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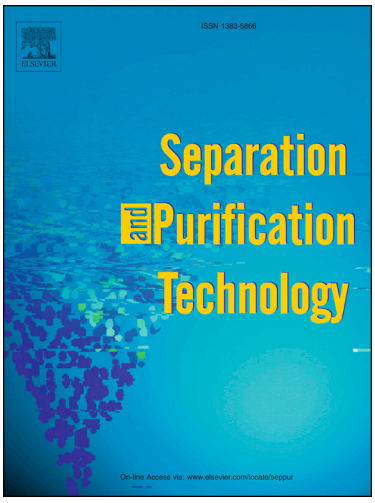

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DEHYDRATION OF PADDY RICE IN A CHITOSAN MEMBRANE DRIER

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Abstract

A chitosan membrane was used to separate water vapor evaporated from moist paddy rice out of the apparatus, called the "membrane drier". It was aimed as an alternative method to dry harvested paddy instead of the traditional open air technique that can encounter rain or flooding problems. The prototype membrane drier was designed from a mathematical air flow pattern analysis, where it was found that a horizontal flow mode with a baffle plate and triangle air flow path (HFwBF&TFP) was the most appropriate feature. The chitosan membranes studied in this research were uncrosslinked dense (UCD), crosslinked dense (CD), uncrosslinked composite-on-spunbond (UCC) and crosslinked composite-on-spunbond (CC) membranes. The highest drying rate of the membrane drier equipped with UCD, CD, UCC and CC membranes occurred in the first hour of operation at 46.4±0.4, 51.7±6.7, 57.8±0.9 and 71.5±4.9 g-water/kg-moist-paddy/h, respectively. Compared to the drying rate by the open air technique and a hot air oven at 40^{o}C (52.7±0.7 and 40.2±0.7 g-water/kg-moist-paddy/h, respectively), the chitosan membrane drier could be used as an alternative method for drying biomass, such as paddy rice. The CC chitosan membrane drier could reduce the moisture content of harvested paddy rice from 22.8±0.4% to 15.7±0.9% within 1 h.

Keywords: paddy; chitosan membrane; dehydration; drier

1. Introduction

There are various processes for drying biomass, where each one has different advantages and disadvantages. Normally, drying process uses hot air to remove the water from materials, such as fibers, powders, solids, semi-liquids, semi-solids and plant seeds, in a tray, tunnel or fluidized bed drier. However, these approaches consume high energy due to the need to generate heat throughout the drying period and to maintain the air flow pattern inside the drying chamber; otherwise the drying rate varies throughout the drying chamber. Furthermore, some materials are heat sensitive that might be degraded or lose some properties at a high air temperature. Thus, the development of a dryer with an appropriate design capable of wide use for drying diverse materials at ambient temperature is of interest.

Paddy drying is the problem in rice post-harvest. Sun drying is the preferred drying method in Asia because of its low cost but unreliable. The sun may not be available when it is most needed. Moreover, if it rains for a week during harvest time the grain is likely to germinate, yellowed or rotten. It is a challenge to engineers and researchers in seeking solutions. In our knowledge, the application of membrane as a dryer prototype for biomass (or paddy in this study) has never been developed and studied.

Membrane technology is a physical process for the separation of mixtures by means of a membrane material. The membrane material is a permeable or semi-permeable thin layer