Title Simulation of airflow in grain bulks under anisotropic conditions

Author O.A. Khatchatourian, N.A. Toniazzo and Y.F. Gortyshov

Citation Biosystems Engineering, Volume 104, Issue 2, October 2009, Pages 205-215

Keywords grain; anisotropic

Abstract

A mathematical model, algorithm, and software were developed to calculate the static pressure, streamlines, and velocity distribution in grain bulks for two and three dimensions under anisotropic conditions. The empirical relationships between permeability factors in horizontal and vertical directions (anisotropy factors) were obtained for soya bean, wheat, maize, oats and rice. It was showed that the anisotropy factor depends on the grain form and increases significantly with a deviation of this form from spherical. The anisotropy factor increases with air velocity, and this influence of velocity varies from very weak for seeds with a form close to spherical (peas, soya bean), up to significant for grains that are much less spherical (lentils, rice). The relationship between midsections for vertical and horizontal flows was used as the principal parameter to specify the anisotropy factor of an anisotropic granular medium. As simulations show, there are differences between airflows in storage bins containing isotropic and anisotropic media. This difference depends on grain type (value of anisotropy factor), cross-sectional area variation of the storage bin (expansion ratio) and air inlet location. Numerical simulations of real and hypothetical aerated grain stores were used to detect the influence of anisotropy on operational risk areas.