

Cold storage

Advantages of chest freezers for biobanks

Keywords

Biobanking, chest freezer, ultra-low temperature, efficiency, sustainability

Touchpoints

- Maintaining consistent temperature to prevent sample degradation
- Door opening recovery
- Energy efficiency and sustainability
- Diagnostic monitoring
- Sample access and organization
- Compliance with EPA SNAP regulations for refrigerants

Introduction

As the demand for thorough annotation of biological samples with accompanying data has increased, keeping samples organized well at optimal temperatures has become imperative. Biobanks handle the entire workflow from sample acquisition, processing, and cold storage to transport or analysis. One of the most important functions of a centralized storage facility is maintaining temperature uniformity in cold storage units, because it helps minimize pre-analytical variability. Reliable temperature uniformity is a measure of performance that can reassure scientists and their collaborators that their samples are being stored in stable environments that support reproducible and impactful research.

Biobank directors and managers have options when it comes to installing new equipment in designated spaces, but for a complete assessment it is important to consider current conditions along with future needs. Many biobank technicians open freezer doors frequently to access and store samples. They should thus understand unit specifications like storage capacity and energy requirements. The time it takes for a freezer cabinet to return to the optimal storage temperature is another factor that governs the number of samples that can be stored and the amount of time they can be stored with confidence. This is often evaluated in terms of door opening recovery (DOR). Having freezers that recover to their specified temperatures within minutes is important for biobank technicians who store and retrieve precious samples.

The International Society for Biological and Environmental Repositories (ISBER) acknowledges that some chest freezers are better than others at restoring cold temperatures after they are opened [1]. Differences in performance can be attributed to the physical properties of dense, cold air and sharp temperature gradients at the boundaries of the freezer lids. Minimizing exposure to the warm air of the surrounding room helps prevent the temperature around samples in a freezer from rising. A well-designed freezer will have enough cooling capacity to quickly remove heat from the cabinet to restore the optimal storage temperature as quickly as possible.

Clear access to organized sample boxes is a major determinant of how quickly samples can be retrieved and utilized. One advantage of using chest freezers for cold storage is the ability to quickly transfer vertical racks to cryogenic units for long-term storage. A chest freezer can also be used as a backup system or holding unit for samples before they are transported outside the laboratory. The versatility of chest freezers becomes evident when different configurations are required for a wide range of sample containers. Our latest ultra-low temperature (ULT) chest freezer has a convenient flat work surface where racks can be placed temporarily, which allows labeled boxes to be viewed without obstructing the screen. The display is easy to read and enables diagnostic monitoring to help ensure reliable performance and prevent biomaterial degradation.

While it is advisable to analyze samples shortly after they are received, many samples remain in cold storage until there are enough to obtain a relevant sample size. Samples may be in cold storage for several years. Having a highly efficient chest freezer, particularly a larger 20-cubic foot unit, can help limit energy costs over time. Energy savings of kilowatt hours per day can factor into scaling a facility that intends to become a national center of excellence, which must be reliable for decades.

Sustainable features are becoming standard and include natural refrigerants that are compliant with the Significant New Alternatives Policy (SNAP) of the US Environmental Protection Agency; labels that help ensure accountability, consistency, and transparency; and polyurethane foam insulation blown with hydrofluorocarbon substitutes that have less potential for ozone depletion and global warming. Quiet operation also makes a ULT chest freezer an ideal unit to place near a sample processing area.

Chest freezers are understandably overlooked as valuable storage equipment when space is a concern, but their advantages are clear. Chest freezers can help biobanks sustainably maintain well-organized sample collections, because they efficiently maintain ultra-low temperatures and easily accommodate vertical racks. Biobanks may need to access samples multiple times per day, sometimes over the course of several months or years. Using chest freezers for cold storage can improve operating conditions in biobanks, which can help scientists focus on making new discoveries.

Reference

1. Campbell LD, Astrin JJ, DeSouza Y et al. (2018) The 2018 Revision of the *ISBER Best Practices*: Summary of Changes and the Editorial Team's Development Process. *Biopreserv Biobank* 16(1):3–6. <https://doi.org/10.1089/bio.2018.0001>