NASH Vacuum Pumps for Freeze Drying & Vacuum Drying

NASH
A Gardner Denver Product

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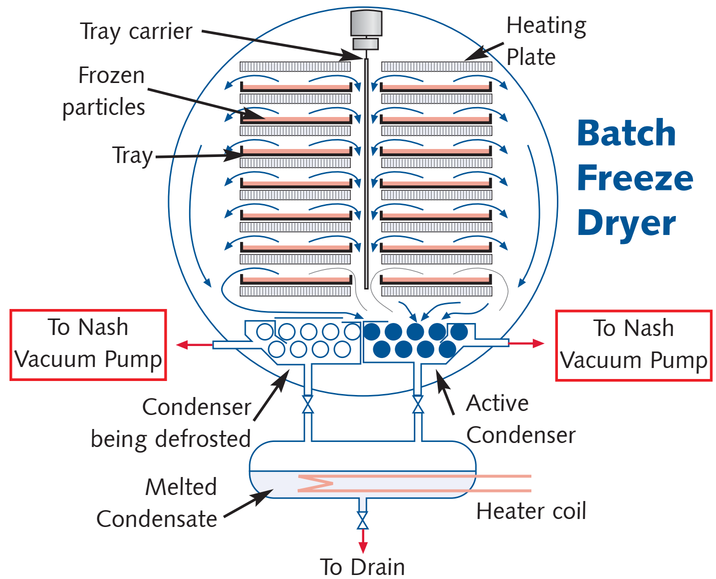
Freeze Drying (Lyophilization)

There are four basic requirements to freeze dry a product:

- The material to be freeze-dried must be frozen solid
- There must be a condensing surface which is colder than the material to be dried
- There must be a vacuum pump which will provide very low absolute pressure
- There must be a heat source

Advantages of freeze drying include:

- low thermal damage
- good retention of volatile flavors
- good vitamin retention
- rapid product rehydration
- low product shrinkage
- long product storage life
- retention of biological activity

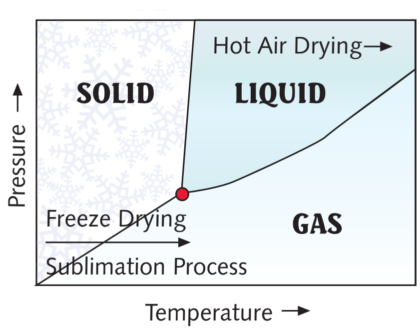


There are three stages to the freeze drying process:

Freezing: the product must be frozen below its eutectic point, the lowest temperature at which the solid and liquid phase of the material can coexist. This ensures that the following steps will lead to sublimation instead of melting.

Primary Drying: During this stage, the pressure is lowered to the range of a few millibars and enough heat is supplied for the water (or other solvent) to sublimate. This removes approximately 95% of the water. Pressure is controlled by using vacuum. At this pressure level, heat is mainly input by conduction or radiation - convection is insignificant here.

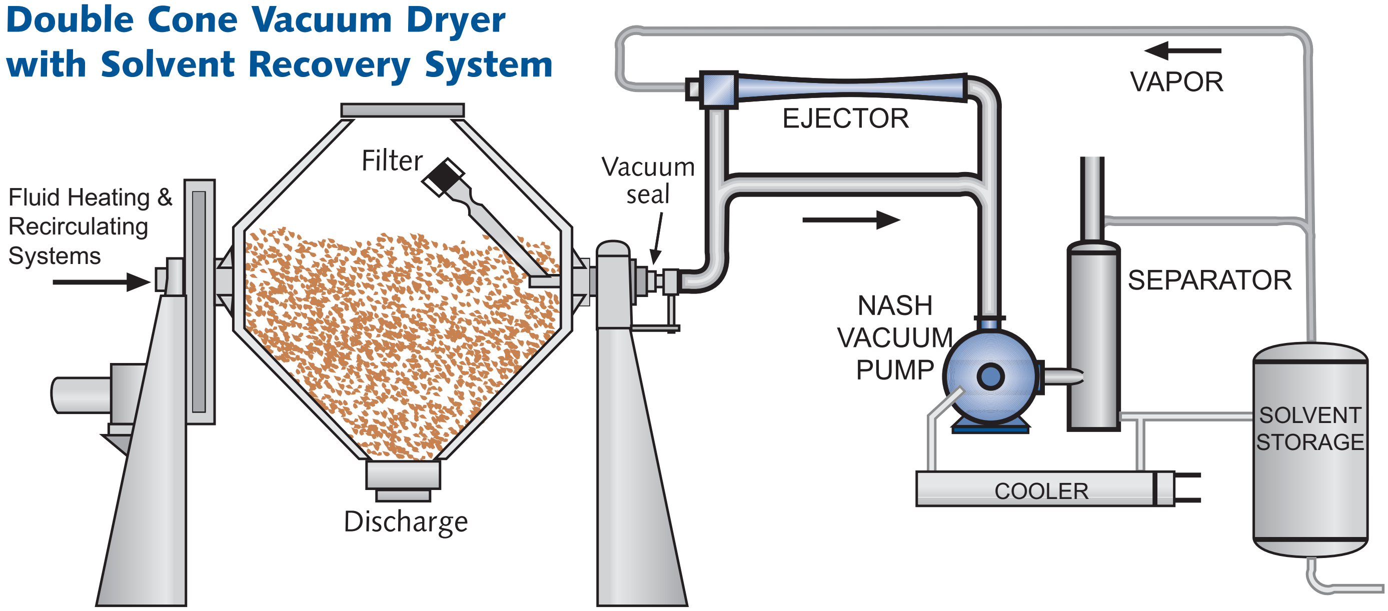
Secondary Drying: Having removed all of the ice in the previous stage, the goal here is to remove unfrozen water molecules. This phase is governed by the material's adsorption isotherms, and the temperature is raised to break any physico-chemical interactions that have formed between the material and the water molecules. Vacuum is usually lowered during this stage to encourage desorption, although there are some products that benefit from increased vacuum levels. Once secondary drying is complete, vacuum is broken with an inert gas (e.g. nitrogen) and the material is sealed in airtight containers. Final water content in the product is around 1% to 4%.



Applications

Pharmaceutical & Biotechnology: increase shelf life of products like antibiotics and vaccines
Food: preserve food and make it lightweight, especially loved by astronauts and hikers.
Technology: chemical synthesis ingredients; late-stage purification in bioseparation
Taxidermy: for your favorite pet
Libraries: recovery of water-damaged books and documents
Historic Collections: textiles, collections, photographs, artwork and keepsakes
Advanced Ceramics: creation of formable powders from a sprayed slurry mist

Double Cone Vacuum Dryer with Solvent Recovery System



Vacuum Dryers

Three methods of heat transfer are used in industrial dryers: convection, conduction and radiation. A dryer is typically used to separate a volatile liquid (usually water or solvents) from a powder, cake, slurry or other moist material. Unlike filtration, which uses mechanical methods of separation, vacuum drying uses only indirect heat. The heat is transferred to the material through contact with the dryer's heated surface, drying the material by conduction. This is done as a batch operation.

When the material to be dried is thermosensitive, vacuum dryers are the process of choice. Two common types are the double-cone (tumble) dryer and the agitated pan dryer. These machines are especially suitable for applications involving solvent recovery, but they can produce a degree of attrition in the dried product if the not properly prepared (freeze drying can eliminate some of these problems).

When using a dryer, the focus is on maximizing the temperature difference between the liquid's boiling point and the heating media's temperature (ΔT) to increase the total heat. By controlling atmospheric pressure, through the use of vacuum, ΔT increases. In other words, vacuum drying simply reduces the boiling point required for removing the liquid. This makes the process well suited for drying heat-sensitive material such as vitamins, antibiotics, certain foods and many fine chemicals.

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