

Title Modeling of forage drying in single and triple pass rotary drum dryers
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Abstract

Rotary dryers are often used for drying of forages such as timothy grass and alfalfa due to a relative ease of handling of these products in rotary dryers. In spite of their advantage, if rotary dryers are designed or operated poorly, they lead to the loss of product quality and demands high energy input. We developed a mathematical model for both single and triple pass rotary drum dryer to dry forages using lumped parameter approach. We selected a co-current type rotary drum dryer and the whole dryer was divided into n number of sections. Heat and mass balance equations were developed for each section and were simultaneously solved using MATLAB software. The particle residence time model was developed based on the cascading action of the particles. Timothy and alfalfa stems were modeled as cylindrical particles and leaves were modeled as disc shaped particles. A single pass rotary dryer was validated with the industrial timothy grass drying data. The single pass dryer model was extended to a triple pass rotary dryer and was validated with alfalfa drying data. The model predicted the downstream moisture and temperature profiles of the feed material and hot gas stream reasonable well. More experimental data on heat and mass transfer coefficients and flow characteristics of material are required to improve the predictive model.