

## Customer Issue

The customer was being audited by regulatory authorities, who requested additional information about the product's freeze drying-related characteristics.

## Product Analyses

The product was analysed by a range of techniques:

- Freeze Drying Microscopy (FDM) using BTL's Lyostat instrument established the collapse temperature and also ascertained that there was no skin formation that could have hindered drying.
- DTA / Impedance Analysis using BTL's Lyotherm instrument identified frozen-state characteristics such as glass transitions and endo- and exo-thermic events that could require adjustments to product or process.
- Karl Fischer moisture analysis was used to test the dry sample to ascertain the final moisture content. It was also used with Frequency Modulated Spectroscopy (FMS), which was then able to non-destructively test large numbers of samples for moisture content.
- DSC was used to analyse the product in the dry state. The dry state glass transition is used to ascertain the product's stability when dry and recommend storage conditions.

## Validating the Existing Cycle

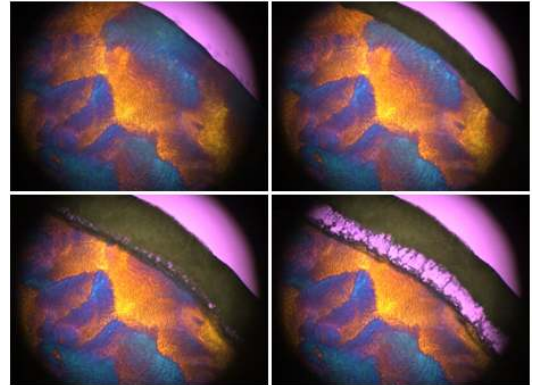
The collapse temperature and frozen-state data were compared to the freeze drying cycle to ensure that the existing parameters were safe and suitable. In this instance there were no areas which required further development.

## Validating Storage Conditions

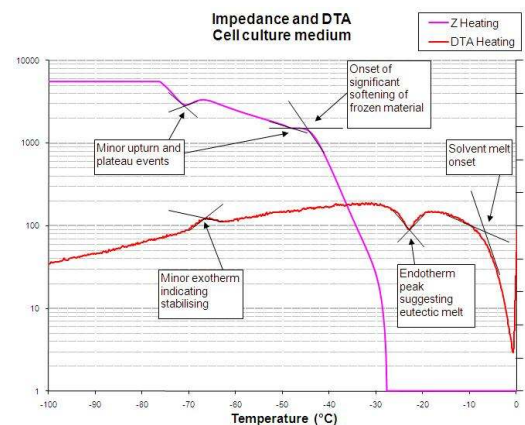
The dry-state glass transition temperature provided by DSC is typically used to recommend storage conditions. In this instance the existing storage specifications were suitable and no changes were required.

## Report of Data

A full report was provided to the customer that detailed each analysis conducted, the raw data, interpretation and discussions of the implications. This data was then incorporated into the customer's regulatory submission and they were able to pass inspection.



**Above: Screenshots of a Lyostat analysis in progress. The product is frozen (top left), dried with good structure (top right) and then collapses (bottom images).**



**Above: DTA / Impedance analysis with annotated thermal events**



**Above: Tray of freeze-dried vials**