# Multiphysics Modeling of a Grain Storage Chamber

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## Abstract

Proper storage of grains depends on minimizing attacks of insects, fungi, mites, etc. Development of such pests can be controlled by controlling the temperature of the storage chamber. Hence, before designing grain storage chambers, mathematical modeling and numerical simulations should be performed to predict the temperature distributions. Changes in storage temperature may occur due to several internal and external reasons. Internal sources of heat are the respiration of grains, insects, mites etc.; while the external sources include changes in ambient temperature, radiation through the bin walls. In this paper, a typical grain storage chamber is considered and it is partially filled with wheat grains. The pictorial view of the chamber is shown in Fig. 1. The transient heat flow due to external sources is modeled using COMSOL Multiphysics®.

The 2-dimensional heat transfer for the grains using the cylindrical coordinate system can be given as:
$\rho_{grains} C_{grains} \partial T/\partial t = \nabla(\kappa_{grains} T) + Q_r$

For the head-space, the heat transfer model can be given as:
$\rho_{air} C_{air} \partial T/\partial t = \nabla(\kappa_{air} T)$
Here $\rho$ is the density in kg/m^3, C is the specific heat in J/kg-K, T is the grain temperature in Kelvin, the thermal conductivity (in W/m-K) is represented by $\kappa$ and $Q_r$ is the internal heat in W/m^3.

Now, solving the above equations, heat profiles are obtained for the storage chamber. Numerical results along with the future scope of this work are given. The presented work is hoped to form a basis for a more comprehensive work towards development of control strategies in the numerical framework of finite element method.

## Figures used in the abstract

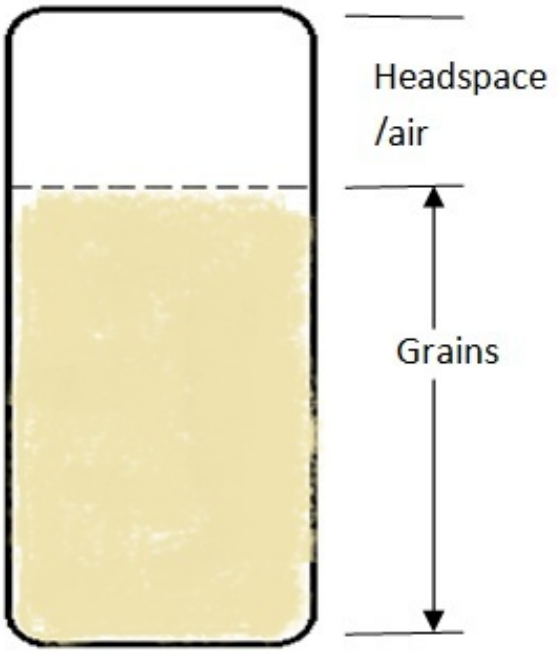


**Figure 1**: The schematic view of a storage system