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MASTER THESIS

Title:

Development of Turning Devices for Drying of Paddy Rice in the Philippines

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Abstract

This master thesis investigated (i) fundamental drying principles of rough rice with respect to bulk height and turning interval and (ii) turning devices for rice inside a solar greenhouse dryer in the Philippines. In part one, controlled environmental conditions were established using a conventional flat bed dryer. Air temperature and air velocity remained constant at 46.5 °C and 0.47 m/s, respectively. Paddy rice was harvested at moisture contents between 18 and 25 % and dried to equilibrium moisture content. Effects of different intervals for turning rice, i.e. hourly turning, turning every two hours and no turning, were subject of investigation. Additionally, the influence of bulk heights of four, six and ten centimeters was examined. Experimental data on moisture content was simulated using different models, i.e. Henderson-Pabis, logarithmic and Page model. Goodness of fit calculations revealed that logarithmic model was most suitable to fit experimental data on fundamental drying principles. Turning interval and bulk height did not impact drying behavior. Reasons for that included that harvest moisture contents varied considerably among the experimental trials. Also, the flat bed dryer could not represent drying conditions in a solar greenhouse dryer adequately. Part two explored new methods of turning paddy rice during drying operation in a solar greenhouse dryer. Eight devices were designed and tested. A laboratory method for determination of turning efficiency was developed using ImageJ image analysis software. Rice grains were painted blue, green and red with water-based lacquer. Homogenous layers of colored grains were

stacked in the solar greenhouse dryer and turning procedures were applied. Subsequently, photographs were taken in order to assess the composition of colored grains in each layer. From this data, displacement of colored grains was traced. After successful testing of the laboratory method it was developed how this methodology could be implemented for in-field evaluation of turning efficiency. With the use of the grain turning A turning device that used horizontal oscillatory motion gave satisfactory results on turning efficiency. The device significantly improved grain movement in the bulk compared to the seven alternative devices. The proposed in-field analysis tool for turning efficiency of rice grains proved to be useful and embodies a promising tool for future rice turning applications.