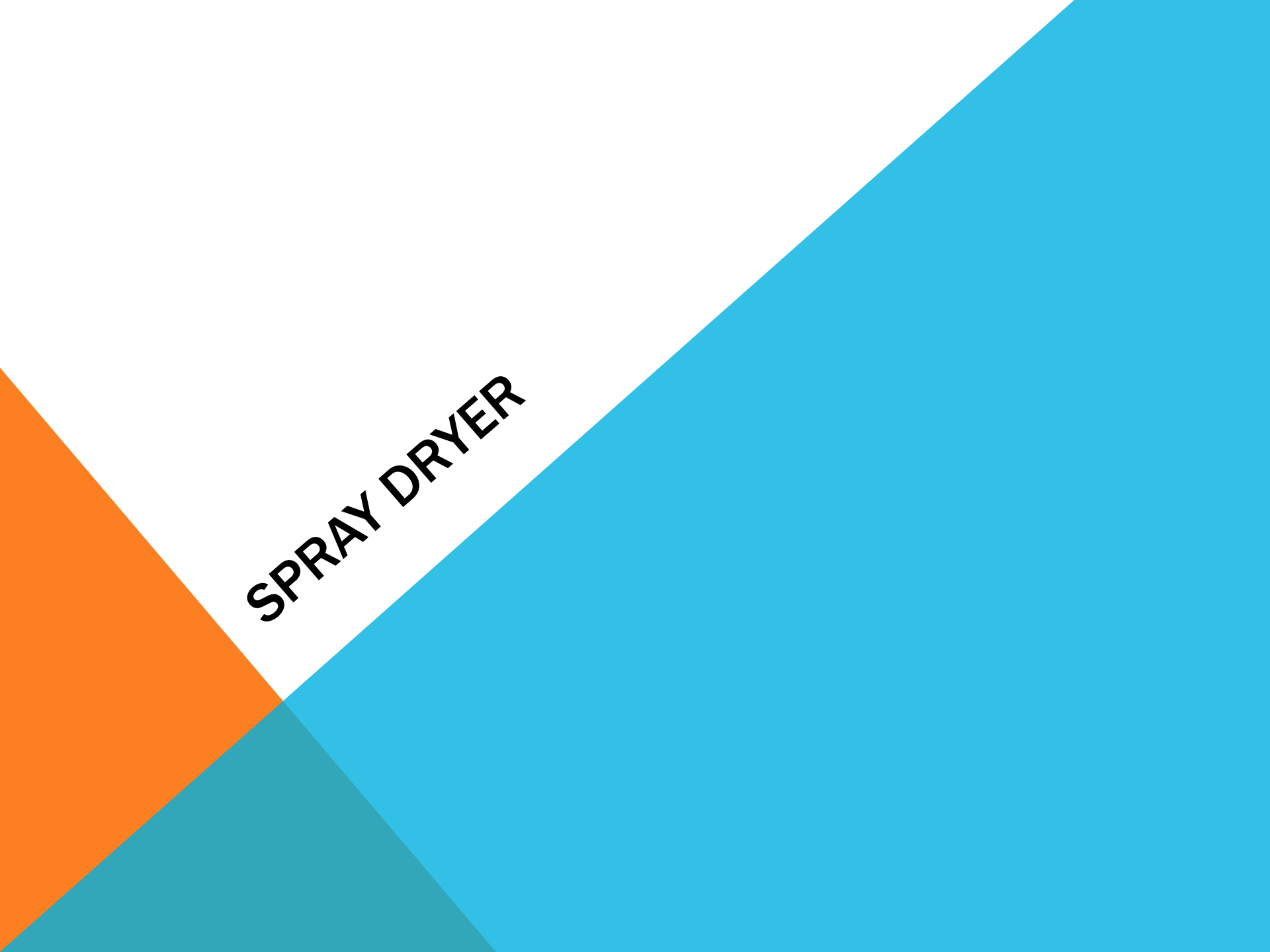
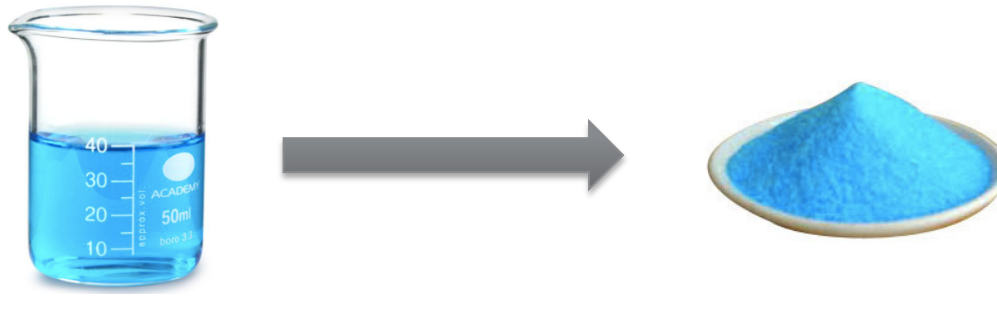




SPRAY DRYER

INTRODUCTION

- ❖ The spray drying process is based on obtaining the product in powder form as a result of spraying liquid samples into the hot air environment and evaporation of the water contained in the sample
- ❖ The sprayed sample may be in suspension, emulsion or solution.
- ❖ Form of the product depends on the physical and chemical properties of the feed solution, design of the dryer and operation conditions.



APPLICATION AREAS

- ❖ Food: Coffee, coffee cream, milk, soap, baby formula, sweetener
- ❖ Pharmacy: Drug production
- ❖ Kozmetik: Powdered cosmetics, detergents
- ❖ Spray dryers are generally used in the production of temperature sensitive chemicals



ADVANTAGES

- ❖ The only dryer type with powder particles in micron size and low moisture content
- ❖ Feeding speed that can work from 1-2 kg to 100 tons.
- ❖ Homogeneous Product Quality
- ❖ Suitable for temperature sensitive products.
- ❖ It has a wide range of uses from pharmacy to mining.

DISADVANTAGES

- ❖ High assembly costs
- ❖ They take up more space physically than other dryers.
- ❖ They are not highly efficient on their own.

PROSES BASAMAKLARI

- ❖ Spraying the feed entering the spray dryer (Atomization)
 - ❖ Contact of the sprayed feed with hot air
 - ❖ Drying the sprayed feed
 - ❖ Separation of dried product from air
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- ✓ During the drying process, the solution is sprayed into the hot air by the atomizer to form droplets.
 - ✓ Moisture quickly evaporates from droplets
 - ✓ The cooled air is discharged out with the help of a fan.
 - ✓ Solid particles are sent to the cyclone with the rotari fan and collected in the collection chamber.
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ATOMIZASYON

Atomization is the characteristics of the drying process.

- ❖ Selection of the atomizer and its operation under suitable conditions are important in terms of providing good quality and economical products.
- ❖ Spraying is done using a nozzle or rotary type injectors.
- ❖ The choice of atomizing depends on the desired properties of the feed and the product.



Rotary

Nozzle

- ✧ If the feed viscosity and surface tension are high, larger droplets are obtained with the same energy.
- ✧ A rotary atomizer is used for smaller and medium size product.
- ✧ Nozzle atomizer is preferred for large size products.
- ✧ Gas and solution flow can be in the same or opposite direction.

DRYING

- ❖ The solution is made into very small droplets in the atomizer.
- ❖ It is sent to the drying circle.
- ❖ When the droplets come into contact with hot air, a saturated vapor film is formed on the droplet surface and evaporation begins.
- ❖ The temperature on the surface of the droplet is equal to the wet bulb temperature of hot air.
- ❖ Evaporation takes place in two stages.

First Stage:

- ✧ There is enough moisture in the droplet to meet the moisture loss on the surface.
- ✧ While evaporation continues, moisture is diffused from the droplet to the surface in order to maintain saturation conditions on the surface.
- ✧ During this time interval, the evaporation rate is fixed.

Second Stage:

- ✧ When the moisture inside the droplet cannot meet the moisture loss on the surface, a crust begins to form on the surface of the droplet.
- ✧ Crust thickness increases over time and evaporation rate decreases.

DRYING PROCESS SYSTEM PARAMETERS

❖ Feed Properties:

Increasing the viscosity or solid percentage of the feed and lowering the feed temperature causes irregular atomization. Surface tension has no significant effect on the operation. If the amount of solids in the feed increases, the evaporation characteristics are affected and the density of the formed particles increases.

❖ Feed Flow Rate:

Increasing the feeding flowrate leads to more irregular and coarse droplets and moist product, while the product quality is also low.

❖ Air Flow Rate:

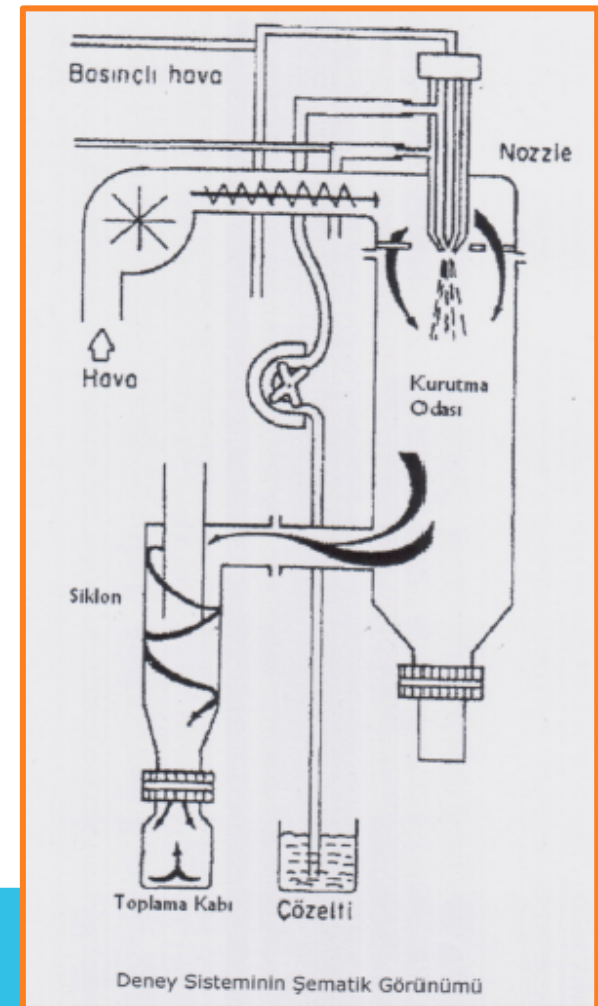
If the air flow rate is increased, the percentage of moisture in the drying product remains high, since the particle's residence time in hot air is shortened. When the flow rate is reduced, the exposure time of the hot air will increase and the product will have a lower moisture content.

❖ Drying Temperature:

When the inlet temperature (inlet) is increased, the evaporation capacity of the dryer increases and a more porous structure is obtained when the density of the dried particles decreases. Raising the outlet temperature (outlet) leads to lower moisture content of the product.

EXPERIMENTAL PROCEDURE

- ❖ Connect the spray drier to the electrical main supply.
- ❖ Fill the sample bottle with distilled water. Place pump feed tube into sample bottle.
- ❖ Switch on first the blower and then the heater.
- ❖ Switch on compressor
- ❖ Start taking inlet and outlet air temperatures as a function of time until the required inlet air temperature (set temperature) is reached and uniform outlet air temperature is attained.
- ❖ Switch on pump to feed distilled water.
- ❖ Flow rate is determined using the scaled sample bottle as mL/s or mL/min.
- ❖ Feed distilled water until steady state condition is reached (uniform outlet temperature is obtained)
- ❖ Start pumping the feed solution prepared before. Dried powder should be observed spiraling down the cyclone into the sample collection bottle. Take inlet and outlet air temperatures. Also measure the flow rate for the feed solution.
- ❖ After termination of sending the feed solution, feed the dryer again with distilled water, now to clean pump feed tube completely.



EXPERIMENTAL PROCEDURE (CONT'D)

- ❖ Feed distilled water until steady state condition is reached (uniform outlet temperature is obtained)
 - ❖ Start pumping the feed solution prepared before. Dried powder should be observed spiraling down the cyclone into the sample collection bottle. Take inlet and outlet air temperatures. Also measure the flow rate for the feed solution.
 - ❖ After termination of sending the feed solution, feed the dryer again with distilled water, now to clean pump feed tube completely.
 - ❖ Weigh the solid material collected in the sample collection bottle.
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EXPERIMENTAL SET-UP



CALCULATIONS

- 1) Place the sample you are weighing by spreading it on a watch glass. After waiting 24 hours in the oven at 120°C , weigh again.
 - 2) Plot inlet and outlet air temperatures as a function of operating time.
 - 3) Make a material balance for water.
 - 4) Find the percent recovery of the solid based on total solid input.
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