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Performance of a double drum dryer for producing pregelatinized maize starches

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Abstract

The response of an industrial scale double drum dryer to variation of steam pressure, drums rotation speed and level (height) of the gelatinization pool between the drums is presented. To our knowledge, this is the first time that the gelatinization pool level is treated as an input variable. The output variables are the product's moisture content, mass flow rate and specific load (equivalent to the product's film thickness). The effect of the drum surface temperature and width of the gap between the drums on the behavior of the output variables is examined. A theoretical analysis is presented for the qualitative assessment of the basic process variables that control the film thickness of the product. The role of the thermal inertia of the drum wall to the response of the dryer is discussed. Changes in the thermal efficiency of the dryer are inferred from overall heat transfer coefficients.

Keywords: Drum drying; Double drum dryer; Pregelatinized starch; Instant starches; Film thickness

1. Introduction

Drum-drying is one of the main commercial hydrothermal treatments of starchy food products, i.e., cereals, tuber and legume seeds, flours (Collona, Buleo, & Mercier, 1987). This type of drying is suitable for products which are viscous in their natural state or after concentration, such as mashed potato, precooked starchy baby foods, casein, milk, maltodextrins, fruit pulps, etc. (Falagas, 1985).

Drum-drying results in specific physicochemical modifications of the native starch due to the gelatinization and further solubilization of the starch granules (Mercier, 1987). The delivered products, often referred to as pregelatinized or instant starches, are customarily in the form of thin solid sheets. These starches are prepared in two consecutive stages: complete gelatinization (to improve the nutritional value of starch) and drying. Both stages exploit the heat transferred from the surface of the steam-heated drums to the wet product. Enhanced by the boiling-type of drying (Vasseur, Abchir, & Trystram, 1991a) the obtained drum-dried sheets present excellent wettability and are easy to rehydrate, qualities very important for ready-to-use products (Bonazzi et al., 1996).

Specifically, in a double drum dryer gelatinization takes place inside a "pool" of material formed between the drums by the use of two spring-loaded end plates bearing on the flat ends of the drums. The actual drying starts only after the gelatinized material leaves the pool and forms a thin film upon the surface of the drums. Film thickness control is a result of adjusting the gap between the two drums where a limitation is set by the necessity for preventing fall-through of feedstock at the gap. This feature dictates somewhat different operational characteristics by double-drum dryers than for single drum dryers, i.e., single drum dryers usually use higher drum rotating speeds (Gardner, 1971).

Gardner (1971) presented a comprehensive review of a broad range of drum dryer operational characteristics for industrial applications. Fritze (1972, 1973a,b) compared the performance of four different types of drum dryers – including a double drum dryer – for drying maize starch slurries (15–40% w/w solids). Drum speed

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