**Title** Transient numerical study of the effect of ambient temperature on 2-D cereal grain storage in cylindrical silos

**Author** Marcelino Carrera-Rodríguez, Gloria M. Martínez-González, José L. Navarrete-Bolaños, J. Enrique Botello-Álvarez, Ramiro Rico-Martínez and Hugo Jiménez-Islas

**Citation** Journal of Stored Products Research,Volume 47, Issue 2, April 2011, Pages 106-122

**Keywords** Convective transport; Grain storage; Mass transfer; Mathematical modeling; Orthogonal collocation; Porous media

**Abstract**

A numerical study was performed on the transient heat and mass convection of grain storage in a cylindrical silo. Temperature gradients were induced by the heat of respiration, and thermal gradients were generated by variations of the temperature surrounding the cavity. The model was developed using the equations of heat, mass, and momentum transport for multiphasic media. The equation that represents the environmental temperature along the day-night cycle was obtained via a least squares regression using statistical data. In this study, the effects of different geometric ratios (*A*) and Rayleigh (Ra) numbers on the isotherms, flow patterns, and concentration isolines were analyzed. The governing equations were solved using discretization of the spatial coordinates by orthogonal collocation with Legendre polynomials and an implicit-trapezoidal formulation for time. The resulting algebraic system was solved by employing the Newton–Raphson with LU factorization method. A computer code called NEWIMPC2 in the FORTRAN 90 language was developed; this code was used to calculate the dynamics and hot regions in the bulk mass grain in the cavity. The thermodynamic properties for sorghum were used in the simulation, although the model is applicable to any cereal grains. For simulation data, typical prevailing conditions in the Bajio, an agricultural region located in Guanajuato State, were used. When the geometric ratio (*A*) increases, the hot nucleus is displaced toward the top of the cavity. In the case of Rayleigh numbers (Ra), a small increase significantly increases the stiffness of the parabolic equations. The ambient temperature has a significant effect on the formation of hot regions inside the cavity. When Ra increases, an increase can be observed in the temperature of the hot nucleus, with this temperature reaching 31 °C near the top wall of the enclosure. There was no evidence of the formation of multicellular flows.