

141a A Novel Evaporation Cell to Study Gradient-Driven Water Transport through Hydrogel Membranes with Zero External Mass-Transfer Resistance

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Water transport through soft-contact-lens (SCL) materials is important both for comfort and for safe wear. Unfortunately, little is known about water transport across a soft contact lens driven by a gradient in water content. One of the reasons for the lack of understanding is that water flux through hydrogel membranes driven by evaporation from one surface experiences a significant air-side mass transfer resistance that requires careful correction. In this work, we use a novel evaporative cell that incurs no external mass-transfer resistance. A small vertical, cylindrical chamber is capped at the bottom end by a hydrogel membrane with a sealed layer of water resting on top of the membrane. Evaporation from the bottom surface is monitored by the weight loss of the cell. The key to eliminating external mass-transfer resistance is to place the evaporation cell in a vacuum chamber that excludes the presence of air. Relative humidity is set by exposing the vacuum chamber to vapor in equilibrium with differing concentrations of aqueous salt solutions. Because no air is present, exposing the membrane to gas flow is unnecessary. Good comparison of measured water flux through soft-contact-lens materials at relative humidities from 11 to 90 % with those obtained in flow evaporation cell establishes the validity of the method. However, the vacuum evaporation cell is both simpler and more precise. We report Extended Maxwell-Stefan concentration-dependent water diffusivities from the vacuum evaporation cell for SCL materials with water contents ranging from 25 to 70 weight %. A simple and robust method is now available to establish water transport rates through soft contact lenses.