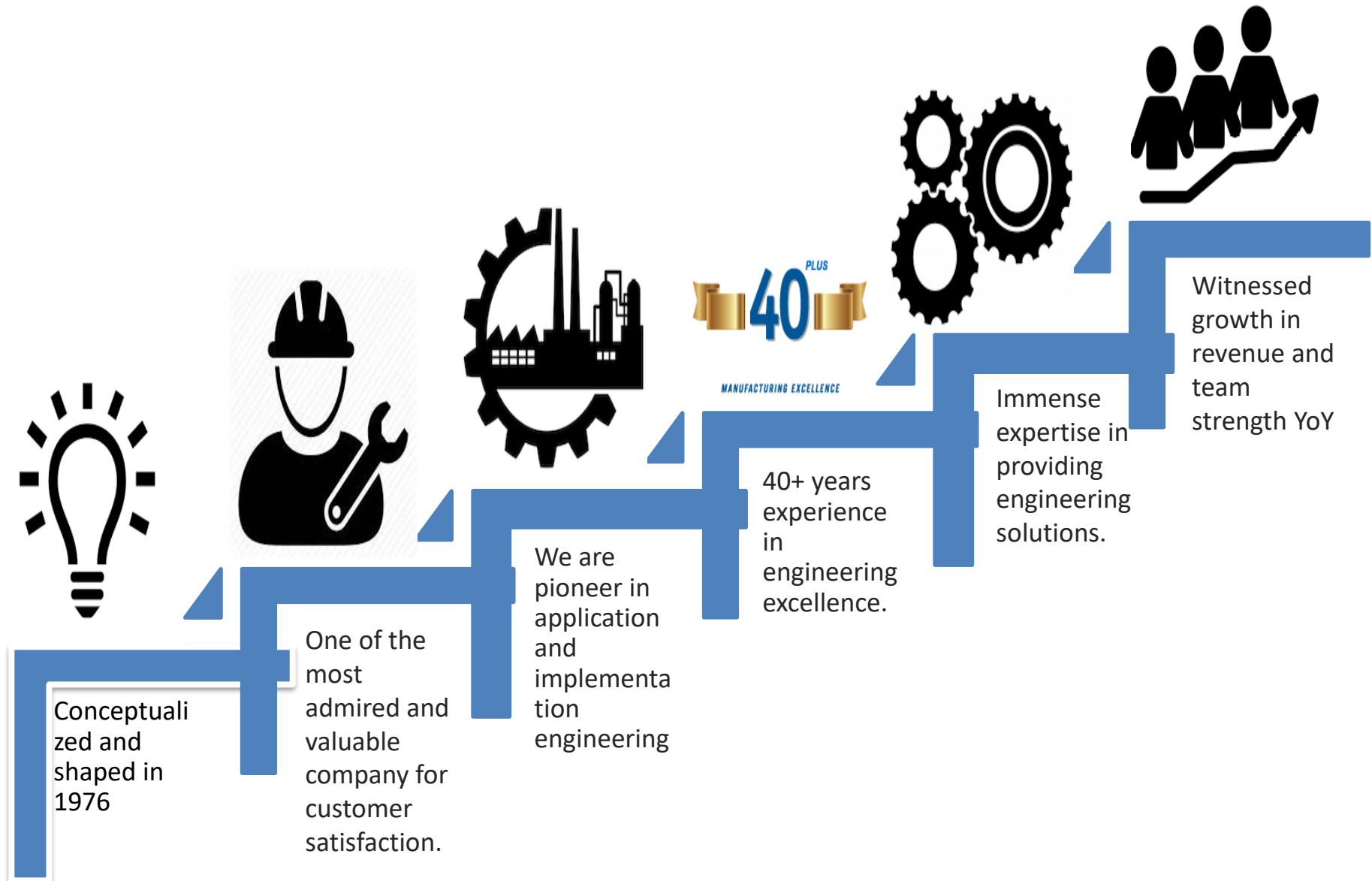




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# WHAT DOES A SPRAY DRYER DO?

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

- Chemical Industry
- Petroleum Industry
- Mining Industry
- Instant Dairy
- Food Products
- Laundry Detergents
- Ceramics
- Agrochemicals.



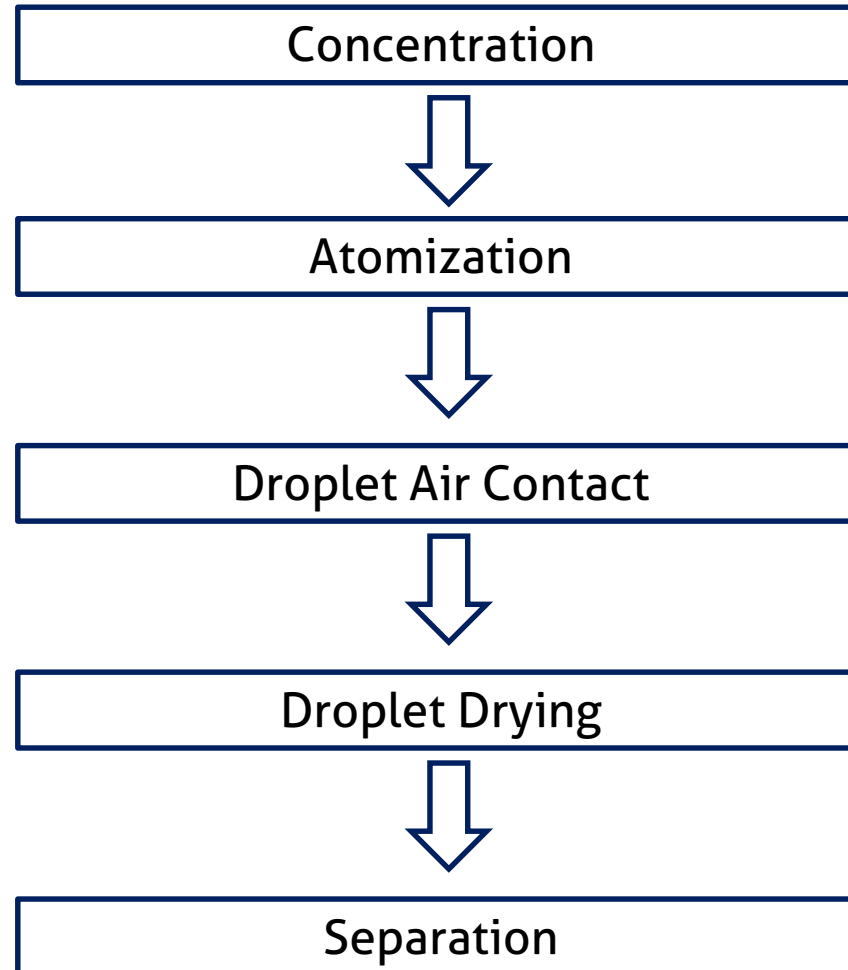
## TYPES OF SPRAY DRYING SYSTEM

- Co-current flow dryer
- Counter-current flow dryer
- Mixed flow dryer
- Open Cycle Dryer
- Closed Cycle Dryer
- Semi-closed Cycle Dryer
- Single Stage Dryer
- Two Stage Dryer
- Vertical Dryer
- Horizontal Dryer





## GENERAL PROCESS INVOLVED



## **CONCENTRATION**

- Increases the solids content.
- Reducing the amount of liquid that must be evaporated in the spray dryer.

## **ATOMIZATION:-**

- To create the optimum conditions for evaporation.
- To lead to a dried product having the desired characteristics.
- Nozzles(1-100) and rotary atomizers are used to form sprays.

## **DROPLET-AIR CONTACT:-**

- The central element of a spray dryer is the spray dry chamber where atomized liquid is brought into contact with hot gas (usually air, at a vacuum).
- Resulting in the evaporation of 95%+ of the water
- The way in which the spray makes contact with the air in the dryer influences the behavior of the droplet during the drying phase and has a direct bearing on the properties of the dried product.

**DROPLET- DRYING:-** Moisture evaporation takes place in 2 stages.

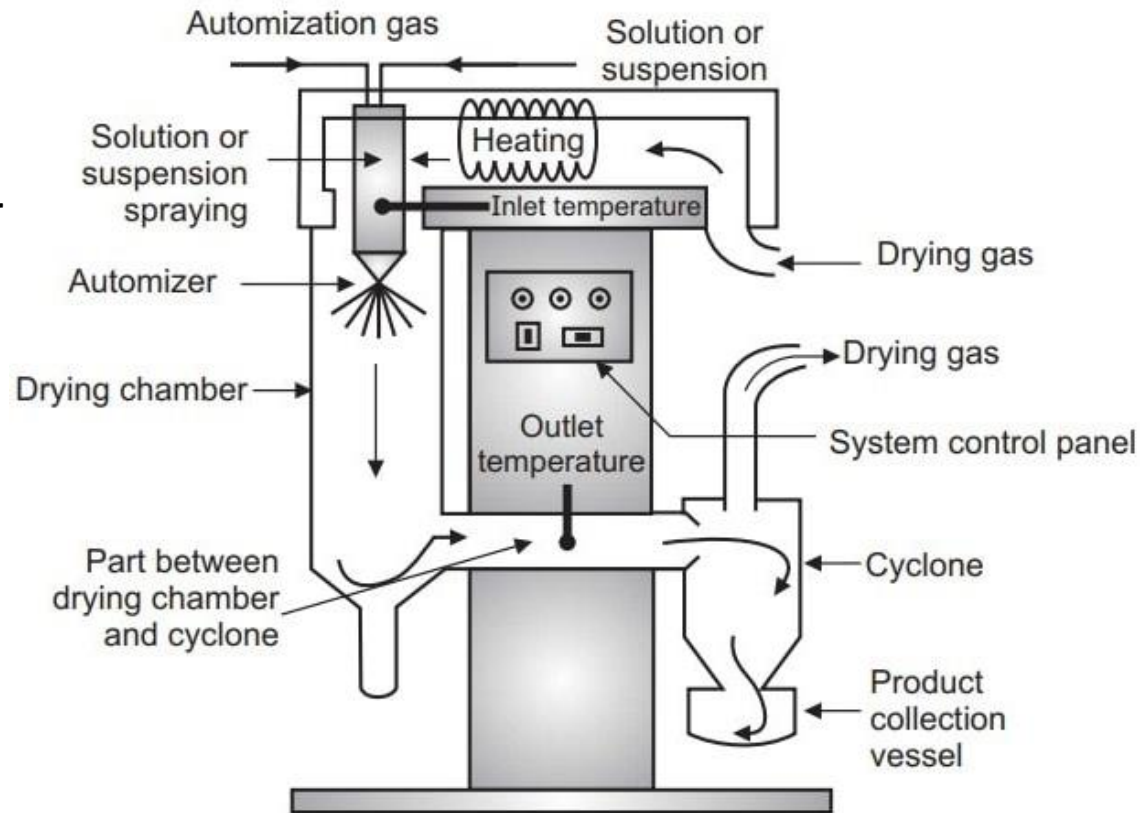
First Stage	Second Stage
<ul style="list-style-type: none"><li>✓ Saturated Air Temp.=Drying Air Wet-bulb Temp.</li><li>✓ There is sufficient moisture in the drop to replace the liquid evaporated at the surface.</li><li>✓ Evaporation takes place at a relatively constant rate.</li></ul>	<ul style="list-style-type: none"><li>✓ Begins when there is no longer enough moisture to maintain saturated conditions at the droplet surface.</li><li>✓ It cause a dried shell to form at the surface.</li><li>✓ Evaporation then depends on the diffusion of moisture through the shell, which is increasing in thickness.</li><li>✓ The rate of evaporation falls rapidly during the second phase.</li></ul>

### **SEPERATION:-**

- Primary separation is accomplished by the particles simply falling to the bottom of the chamber & a small fraction of the particles remain entrained with the air and must be recovered in separation equipment.
- Cyclones, bag filters, and electrostatic precipitators may be used for the final separation stage & wet scrubbers are then often used to purify and cool the air so that it can be released to atmosphere.

# CONSTRUCTION OF SPRAY DRYER

Many different types of spray dryers exist, each with different features for meeting various spray drying needs. A spray dryer consists of a feed pump, atomizer, air heater, air dispenser, drying chamber and systems for exhaust air cleaning and powder recovery/separator and process control systems. It consists of a large cylindrical drying chamber with a short conical bottom, made-up of glass (lab scale) or stainless steel (large scale).



The diameter of the chamber is 2.5- 9 meters and height 25 meters or more. An inlet for hot air is placed in the roof of the chamber and another inlet carrying spray disk atomizer is set in the roof. The spray disk atomizer is about 300 mm in diameter and rotates at a speed of 3000 to 50,000 r.p.m. Bottom of the dryer is connected to a cyclone separator.

## WORKING OF SPRAY DRYER

Spray drying is a one-step continuous unit operation that employs liquid atomization to produce droplets that are dried to individual particles when moved in a hot gaseous drying medium. The three stages that occur in a spray dryer before drying is accomplished include atomization, spray-air mixing, and moisture evaporation, and dry product separation from the exit air. The spray drying process begins with atomization. During atomization, a nozzle or rotary atomizer turns the liquid feed stock into small liquid droplets. This is followed by the separation of the solute or suspension as a solid and the solvent into a vapor. It is during this stage that many of the desired product qualities such as particle size and viscosity are developed.

When droplets exit the nozzles or atomizer, they are dried to form a powder that is easily packed and transported. Solids form as moisture quickly leaves the droplets. The solid is usually collected in a drum or cyclone. The nature of the final product depends on the design and operation of the spray dryer and the physicochemical properties of the feed. Drying of the powder is commonly completed using hot air.

The final moisture content in the powder is controlled by adjusting the hot air temperature. The recovery process is the last step that takes a few seconds to recover the powder from the exhaust gas within the cyclone.

## 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.

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