Title Mathematical Modelling of Airflow and Thermal State in Large Aerated Grain Storage
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Citation Biosystems Engineering, Volume 95, Issue 2 , October 2006, Pages 159-169
Keywords grain; aeration; airflow

Abstract

A mathematical model, algorithm and software were developed for simulation of airflow and heat transfer in aerated soya bean storage under non-uniform conditions of the seed mass. The problems of airflow in an aerated soya bean store and propagation of a cooling zone through a grain bulk were solved consecutively. To calculate airflow lines in silos, a model developed for isothermal flow was used. To simulate the cooling dynamics of the soya bean mass, three models were analysed and compared with experimental data. The first method is based on the solution of system of partial differential equations, describing the heat and mass transfer and conservation of energy. In second method, the deep bed is hypothetically divided into a limited number of thin layers ('homogeneous reactors'), in which the respective temperatures of the grain and of the surrounding air are considered identical. Experimental equipment was developed to study soya bean cooling dynamics for different airflow velocities in deep beds of uniform and variable cross-section. Using a homochronous number as the argument, the dimensionless temperature data in a deep bed of uniform cross-section in different sections at various speeds were satisfactorily described by generalising empirical dependence. The third method of simulating the cooling dynamics of the soya bean mass, based on the use of this dependence, gave the best results in comparison with other methods considered. This method was adapted for a variable section deep bed, tested on experimental data and used for modelling the thermal state of silos.