ELSEVIER

Journal of Food Engineering 54 (2002) 45–58

JOURNAL OF FOOD ENGINEERING

www.elsevier.com/locate/jfoodeng

Heat transport to a starch slurry gelatinizing between the drums of a double drum dryer

M.A. Gavrielidou [a], N.A. Vallous [a], T.D. Karapantsios [a,b,*], S.N. Raphaelides [a]

[a] *Food Process Engineering Laboratory, Department of Food Technology, Technological Educational Institution of Thessaloniki, University Box 14561, Thessaloniki 541 01, Greece*

[b] *Division of Chemical Technology, Department of Chemistry, Aristotle University of Thessaloniki, Box 116, Thessaloniki 540 06, Greece*

Received 2 March 2001; accepted 19 September 2001

Abstract

This work is concerned with the thermal field inside the pool of a starch slurry that preheats and gelatinizes between the drums of a double drum dryer. Experiments are conducted at several steam pressures, drum rotation speeds and levels of the pool between the drums. Temperature time records are employed as a means of studying the effect of all variables to the thermal distribution in the pool. Measurements indicate that subcooled boiling may be the dominant mechanism for heat transport in the pool.

Keywords: Drum drying; Pregelatinized starch; Temperature measurement; Time series analysis; Subcooled boiling

1. Introduction

Drum dryers are used to dry a wide variety of heavy pastes and thick liquids in both the food and chemical industries. A partial list of typical materials dried are precooked breakfast cereals, dry soup mixtures, yeast, various fruit purees, polyacrylamides, sodium benzoate, various propionates, various acetates, and many other chemical products (Moore, 1995). Among this variety of products the production of pregelatinized starch is a common industrial practice (Bonazzi et al., 1996). Double drum dryers are especially applicable in this process because of their ability to handle a wider range of products, better economics, more efficient operations, higher production rates and fewer operating labor requirements (Moore, 1995).

A double drum dryer consists of two cylinders (drums) of equal diameters rotating very close together in opposite directions, Fig. 1. The heating medium is usually saturated steam, introduced to the inside of the drum and condensed on the drum wall. The starch suspension is fed into the wedge shaped space between the drums (henceforth the pool) by means of a distribution pipe. Under the influence of the heat transferred from the hot drum surfaces to the starch suspension in the pool, the starch gelatinizes and swells to form a viscoelastic fluid (Fritze, 1973). The rotation of the cylinders causes the material in the pool to pass through the narrow space between them (henceforth the gap) and divides it into two films; one on each drum. This film is no longer in motion relative to the drums because of the rapid drying and solidification. After traveling part of a revolution, the dried film is removed in the form of thin sheets by scraper (''doctor'') blades spanning the whole width of the drums.

There are five variables involved in the operation of a double drum dryer on a given material:

1. steam pressure;
2. speed of rotation;
3. gap between the drums;
4. pool level between the drums; and
5. condition of the feed material, that is, the concentration, physical characteristics, and temperature at which the material reaches the drum surface.

A survey of the recent literature shows that studies dealing with double drum dryers are rather scarce and are mainly of technological interest, e.g. Kitson and MacGregor (1982), Rosenthal and Sgarbieri (1992). On

* Corresponding author. Tel.: +30-31-791-373; fax: +30-31-791-360.
E-mail address: karapant@cperi.certh.gr (T.D. Karapantsios).

0260-8774/02/$ - see front matter
PII: S0260-8774(01)00184-4