MATHEMATICAL MODELS FOR CARBON DIOXIDE DISTRIBUTION AND LOSS

D.S. JAYAS[1], W.E. MUIR[1] and N.D.G. WHITE[2]

[1]*Department of Biosystems Engineering, University of Manitoba, Winnipeg, MB, Canada*

[2]*Agriculture and Agri-Food Canada, Research Centre, Winnipeg, MB, Canada*

A mathematicaI model was developed for predicting the distribution of carbon dioxide (CO_2) through bulk grains. The model was solved using a finite element method and can be used for any shape or size storage structure provided that the structure can be discretized into 8-node brick elements and input data can be created for the model. The model was developed in stages. Initially, the model was based on pure diffusion of CO_2: through bulk grain. In the current form, the model includes diffusion and bulk movement of CO_2, within the grain bulk and sorption or desorption of CO_2, by grain. The predictions of the model, in its various stages of development were compared with the experimental data on distribution of CO_2 from three pilot-scale bins (about 1.5 m in diameter and 1.5 m high). The details of the model and the results of the comparison of the predictions with the measured data will be given in the paper.

Also, two mathematical models reported in the published literature were evaluated using experimental data for their capability to predict the loss of CO_2, from storage structures. The results of this evaluation will be included in the paper. The use of the mathematical models as an engineering design tool and need for further research in the development of mathematical models will also be discussed in the paper.