MATHEMATICAL MODELING OF MAIZE DRYING DYNAMICS IN CAMERA OF FIXED BED

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ABSTRACT

The proposed work is a stage for accomplishment of a software seeking the optimization of the maize grains drying processes for continuous dryers of mixed flow. The mathematical model counts a system of four partial differential equations, that describe the heating and the detachment of humidity of the grains, the fall of temperature of the air and the increase of its humidity in the considered conditions. For determination of the intensity of the mass and heat flow the experimental data were used for thin layer, obtained experimentally and from the literature. The analysis and treatment of experimental data have shown that the flux’s dependence between the mass of water and the gradient of the concentration of water’s vapor is not linear as the law of Fick set up. In this work it is proposed an equation for determination of the intensity of the mass flow in thin layer. There is a good agreement between the experimental and computed curves of the dynamics of maize drying in thin layer. An equipment was developed for obtaining of the curves of drying of grains in dryer of fixed-bed, in order to identify the model. For resolution of the hyperbolic system of the partial differential equations coupled no-lineal the explicit and implicit methods of finite differences (for instance, methods of MacCormack, Beam and Warming, Crank-Nicholson, etc.). For analysis of the convergence the methods of Neumann and matrix were used (considering the border conditions). It was shown that even with absolute stability of the implicit outlines (demonstrated these methods through), a maximum value of the number of Courant-Friedrichs-Lewy exists, starting from which a numeric oscillation appears. The analysis of the results allowed to recommend the most appropriate method for each type of the problem. The comparison among the experimental results and of the numeric simulations of the drying dynamics showed a good coincidence.

Reference:

Bakker-Arkema, F.W., Lerew L.E., DeBoer S.F., and Roth M.G., 1974, Grain dryer simulation, Agricultural Experiment Station Report No. 224, Michigan State University, East Lansing, MI


