LYnfinity

Spray Freeze Drying

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IMA LIFE
Aseptic Processing & Freeze Drying Solutions

A LITTLE HISTORY

- The design of freeze dryers has not changed much in the last 30 years
  - Significant changes around steam sterilization of the equipment and clean-in-place (CIP/SIP)
  - Use of non-CFC based refrigerants (for global warming potential); reduced thermal mass from stainless steel and vessel construction
  - Auto-loading system and operator/process risk mitigation with the use of RABS and followed by barrier-isolator technology
  - Improved use of PAT for real-time process analysis
- All of the above developments are aimed at improving/maintaining the product quality/operatory safety

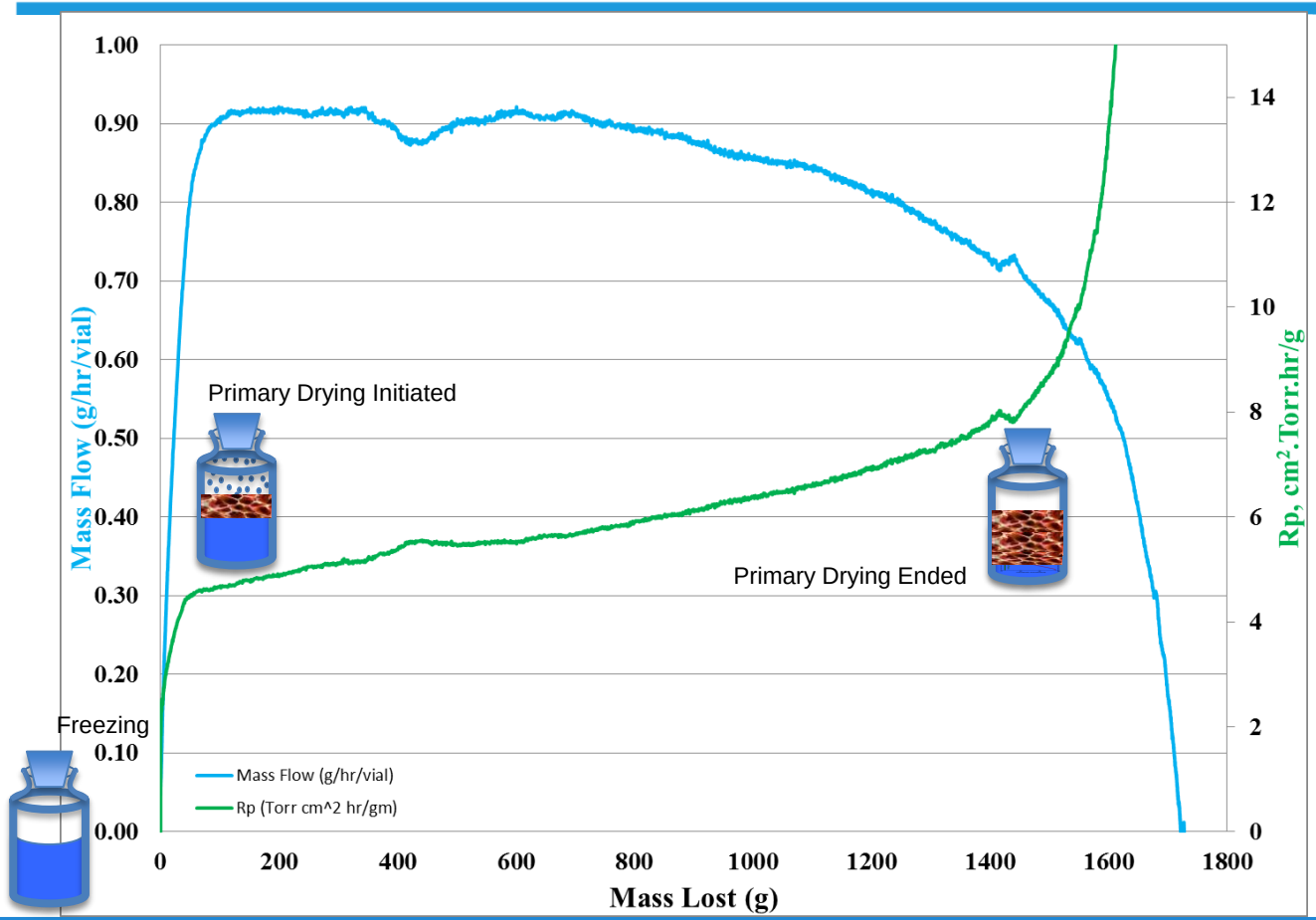
CURRENT STATUS: TRADITIONAL FREEZE DRYING

Traditional Freeze drying batch process = time consuming and energy intensive

- Drying rate is limited by poor heat transfer coefficient leading to long cycles.
- While the use of new process analytical technology has aided in-process understanding, most processes are run conservatively, making it inherently inefficient.

Thus, there is a need to re-think the heat and mass transfer for making the process more efficient.

SCHEMATIC: FREEZE-DRYING



Drying is limited by the mass transfer resistance offered by the drying cake

CONTINUOUS SPRAY FREEZE DRYING

Continuous Spray Freeze Drying process = high throughput and high cycle efficiency

The current development effort focuses on developing a robust yet gentle continuous aseptic process for spray freeze-drying.

Spray Freeze Drying (SFD) can have a transcending impact on process efficiency related to Biologic drug substance storage, inhalation systems, antibiotics for bulk storage among others with direct powder dosing capabilities directly into product containment systems.

CONTAINERS

Vials

Dual chamber cartridge

Inhalation device

Dual chamber syringe

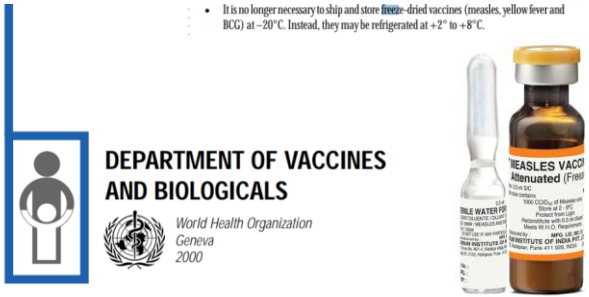
Trend in container systems

https://drug-dev.com/lyophilization-packaging-packaging-freeze-dried-substances-there-are-options/

https://pdfs.semanticscholar.org/dc21/650ffa6b825d6f00c1a4572df145391682ea.pdf

APPLICATIONS

- Antibiotics and other Bulk dried products require milling and powder filling today.
- Better self administration through the use of pre-filled syringe/cartridge system with improved process efficiency.
- Most Biologic drug substance (DS) are often stored and transported in cryogen vessels (>100 L) before being converted to drugs, making it extremely expensive.
- Vaccines require high volume, low downtime/cost production
- Opportunity to reduce recon time in hard to reconstitute products.

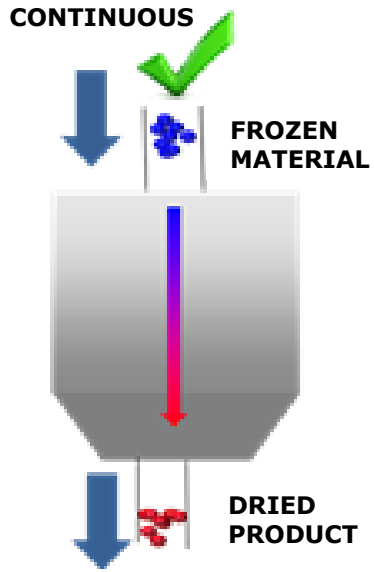


CONTINUOUS SPRAY FREEZE DRYING PROCESS

Freezing:
Spray of liquid formulation into a cryogenically cooled freezing chamber.

Drying:
The resultant frozen particles are freeze-dried in the drying chamber.

The drying chamber contents are both transported and heated in a vacuum chamber to promote rapid sublimation and prevent agglomeration.



CONTINUOUS SPRAY FREEZE DRYING

LYNFINITY

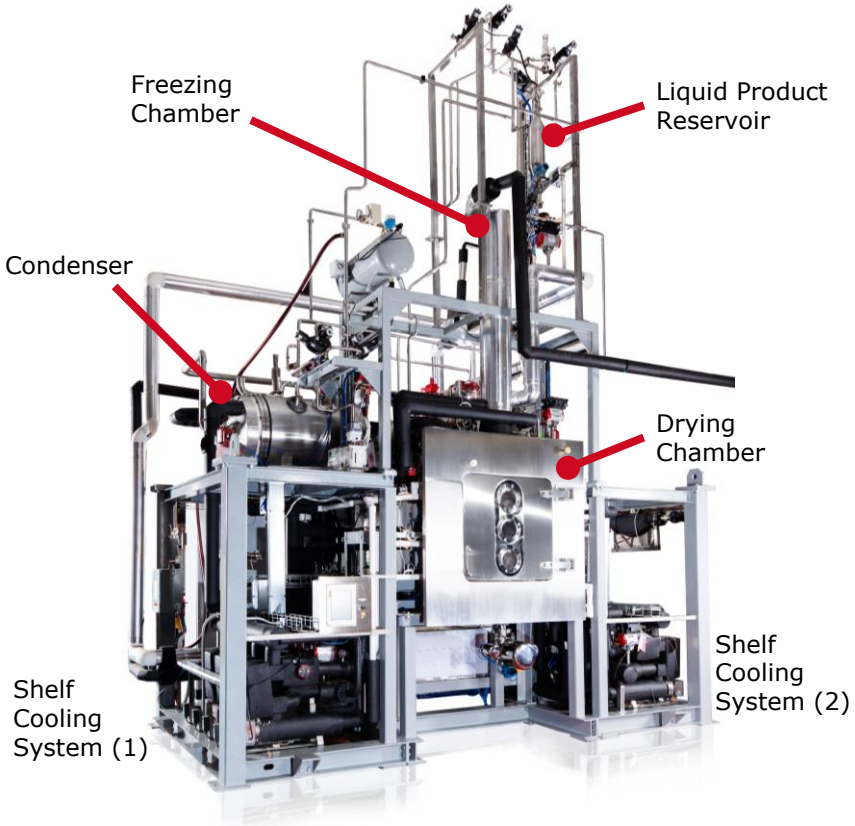
A continuous spray freeze drying technology that produces a dry powder in bulk form aseptically.

Technology

- Spray freezing in a freezing chamber.
- Continuous freeze drying of frozen particles in vibratory agitated drying chamber.

Resulting dry powder is ready for dosing into vial, syringe or inhaler.

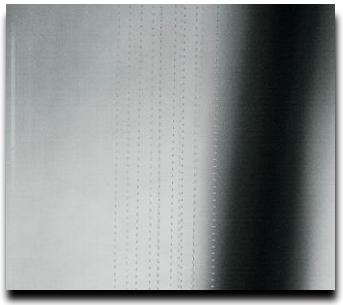
Possibility to use CIP/SIP powder filler.



SPRAYING AND FREEZING

Spraying Step

- The product spray is initiated when a steady laminar product feed is broken into uniform droplets at the top of the freezing chamber.



Freezing Step

- Introduction of spray product into LN_2 cooled freezing tower.
- Product particles are quickly frozen and accumulated at bottom of container.
- Particle size is controlled for uniformly frozen particles, allowing rapid drying in subsequent steps.

High speed camera view of frozen particles

DRYING AND TRANSPORT

Drying Step

- Frozen particles are transferred into a temperature and vacuum controlled drying chamber.
- Surface heating is provided by individually temperature controlled shelves.
- Transport of the particles is done by vibrating shelves.
- Dual condenser design to allow continuous operation with conventional vacuum design.

STERILE POWDER FILLING

- Fills sterile powder in low cost Grade C/D background
- CIP-SIP compatible

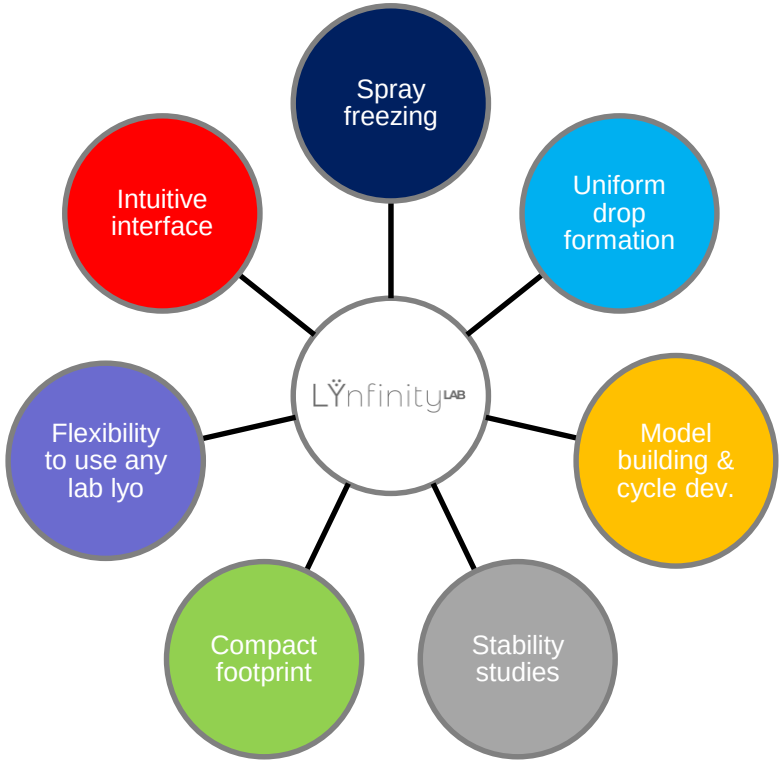
SPRAY FREEZE DRYING AT LABORATORY SCALE

- This laboratory module for spray freezing features a controlled spray of liquid product into a cryogenically cooled freezing column
- The design of the laboratory freezing module is identical to that used in the production version to allow for easy model building and cycle development
- The frozen pellets are manually transferred into a separate drying module such as a traditional laboratory freeze dryer

LYNFINITY LAB: KEY FEATURES

The LYnfinity LAB offers access to the emerging technology of spray freeze drying:

- Ease of use
- Low barrier to entry prior to moving product towards continuous freeze drying
- Generate uniform frozen droplets of mean volumetric diameter 600 microns
- Use of traditional freeze dryer as drying module
- Process development with limited formulation (down to 200 ml)
- Technology evaluation
- Model building
- Dried product characterization
- Stability testing
- Small footprint for setup in the lab
- Designed for handle and install in laboratory with standard double doors



LAB USER WORK FLOW

(1)

(2)

(3)

(1) User loads liquid product into liquid product reservoir
(2) User initiates LYnfinity LAB spray freeze cycle through HMI panel, with cycle status displayed through the HMI and LED strip
(3) Upon cycle completion, user removes the frozen product canister for manual transfer for drying in a traditional lab freeze dryer

USER INTERFACE & INSTRUMENTATION

The UI has been designed to be intuitive not only in terms of the hardware interaction for first time users, but also thanks to its multi-touch HMI and integrated LED messaging board on the front panel.

Integrated instrumentation provides the user with real-time process data, including the mass of the liquid product and temperature of the temperature controlled liquid product reservoir platform.

Built in connectivity features allow for remote support from IMA's global service team.

THANK YOU

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