ABSTRACT

Nelson III, Louis V. M.S. A.B.E., Purdue University, May 2007. Mathematical Modeling of Moisture Sorption Isotherms and Effective Diffusivities of the Coconut. Major Professor: Martin Okos.

During this investigation, the sorption isotherms and effective diffusivities of copra were measured. This study was initiated in an effort to add to the knowledge base of copra sorption characteristics and aid in the creation of a drying protocol for copra. Adsorption and desorption isotherms were measured at temperatures of 25, 35, 45, and 55°C using an automated gravimetric analyzer, the IGASorp, from Hiden Isochema. The effect of thickness was also examined. Samples with thicknesses of 100μ, 150μ, and 1mm were all measured using the IGASorp. The desorption isotherms of copra were also measured statically within glass desiccators at room temperature using saturated salt solutions to produce the desired relative humidity. Effective diffusivities were estimated from the isotherms and drying curves using the kinetic outputs of the IGASorp and Fick's solution for a slab.

All isotherms measured varied between the BDDT type II and type III classifications. with peak equilibrium moisture contents varying between 3 - 40%, significantly higher than those of previous studies which varied between 4 - 13%. The effect of temperature on the gravimetrically measured sorption isotherms appeared relatively insignificant. Inversion occurred with isotherms measured at higher temperatures having greater sorption capacities than those from lower temperatures. The effect of thickness was also apparent with sample sorption capacity increasing with decreasing sample thickness.

Effective diffusivities measured from isotherm kinetics were similar to that of starchy materials such as dry biscuit; corn, manioc, and potato starch; and cereal composite foods. The diffusivities were found to be dependent upon sample thickness with peak effective diffusivities occurring at low and high moisture contents depending upon sample thickness. D_{eff} values ranged

in magnitude between 10^{-14} – 10^{-9} with effective diffusivities increasing with increasing sample thickness.

After the sorption isotherms and effective diffusivities were determined, several models were used to fit the behavior. The GAB, Modified Oswin, and Modified Halsey equations were used to fit the isotherms while three models from the literature were implemented to model diffusivity behavior. The GAB was proven the best model for sorption isotherms while neither of the models chosen could adequately describe the diffusivity behavior.