Evaporation from Porous Media

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We have a porous material that is filled with a liquid solution containing molecules from multiple species with known starting concentrations. As the solvent evaporates these molecules are left behind on the internal pore walls within the porous material. Last year we developed a model that describes evaporation and deposition in a single cylindrical pore structure. In this year's workshop we would like to

a. Further examine the dependence of the mass distribution of molecules through pore and drying rate/time on pore diameter, pore length, fluid wetting properties, and evaporation conditions.

b. Extend the model to a porous structure that has a distribution of pore sizes specified by a pore size distribution. Fluid moves within this pore space and between pores due to capillary force. We are interested in different approaches, viz. continuum, network, and network homogenization, towards this problem.

c. How does the mass distribution of molecules change upon cycles of wetting and drying?

Evaporation in this system can occur under two conditions – constant temperature and relative humidity or constant evaporation rate.

Some relevant literature:

1. Simultaneous heat, mass, and momentum transfer in porous media: a theory of drying
   S Whitaker - Advances in heat transfer, 1977
   * Whitaker has a series of papers on transport of heat and moisture in a porous medium. He does not necessarily consider the deposition of molecules, but the basic framework for transport has been laid out in his work.

2. Modeling Moisture Distribution and Binder Migration in Drying Paper Coatings
   Pan, S.X., Davis, H.T., Scriven, L.E., 1995 Coating Conference Proceedings
   * Network approach to drying of ink in paper.

3. MPI 2020 report and presentation

   MPI 2020 - Program & Reports (uvm.edu)