Indoor/outdoor connections exemplified by processes that depend on an organic compound's saturation vapor pressure - DTU Orbit (15/01/2019)

Outdoor and indoor environments are profitably viewed as parts of a whole connected through various physical and chemical interactions. This paper examines four phenomena that share a dependence on vapor pressure—the extent to which an organic compound in the gas phase sorbs on airborne particles, sorbs on surfaces, sorbs on particles collected on a filter or activates trigeminal nerve receptors. It also defines a new equilibrium coefficient for the partitioning of organic compounds between an airstream and particles collected by a filter in that airstream. Gas/particle partitioning has been studied extensively outdoors, but sparingly indoors. Gas/surface partitioning occurs primarily indoors while gas/filter partitioning occurs at the interface between outdoors and indoors. Activation of trigeminal nerve receptors occurs at the human interface. The logarithm of an organic compound's saturation vapor pressure correlates in a linear fashion with the logarithms of equilibrium coefficients characteristic of each of these four phenomena. Since, to a rough approximation, the log of an organic compound's vapor pressure scales with its molecular weight, molecular weight can be used to make first estimates of the above processes. For typical indoor conditions, only larger compounds with lower-saturation vapor pressures (e.g., tetracosane, pentacosane, or di-2-ethylhexyl phthalate) have airborne particle concentrations comparable to or larger than gas phase concentrations. Regardless of a compound's vapor pressure, the total mass sorbed on indoor airborne particles is quite small compared to the total sorbed on indoor surfaces, reflecting the large difference in surface areas between particles within a room and surfaces within a room. If the actual surface areas are considered, accounting for roughness and porosity, the surface concentration of organics sorbed on typical airborne particles appears to be comparable to the surface concentration of organics sorbed on indoor carpets, walls and other materials (based on data from several studies in the literature). Mirroring the importance of phase distributions outdoors, an organic compound's indoor lifetime, fate and even health impacts depend on its distribution between phases and among surfaces.