Fluidized bed dryers

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Mohd Faizal Mohideen Batcha [1], *Shahrin Hisham Amirnordin* [1] *and Ahmmad Shukrie Md Yudin* [2]
[1]Center for Energy & Industrial Environment Studies, Universiti Tun Hussein Onn Malaysia, Batu Pahat, Johor, Malaysia; [2]Faculty of Mechanical & Automotive Engineering Technology, Universiti Malaysia Pahang, Pekan, Pahang, Malaysia

4.1 Introduction

Fluidization, as defined by Gasmelseed & Mohammed (2017), is the process by which solid particles are transformed into a fluidlike state by suspending in a gas or liquid, and the gas passes through a layer of solid particles which was supported by a distributor. At low flow rates, the fluid penetrates through interstices between the solids. As the fluid velocity increases, the size of the interstices increases, and the pressure drop in the bed also increases until a point at which the drag force of the fluid is sufficient to suspend the solids. This condition is known as incipient fluidization, and the solid particles now transform from the packed bed into a fluidized bed. A variety of processes benefit from this fluidized condition, among them drying.

Drying involves heat transfer to a wet solid and simultaneous moisture removal from the wet solid. In food processing, drying is usually carried out for food preservation. Apart from depending on parameters such as relative humidity, temperature, and velocity of drying air, as well as physical properties of food, fluidized bed drying is also strongly depends on the fluidization quality and degree of mixing between food material inside the fluidized bed. Fluidized bed drying has apparent advantages, including high heat and mass transfer, homogeneous moisture reduction in a short amount of time, and a high drying rate (Dehbozorgi et al., 2014). A typical fluidized bed dryer (FBD) system is shown in Fig. 4.1.

FBDs can maintain a stable bed temperature throughout the drying cycle and prolong the period of constant drying rate. However, stratified flow and the creation of hotspots in FBD dryers can cause significant moisture variation in the product, resulting in a loss of quality.

A food product's drying curve describes the product's drying properties under a certain temperature, velocity, and time. A typical drying curve for food products dried in an FBD is similar to those dried via other methods, as shown in Fig. 4.2. Typically, there are three distinct phases; the initial phase is when sensible heat is supplied to the wet product to preheat it. The second, or constant rate period begins with the evaporation of free moisture at the surface and continues until all surface moisture has been evaporated to the material essential moisture content. During the decreasing rate stage, moisture from the particle's internal interstices must be dispersed to the particle's outer surface, which takes a longer time and requires a

Drying Technology in Food Processing. https://doi.org/10.1016/B978-0-12-819895-7.00006-7