

EQUIPMENT USED FOR MILK DRYING



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- # About PMG Engineering

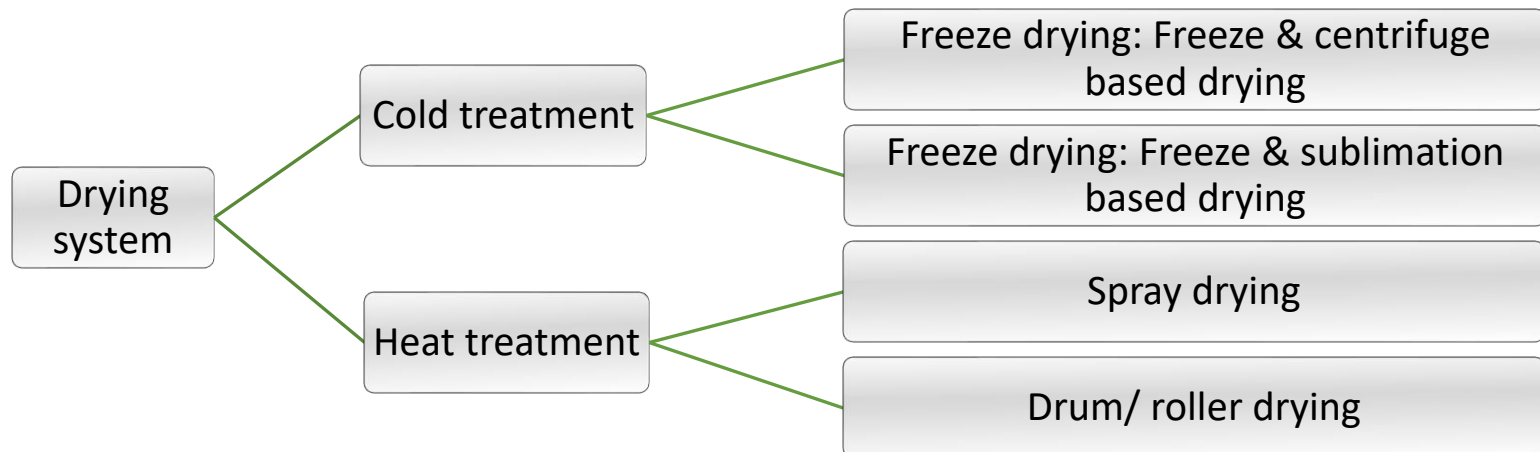
1. Introduction

- A crucial process in the dairy industry involves removing water from liquid milk using drying equipment to produce powdered milk.
- Purpose of drying milk :
 - Inhibit microbial growth
 - Prevent quality deterioration and
 - Increasing the shelf life of the product enough to be used in the off-season.



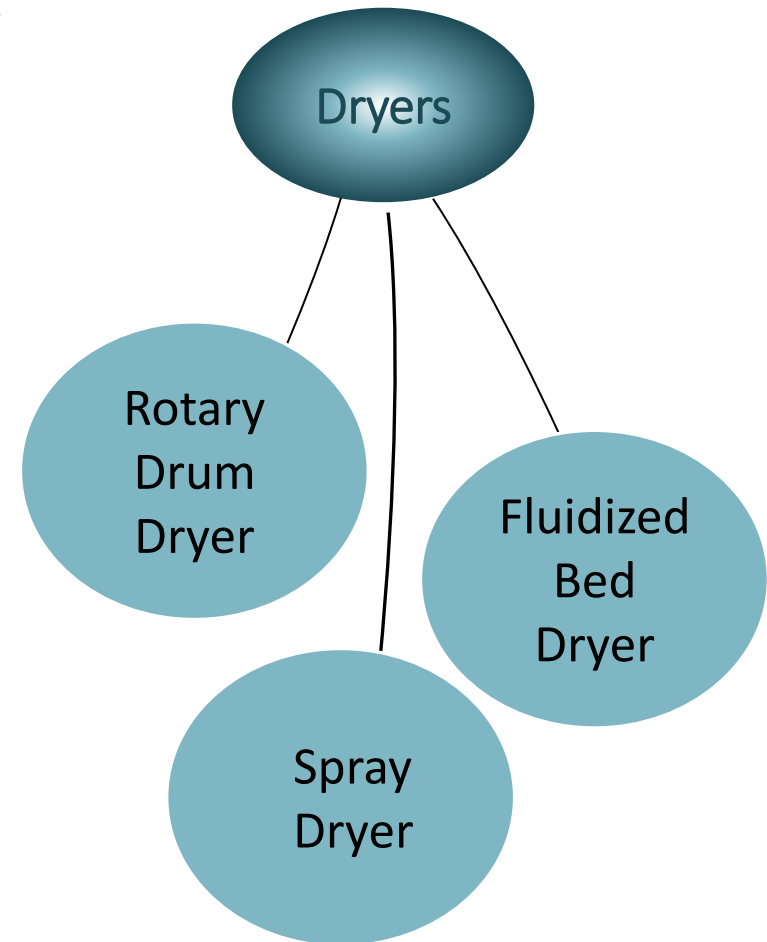
1. Introduction (Cont.)

- Two types of drying system is used in dairy
 - Cold treatment based drying and
 - Heat treatment based drying

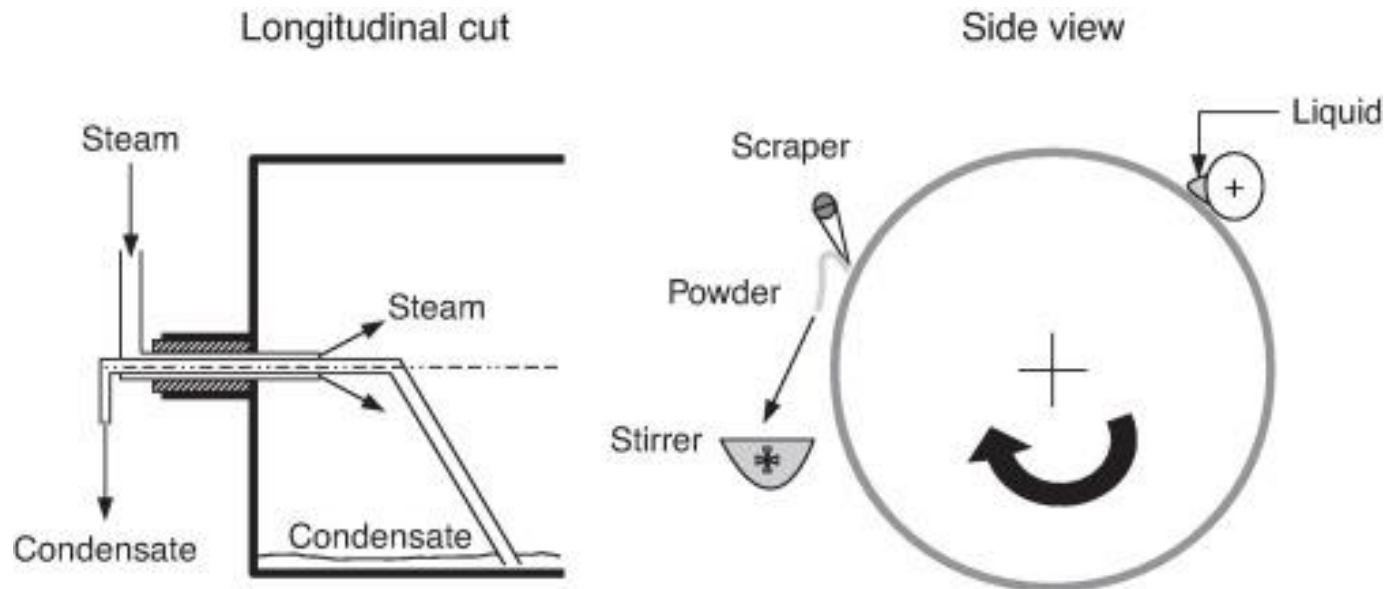


2. Types of Equipment Used

- Various types of dryers are used for drying milk into powder, including:
 - Rotary Drum dryer
 - Spray drying
 - Fluidized Bed Dryers
 - Vacuum dryers
 - Freeze Dryers
- However, two types of dryers are commonly used in dairy plants: **spray dryer and drum/roller dryer.**



2(a). Drum/Roller Dryer



- The liquid substance is spread thinly onto the surface of the heated cylinder.
- Heated at **120–155°C** using condensing steam inside the cylinder at 200 to 500 kPa.
- As the rollers rotate, the liquid milk dries and solidifies, forming a thin film on them.
- The film is scraped off to create milk flakes
- Upon further grinding and straining, produce powder.

2(a). Drum/Roller Dryer (Cont.)

- Types of drum dryers are such as :

1. Single drum
2. Twin drum
3. Double-drum dryers

For milk and milk products, a double drum dryer with a nip formed between the drums is used, where previously evaporated milk is fed using pumps either directly or by spray nozzle.

- **Benefits:**

- Efficient in removing moisture while preserving the flavour and nutrients of the original substance.
- Suitable for heat-sensitive materials,
- Lower energy consumption compared to spray drying.
- Cost-effective



2(b). Spray Dryer

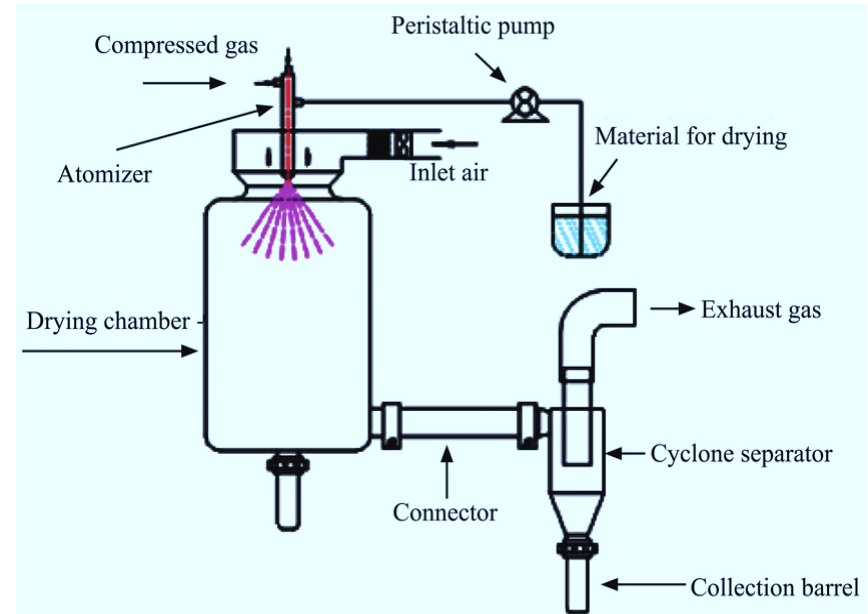
- Spray dryer involves particle formation at first and then drying.
- Suited for continuous production of either powder or agglomerated product from liquid feedstock (milk).
- 3 fundamental steps of performance:
 - **Atomization** of the fluid into minute droplets.
 - Interaction between droplets and hot air (@180-210°C) in a chamber allows water to evaporate into vapour and causes the droplet to lose moisture and become dry.
 - Separation of dried powder from the vapour (@80°C) and collection at another end of the chamber.



2(b). Spray Drying (Cont.)

- **Elements of spray dryer:**

- Air heater
- Atomizer
- A pump: for feeding the liquid to the atomizer
- Drying chamber
- Cyclones: Solid-gas separators
- Fans: for moving the air



- **Benefits:**

- High production capacity, & Adaptability,
- Retention and preservation of original liquid substance's flavor, aroma, and nutritional value.
- The ability to create uniformly fine powder particles appropriately for a range of application.

2(c). Fluidized Bed Dryers

- Used as a bed of solid particles suspended and fluidized by a stream of air or gas to remove moisture from materials efficiently.
- Material is fed using a hopper where it comes into contact with hot air or gas moving at 40° to 80°C with an air velocity of 10 m/s, promoting the evaporation of moisture.
- It is used
 - To produce products like milk powders, whey powders, and dairy-based ingredients.
 - To Agglomerate and control particle Size of powder produced by other dryers.

2(d). Vacuum Dryer

- Material is fed into enclosed container to remove atmospheric air from chamber and create vacuum using a vacuum pump. It increases water vapour partial pressure difference leading to drying at low temperature.
- Pressure maintained at 0.03– 0.06 atm with three times fast drying with temperature 25 °C.
- Allows material to be dried thoroughly even from the inside uniformly and produces dried product with higher porosity, higher rehydration and reconstitution capabilities.
- Used for drying hygroscopic and heat-sensitive milk products.



2(e). Freeze Dryer

- Water is removed from frozen material by sublimation or by desorption of the sorbed solvent typically under vacuum condition with 4.7 mm of Hg pressure and at 0 °C temperature.
- In dairy industry it is used
 - to preserve flavours, bioactive cultures, and other properties of milk while extending shelf life of the milk and milk products.
 - To produce products such as dairy cheese, lactose, cream, and ice-cream.



3. Comparison Between Major Dryers

#	Parameters	Drum/Roller Dryer	Spray Drying
1.	Feeding	Highly evaporated feed onto rotary drums/rollers	Feed material spray using atomizer as a liquid mist.
2.	Heat media	Hot air/ steam inside drum/roller	Hot air
3.	Drying period	Very short	Longer
4.	Heat transfer	Heat is indirectly transferred to milk	Heat directly transferred to milk from hot air.
5.	Powder texture	Coarse	Fine particles
6.	Powder colour	White to yellowish, Non-uniform colour	Yellowish, but uniform colour
7.	Powder solubility	Lower	Higher
8.	Nutrient quality	Retain most of the heat sensitive nutrient	Retain less heat sensitive nutrients
9.	Operating energy	Low	High, energy intensive
10.	Cost	Relatively low	High

4. Equipment Selection Criteria

1. Total plant capacity
2. Types of dried product
3. Dryer's capacity (kg/ Hr.)
4. Inlet/outlet moisture content of the product
5. Upstream/downstream equipment – batch or continuous
6. Maximum allowable processing temperature
6. Feed cohesiveness
7. Nutrient's sensitivity
8. Product fragility
9. Explosion characteristics of vapour or air/gas
10. Toxicological properties
11. Corrosion aspect of product

5. Reference

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