Dynamic Developments in Freeze Drying Technology from Hosokawa Micron

Since the early Incas who freeze dried their potatoes to the development of freeze dried instant coffee in the 1930's freeze drying technology has continued to be developed on an industrial scale for particular use in preserving and extending the shelf life of temperature sensitive materials such as food stuffs, pharmaceuticals and blood plasma .

Traditionally carried out using tray freeze dryers incorporating a large chamber for freezing and a vacuum pump for removing the moisture, freeze drying has been recognised as a slow and labour intensive process often with the need for an additional grinding stage to reduce the dried cake into a fine powder.

New developments in active freeze drying by Hosokawa Micron have now created a much quicker, less labour intensive and all round improved freeze drying process that is particularly beneficial in pharmaceutical and nano-material applications. Suitable for batch volumes from a few litres to bulk drying of hundreds of litres.

Production Applications

Applications in the pharmaceutical industry in the production of antibiotics macromolecules and electrolytes are now common along with freeze drying of proteins, hormones, viruses, vaccines, bacteria, yeast, blood serum, liposomes and transplant materials like collagen sponge. For all these products the decisive factor to use active freeze drying technology is the preservation of the product structure, particle size and the minimal temperature load.

Another fast growing market for the application of Active Freeze Drying on a larger scale is in materials development, in particular nano-materials. By using dynamic freeze drying for these wet base processed materials special advantages are obtained. The suspended particles remain separated during freezing as well as the drying process. During the sublimation process single particles will become separated but the continuous motion of the material will induce the formation of weak agglomerates. The final product will consist of loosely bound single particles forming a fine cohesive powder.

Active Freeze Drying Process

Active Freeze Dryers exhibit a good heat transfer rate due to the continuous motion of the product; this shortens the drying process because the dried product does not hinder the sublimation as is the case in traditional tray freeze drying methods. The Active Freeze Drying process steps are all carried out in a single processing unit resulting in easy to handle lump-free, free-flowing product. Due to the forced motion of the material, being a liquid, paste or solid, it will be transformed into solid granules. The size and shape of the granules can be controlled by the dynamics of the machine.

Once the freezing step is completed the drying chamber is closed and vacuum applied. After evacuation of the freezing agent the sublimation process starts. From this stage the product temperature is dictated by the vacuum level. During sublimation the heat is supplied through the jacket and efficiently distributed throughout the product by the chamber design. The initial coarse granules gradually reduce in size due to the sublimation of the connecting ice structure in between the forced material. The released dried particles will make up a loose powder. Towards the end of the drying process when most of the frozen solvent is sublimated the product temperature will start to rise and finally equalise the wall temperature indicating that the drying process is finished. All material is transformed into a fine loose powder that can easily be discharged as a free-flowing material from the dryer vessel, assisted by the transporting characteristics of the drying chamber.

With the development of this new, dynamic method of freeze drying from Hosokawa Micron a new type of production technology is available with the benefits of preservation of the product structure and the potential for further exploration into particle design.