New Developments in Controlled Nucleation: Commercializing VERISEQ® Nucleation Technology

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Introduction

Freeze drying, which is also known as lyophilization, plays an important role in drug manufacturing by stabilizing delicate pharmaceutical and biological products. Over the past several decades, significant progress has been made in the design of freeze-drying processes enabling the industry to take full advantage of the recently developed technologies, including those in the field of controlled nucleation.

Freeze-drying was developed commercially in the 1940s to produce a dry product that can be readily reconstituted to its original form by adding solvent (usually, water) when required [1]. Removal of moisture facilitates the slowing down of chemical, microbiological, and physical degradation processes, and therefore, extend the shelf life of the products.

The freeze-drying process is comprised the following three main steps: freezing (solidification), primary drying (ice sublimation), and secondary drying (moisture desorption) and can be quite lengthy (taking up to several days). During the first step, serum vials or other containers filled with a liquid drug formulation are cooled down to low temperatures until the liquid content nucleates and completely solidifies. The temperature is lowered further until the solute portion also solidifies by forming either a crystal or a glass. During the second step, the frozen solvent (primarily, ice) is removed by sublimation under reduced pressure and increased temperature. During the third step, the remaining unfrozen solvent, which is chemically bound to the solid product, is removed by a desorption process.

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