A guide on choosing a Freeze Dryer.

Not all freeze dryers are the same. Some are designed for Pharmaceutical and Nutraceutical with benchtop dryers that hold vials and flasks, to the larger floor units that can have moveable shelves to push in stopper on vials when the drying stage is completed. Others are designed for the home market and sit on your bench, while the rest can range from pilot size dryers to big 1500+kg batch dryers and be used for drying anything from foods to documents.

So, with so many different types what is best? There are companies all over the worlds that make and sell freeze dryers, and it is a matter of looking at what they offer and comparing each machine. Unfortunately there is no standard type of freeze dryer out there so you may not be able to compare apples with apples.

Here are some questions you should be asking when looking at freeze dryers and what is on offer:

What vacuum do I need?
As a guide, atmospheric (sea level) pressure is 1017mBar, and most chambers are evacuated to around 1mBar before drying begins. Some dryers can have a 2 stage vacuum pump that will allow the vacuum pressure to go lower.

What temperature does it need to be?
All products must be frozen solid. This is usually around -20°C, but some products need to go down to -35°C (products with high brix levels or sugars). For sublimation to happen (transformation from ice to vapour without passing through the liquid phase) there must be a difference of temperature between the product and the ice coil of at least 10°C (20°C is better), so the ice coil should be around the -40°C range.

Energy is needed to be added to the product to start the sublimation process.

Can you freeze in place?
Some freeze dryers have the ability to freeze product inside the dryer. Whilst this will save on the purchasing of a separate blast freezer, it will add time to the process of freeze drying by up to 6 hrs or more. If turn-around time is important then it is best to have a separate freezer to get the next load ready once the dryer is unloaded and defrosted.

Dryers that are able to freeze in place will have some form of HTF (Heat Transfer Fluid) running through the shelving, and this will also be used in heating as well. Types of HTF would be glycol, brine, oil or hydrocarbon and these will determine how hot or cold the dryer will go.

Internal cleaning process?
Some freeze dryers have CIP (Clean In Place) options. This is where there are jets inside the chamber that can have cleaning agents spray through them to clean the shelving module and chamber. Another option that dryers can have is the ability to remove the shelving module from the chamber, allowing for cleaning and inspection of the chamber and shelves.

If the dryer uses electrical heating plates on the shelves, you need to check these are ok to have water hosed on them for cleaning. Dryers that use HTF in the plates are generally better and easier to clean.

How long is the cycle time on freeze dryers?

Drying cycle times will depend on the type and amount of product being dried. Some dryers can do a batch in 8 hrs and others in 24 hrs, or longer.

This is product dependant and how fast you get the energy in. The faster the drying time the higher the energy used in the dryer. This can be an issue with heat sensitive products like proteins or flowers, so you need to be aware that speed is not always the best option.

The average drying time cycle would be a 24-hour cycle.

What warranty to expect?
You would expect a minimum of a 12-month warranty as standard. This could be extended to 24 months but you would need to ask as most of the time this is governed by the suppliers of the plant equipment. You should be expecting workmanship on a chamber to last well over 20 years.

Is after-sales service standard?
Any reputable freeze dry company would give you the same service post installation as pre installation. There should be a network of local trade's people who have been set up to help in maintaining your equipment.

Do Freeze Dryers come with optional extras?
Yes, but you may not need these. Depending on the type of dryer and its design, here are some of the options that you could look at:

- Cooling tower for refrigeration condenser
- Air-cooled refrigeration condenser instead of water-cooled
- Dry vacuum pump for lower maintenance
- Heat recovery system to allow for faster ice coil defrost time
- Inclusion of remote monitoring facility via modem
- IQ/OQ validation
- Lower and higher shelf freezing/heating as required
- Tray trolley's for ease of handling
- SCADA data acquisition

Footprint and physical size?
This can be the deciding factor to which model you can get. There are some dryers that have separate ice coils that can take up as much room as the chamber, whereas others are combined into the chamber. The plant equipment with the HTF and vacuum pumps can be under the chamber on smaller dryers and in a separate room on the larger ones.

Do you require a wet and dry area for loading and unloading? Some dryers are designed to have a clean room flange around them, allowing for one room to be used as a loading area (wet room) while the other end is the dry room and the product is unloaded. Of course the dryer must have two doors on it for this to happen.

You also need to consider the work space around the dryer for trolleys to be moved in and out and how the work flow will go. The freeze dry company should be able to help with this based on a floor plan provided and or a site visit.

Working space inside
Not all dryers have the same useable shelf space inside. These can vary quite a bit so make sure that you find this out. This will help you work out how much product you can dry in one batch. In a commercial world, the more in one batch the cheaper the cost to make. Doing less volume in a short amount of time is not as economically viable as doing larger amounts in say 24hrs. This is because the turnaround time frequency is greater and will cost more.

The other thing to look out for is the working height of the shelves. Some are changeable and others are fixed. If height is important then ask if the shelves can be altered at the time of manufacturing. It shouldn't be hard to do and shouldn't cost extra unless it is a total redesign and impacts on other details in the chamber.