Method of Measuring the Heat of Transport and the Coefficient of Gas Diffusion in Porous Media

L. Minkin[C,S]
Physics Department, Sylvania Campus, Portland Community College, Portland, OR, USA
lminkin@pcc.edu

A.S. Shapovalov
Saratov State University, Physics Division, Saratov, Russia

Irreversible thermodynamics reveals that the chemical potential and the thermogradient are two thermodynamic forces that cause gas mass and heat transfer in porous material. To use theoretical equations, one needs to know phenomenological coefficients which cannot be found in the frame of irreversible thermodynamics; only kinetic theory or experimental data allow us to find these coefficients (Onsager's coefficients). As kinetic theory for gas transport in porous materials is not developed adequately for the transition zone (for which mean free path of molecules is on the order of the diameter of the pores), experimental data should be used to find Onsager's coefficients.

We have developed a method for measuring the heat of transport and the coefficient of gas diffusion in porous media (Onsager's coefficients). The method is based on measuring a thermo-molecular pressure difference. Applying this method to a clay sample, the heat of transport of air in clay and its coefficient of diffusion were found. Based on these measurements, a comparison of thermotranspiration and diffusion gas fluxes through a concrete slab used in homes was estimated. It is shown that thermotranspiration radon flow may exceed diffusion radon flow through homes' foundations, and radon thermotranspiration transport should be included in the general model of indoor radon entry. The calculations indicate that thermotranspiration may also be an important factor in gaseous exchange between soil and the atmosphere.