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Freeze Drying (Lyophilization) Application Note



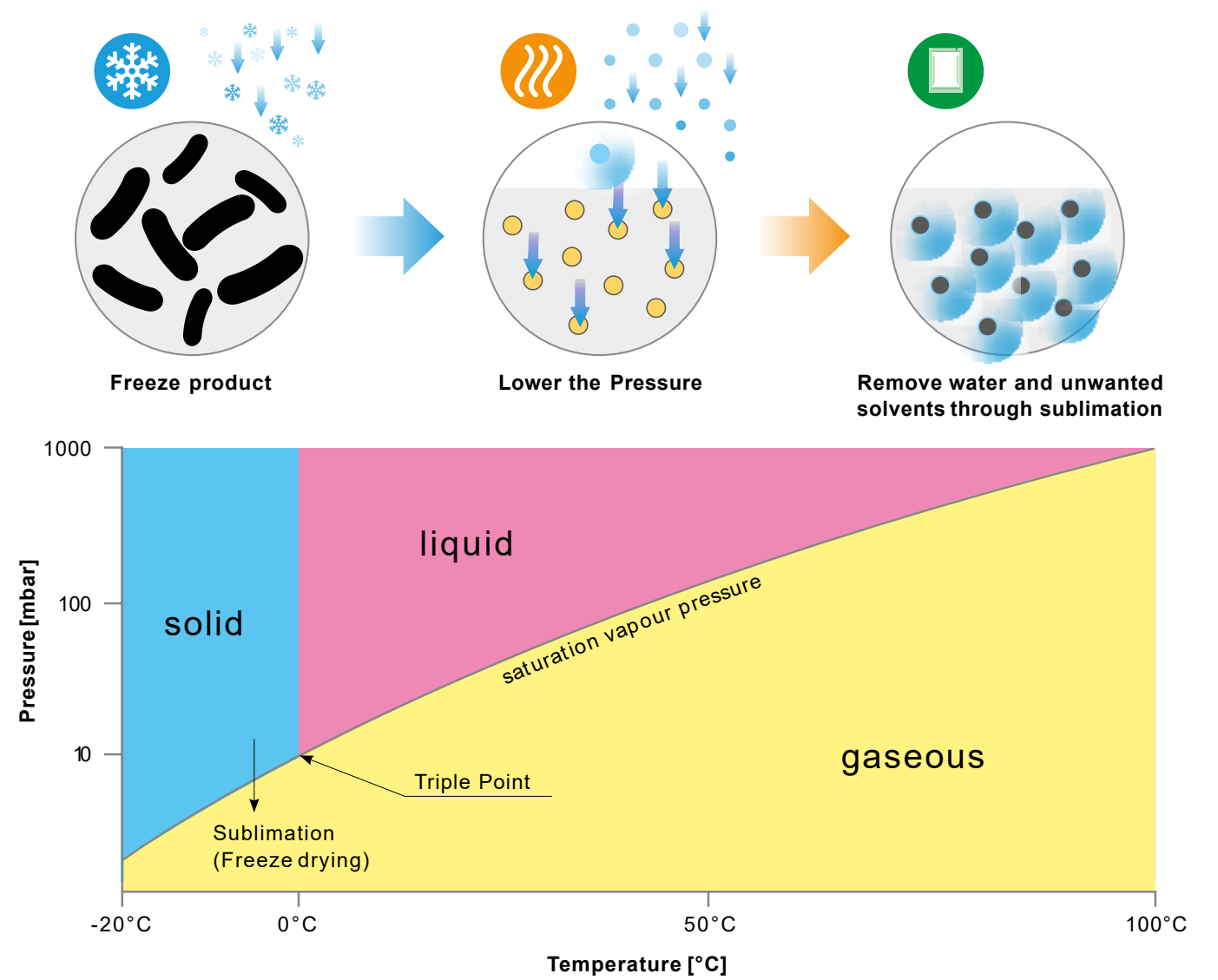
PUMP SOLUTIONS FOR FREEZE DRYING APPLICATIONS

Freeze drying (lyophilization) is the low-temperature process of removing water from foods, pharmaceuticals and other products to enable their easy storage and transportation without the need for constant refrigeration. Compared to dehydration methods that use heat, this process allows for maintaining higher product quality, facilitating preservation.

The freeze drying process consists of three primary steps: a product is frozen, pressure is then lowered and the ice is subsequently removed through sublimation (direct solid to gas transition). By eliminating unwanted moisture, the procedure helps prolong the shelf life of products, while preserving their desired structure.

THE LYOPHILIZATION PROCESS IN 3 STEPS

Removing moisture from frozen material under the vacuum



POWERING FREEZE DRYING DEVICES

Freeze dryers, the devices used to conduct freeze drying processes, need a reliable vacuum source to operate. The choice of the right vacuum pump is crucial in freeze drying applications that typically require ultimate vacuum levels of below 0.1mbar and may also have chemical resistance pump requirements depending on the aggressiveness of the given solvent.

Sizing the pump properly so that it is suitable for a particular freeze dryer is of the utmost importance. A pump flow rate that is too high will result in vapors being pulled through the freeze dryer's condenser too quickly, reducing the condenser's trapping efficiency. The condenser itself needs to be cleaned after each run to mitigate the risk of chemical vapors entering the pump and damaging the oil. Also, the freeze dryer collector's temperature must be compatible with the solvents being lyophilized.

A BROAD RANGE OF FREEZE DRYER PUMP SOLUTIONS

Welch has extensive experience in providing pump solutions for freeze drying applications.

For processes involving aqueous samples we offer a wide spectrum of CRVpro two-stage rotary vane pump models with different pumping speeds.

Model	CRVpro 2	CRVpro 4	CRVpro 8	CRVpro 16
Maximum pump speed	2.5 m³/h (42 l/min)	6 m³/h (100 l/min)	8 m³/h (133l/min)	18.3m³/h (305 l/min)
Ult. Vacuum Pressure Total	3x10 ⁻⁴ mbar	2x10 ⁻³ mbar	2x10 ⁻³ mbar	3x10 ⁻³ mbar

Model	CRVpro 24	CRVpro 30	CRVpro 48	CRVpro 65
Maximum pump speed	26.2 m3/h (436 l/min)	33.1m3/h (551l/min)	55.7 m3/h (928 l/min)	74.3 m3/h (1,238l/min)
Ult. Vacuum Pressure Total	3x10 ⁻³ mbar	3x10 ⁻³ mbar	3x10 ⁻³ mbar	3x10 ⁻³ mbar



For processes involving acidic/organic samples we offer the CRVpro 8 Chem pumps that are optimized for handling corrosive chemical gases and vapors. Their anti-corrosion features include a protective coating and an integral oil filtration system that help significantly increase the pumps' service intervals.

CRVpro 8 Chem pumps with a maximum pumping speed of 8 m³/h (133l/min) and ultimate vacuum of 2x10⁻³mbar

The table below shows how to select the right vacuum pump model depending on the freeze dryer size and the process sample type.



Freeze Dryer Size (volume)	Aqueous samples	Acidic/Organic Vapors
2.5 l	CRVpro2	CRVpro8 CHEM XC
4.5 l	CRVpro6	CRVpro8 CHEM XC
6 - 12l	CRVpro8	CRVpro8 CHEM XC

The main benefits of Welch's freeze drying pumps include:

- 10°C cooler operation than comparable pumps, which results in extended oil life and heightened pump reliability
- Internal surface protection that increases corrosion resistance and product lifespan
- 40% larger oil capacity than comparable pumps, which helps dilute contaminants and minimizes maintenance requirements
- A broad choice of pump sizes and accessories to meet all freeze drying process needs

Welch's freeze drying pumps can be used in applications such as:

- Drug development
- Drug storage
- Food processing
- Cell extraction in biotechnology
- Chemical synthesis
- Nanotechnology

For more information on our range of pumps for freeze dryers, please visit us at www.welchvacuum.com or contact us. Talk to a Welch representative to obtain your specific application consultation.

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