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Chapter 5

Moisture migration in a grain column subjected to drying

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Abstract

In this paper, a mathematical model has been developed to predict temperature and moisture distribution within a column dryer taking into account the influence of the change of air moisture on the grain moisture through the sorption isotherm. In the development of the energy equation, the influence of moisture contents on the properties of the material has been considered. The resulting unsteady, non-linear, coupled differential equations are solved numerically, using orthogonal collocation method. A detail parametric study has been performed to identify important variables. The model is also applied to predict moisture migration under conditions approximating both low and high temperature in-storage drying of grains. The predicted results show good agreement with the experimental values.

Keywords: Mathematical model; drying; moisture distribution; temperature profile; column dryer; sorption isotherm.

INTRODUCTION

A considerable amount of research has been reported in the literature on thin layer drying of agricultural products [Pabis and Henderson, 1962]. However, little research has been reported on in-storage drying characteristics of grains. To evaluate performance of this type of dryer, models involving heat and mass conservation, in conjunction with drying rate equation, are used to simulate the drying system. Early drying models tended to be empirical or semi-empirical in nature. Many models, such as those of Boyce (1965) and Thompson et al. (1968), were proposed to simulate drying in shallow bed, using layer by layer method. Generally, for deep bed drying, these models would not be applicable to predict distribution of grain temperature and moisture content within the dryer. The equilibrium model of Bloome and Shove