Orsolya Molnár:
The receding evaporation front and the heat transfer coefficient due to drying

Theses

Examination of the receding evaporation front:

1. thesis: A procedure based on inner temperature measurement is developed for determining the position of the evaporation front. Consequently the position of the evaporation front can be determined either
a) from temperature profiles inside the material,
b) from the temperature run inside the material as a function of time.

2. thesis: a) It is established by my experiments that in case of plane shaped capillary-porous bodies the evaporation front receds with a constant velocity towards the inside of the material.
b) I also proved theoretically the linear connection between the front position and the drying time.

3. thesis: It is established that time period of the receding front can be determined from the drying curve by measuring the mass of the dried capillary-porous material, and applying a constant receding front velocity, the value of this velocity can be also determined.

4. thesis: It is demonstrated that in case of plane shaped capillary-porous materials such as in my measurements (gypsum, fine glass powder, cement-perlit), there is an exponential connection between the drying rate and the depth of the evaporation front in the period of the receding evaporation front of drying.

5. thesis: It is demonstrated that in case of plane shaped capillary-porous materials such as in my measurements (gypsum, fine glass powder, cement-perlit), the drying kinetics (the drying rate and the moisture content versus drying time) can be explained with an exponential model in the period of the receding evaporation front of drying.

Examination of the convection heat transfer coefficient:

6. thesis: The concepts of latent and sensible heat transfer coefficients are introduced in order to experimental determination of the convection heat transfer coefficient:

$$\alpha_{\mathrm{sens}} = \frac{1}{T_{\mathrm{G}} - T_{\mathrm{f}}} \rho_{0\mathrm{S}} \int_0^{\mathrm{Z}} c_{\mathrm{SW}} \frac{\partial T}{\partial \tau} \mathrm{d}z \; ; \; \alpha_{\mathrm{lat}} = \frac{1}{T_{\mathrm{G}} - T_{\mathrm{f}}} h^{\mathrm{LV}} N$$

The convection heat transfer coefficient can be written as the sum of the latent and the sensible parts.

7. thesis: Measuring procedure is produced for the experimental determination of the latent and sensible heat transfer coefficients through the whole drying process, from the section of the constant drying rate to the section of equilibrium drying.
It is proved by my experiments that the heat transfer coefficient is not a constant value during drying, but decreases with progress of drying. Thus int he event of drying only those formulas from literature can be used for determining Nusselt number which take the effect of mass transfer to heat transfer into account.

8. thesis: It is established that int he receding evaporation front section of drying the sensible heat flux density (and the sensible heat transfer coefficients also) can be written as the sum of three components: one part covers the heating load of diffusion (q_{sens+}), the other part covers the receding of the evaporation front (q_{sens++}) and only the third part is the conductive heat flux density which is heating the material (q_{sens0}). Calculating formulas are developed for all parts of the sensible heat transfer coefficient and changing of value of sensible heat transfer coefficient int he receding evaporation front section is demonstrated through one of my measurings.