SOLVING a TWO-SCALE MODEL FOR VACUUM DRYING BY USING COMSOL MULTIPHYSICS

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Abstract

We solve a two-scale coupled drying model for wood by using COMSOL multiphysics. The first scale corresponds to the material description and the second one to the dryer scale. In material equations, the capillary pressure at equilibrium has been considered as a non-static. The phenomenological one-dimensional drying model was solved by using the coefficient form and a global equation format. We have written the partial differential equations (material scale) in the general form and by using an unsymmetric-pattern multifrontal method. The two ordinary differential equations (dryer scale) were introduced by considering a pump aspiration of 0.0027m3/sec. To add a space-independent equation such as an ODE, we have chosen a global equation format. As the time derivative of a state variable (density of air and water vapor) appears, the state variable needs an initial condition; in fact we consider chamber pressure begins at atmospheric pressure. We obtain a good description of drying kinetics, and mass fluxes. The dynamics and the convergence conditions of the wood result mainly from the rapid change of the boundary conditions. Vapor transport is drive by temperature and pump aspiration. According to numerical results, liquid, water vapor and air dynamics in the chamber have strong interactions with re-homogenization in the surface. We analyses results at 60-100bar and 70°C. Figure 1 compares predicted and experimental moisture content in wood. One can observe the model is able to well predict the global kinetic of drying. Figure 2 shows the mass flux leaving the wood surface. The chamber dynamics is primarily driven by the fluxes leaving the wood, the pump flow rate when switched on, and the dryer leaks.

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