

Osorb®

Researchers at Wooster have developed and fully characterized a novel organosilica material that swells in the presence of neat and dissolved organics. The organosilica material commercial is available as Osorb® via ABS Materials Inc. Osorb is a new type of highly organophilic material that reversibly extracts dissolved or dispersed organic compounds with such high capacity that the sorbent can swell up to eight times its dry volume with neat organic liquid.

Osorb is a hybrid organic-inorganic material that was recently discovered and the synthesis fully described (Burkett, 2008). Swelling is reversible and occurs in <1 s when exposed to neat organic liquids and there is no loss in the observed swelling behavior even after repeated use. Osorb is hydrophobic and does not swell in water. Remarkably, the swelling resulting from absorption is so energetic that the material expands with forces in excess of 500N/g. Chemically, Osorb is composed of polymerized bis(trimethoxysilylethyl)benzene making it similar in composition to poly(dimethylsiloxane), but possessing a bridging aromatic group which has been shown to be a key component in generating the swelling behavior (Burkett et al., 2008).

The absorption process of Osorb has been detailed elsewhere (Edmiston, 2010). Briefly, capture of organic compounds is due to mechanical expansion of a collapsed matrix of silica nanostructures arranged as a complex and microscopically disorganized nanoporous network. Capillary-induced collapse of the nanoporous matrix is incurred upon evaporation of solutes and the tensile forces created in the contraction of the matrix are stored as non-covalent interactions within a high internal surface area (>800m²/g) prevent re-expansion. Upon absorption, the Osorb relaxes to the expanded state creating new surface area and volume for subsequent molecules to be absorbed and permeate through the nanopores (Figure 1). Water is too polar to enter the hydrophobic pore structure and absorption affinity of individual chemical compounds trends with polarity as measured by indexes such as log K_{ow} . In general, the partition coefficient for a dissolved organic species between water and Osorb is approximately one order of magnitude greater than log K_{ow} . Large partition coefficients are attributed to relaxation via expansion of the internal pore structure. Pore expansion also leads to high capacity and linear absorption isotherms through all ranges of concentration (Edmiston, 2010).

Currently, the Edmiston lab in conjunction with ABS Materials is developing a suite of materials using Osorb as a platform technology. These include catalytic materials for water purification and green synthesis as well as novel versions of Osorb designed for particular contaminant absorption and remediation.

Burkett, C.M., Underwood, L.A., Volzer, R.S., Baughman, J.A., Edmiston, P.L. 2008. Organic-inorganic hybrid materials that rapidly swell in non-polar liquids: nanoscale morphology and swelling mechanism. *Chem Mater.* 20, 1312-1321.

Edmiston, P.L., Underwood, L.A., 2009. Absorption of dissolved organic species from water using organically modified silica that swells. *Sep. and Purification Tech.* 66, 532-540.

Figure 1: Model for Swelling

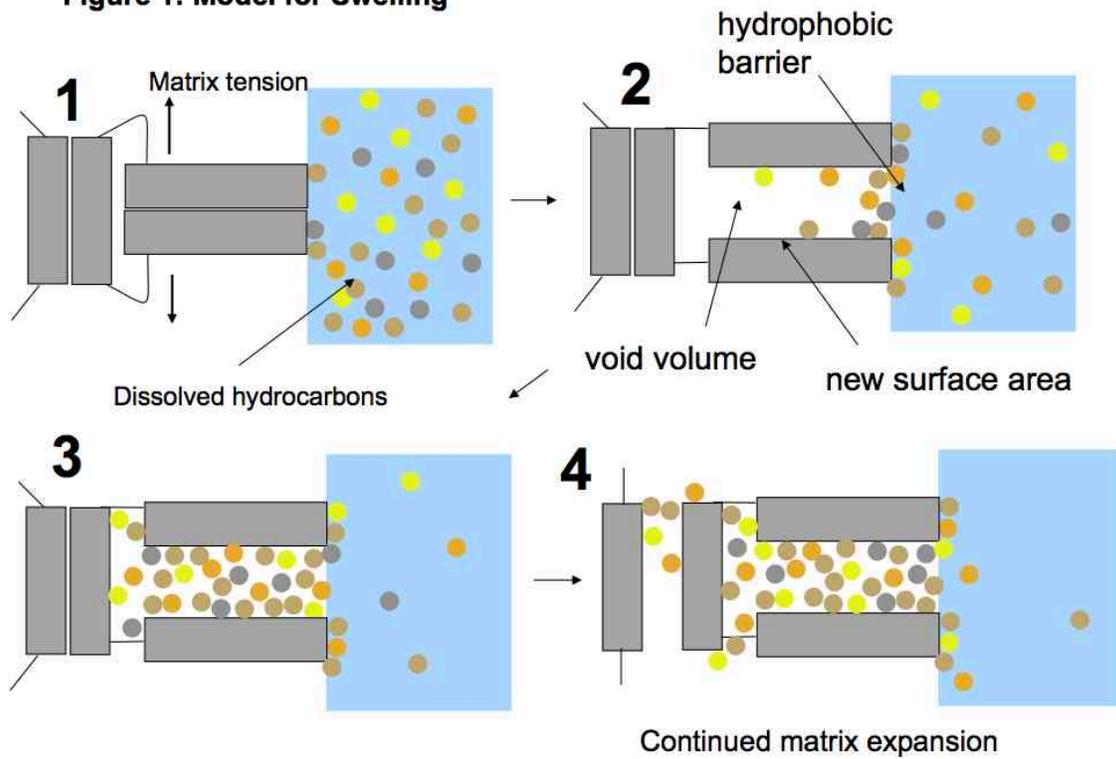


Figure caption: 1. Initial adsorption to the surface of the material. 2. Sufficient adsorption occurs to trigger matrix expansion leading absorption across the sorbent-water boundary. 3. Pore filling leading to further percolation into the nanoporous matrix. 4. Continued matrix expansion increases available void volume.