Analyzing the drying efficiency of an on-farm, cross-flow rice drier

Issue...The energy required for drying rice has been reported to account for over 50% of the total energy consumed for production and processing of rice. Many factors can impact the amount of energy used in removing sufficient water from harvested rice in order to render it safe from respiration and microbiological impacts. Little information exists on the amount of energy required for rice drying in on-farm driers, and the factors that determine the efficiencies of these driers.

Action...Energy use and efficiency of an on-farm, cross-flow dryer located in Pocahontas, AR were measured by performing five tests during the harvest season of 2011 and three tests during the harvest season of 2012. Thermal energy requirements were expressed in terms of energy per unit mass water removed, by dividing the energy requirements of the burner by the total mass of water removed for each drying run. Thermal energy efficiency was calculated as the ratio of theoretical energy requirements to the measured energy requirements.

Impact...Thermal energy use to dry rice in the on-farm dryer ranged from 2,840 to 5,840 kJ/kg water removed for the eight tests conducted during the 2011 and 2012 harvest seasons. Thermal energy efficiency ranged from 44% to 90%. The cost to dry rice from the initial moisture contents, ranging from 16.6 to 21.7%, to ~13% ranged from 7.7 to 12.0 ¢/kg water removed. There was a strong correlation between energy use and ambient air temperature. It was also found that energy use was linearly correlated to the difference between the drying air temperature and ambient air temperature, which is an indicator of the energy required to heat air to the drying temperature. Equations were developed to predict energy use, efficiency, and drying cost, such that management decisions can be made in regards to variables such as when drying is conducted during a day, or the impacts of harvesting at various moisture contents.

Contact:
Terry J. Siebenmorgen
Food Science Department
University of Arkansas
2650 N. Young Avenue
Fayetteville, AR 72704

Collaborating Scientists:
A. Billiris, A. Mauromoustakos

Funding:
U of A Division of Agriculture
Corporate sponsors of the U of A Rice Processing Program
Arkansas Rice Research and Promotion Board