Relative Velocity, Density, and Temperature Effects on Cotton Moisture Transfer Rates

Authors: Gary L. Barker, J. Weldon Laird, Mathew G. Pelletier and Greg A. Holt
Pages: 243-251
Engineering and Ginning

Full Text PDF (374K)

Moisture control during cotton (*Gossypium hirsutum* L.) harvesting, storage, and processing is essential for producing a quality product. The objective of this study was to quantify the effects of relative air velocity, air temperature, and lint density on moisture transfer rates for cotton burs, cottonseed, and cotton lint during the drying or moisturerestoration process. The volumetric flow rate of air, passing over, through, and around a sample, was varied from 104 to 944 cm s^{-1} (0.22 to 2.0 ft^3 min^{-1}). Air relative velocities varying from 4.45 to 50 cm s^{-1} (9 to 98 ft min^{-1}), depending on the sample holder used, were achieved in this way. The density of cotton lint was varied from .005 to .03 g cm^{-3} (0.31 to 1.87 lb ft^{-3}). A 40°C temperature was used for all samples. In addition, the burs were exposed to a 75°C temperature and the lint to an 80°C temperature. As expected, temperature had a pronounced effect on moisture transfer rates. Increasing the relative velocity for burs in humid air and for cotton lint in both humid and dry air resulted in increased moisture transfer rates. However, cottonseed and burs exposed to dry air showed no apparent change in moisture transfer rates with changes in air velocity. Increasing the density resulted in significantly reduced moisture transfer rates for cotton lint. A generalized equation consisting of temperature, relative velocity, and density was developed for predicting the coefficient D (containing diffusivity) for cotton lint exposed to the experimental conditions.