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Do electroviscous effects impact the hydraulic conductance of xylem? A theoretical inquiry[1] MICHAEL SANTIAGO, VINAY PAGAY, ABRAHAM STROOCK, Cornell University — Experiments show that the hydraulic conductance of plant xylem (K) varies with the ionic-strength (I) and pH of the sap, a behavior usually attributed to the swelling of hydrogels that cover bordered pits—conduits that interconnect individual xylem vessels. These gels are believed to swell at low I or large pH, and thus decrease the flow cross-section and K. But experiments have shown behaviors that contradict this hypothesis, where a decrease in I serves to increase K. Here, we investigate whether these observations could be explained by electroviscous effects in the pores of bordered pits, since the literature suggests that pits are covered by materials that develop electric charge in aqueous solution, e.g. lignin and pectin. We use experimental measurements from the literature, combined with standard electrokinetic theory, to estimate the electroviscous effect of I and pH on K. We find that K varies non-monotonically with I and can drop to a minimum of 0.8 of its maximum value, and that our predictions fit the available experimental data for physiologically relevant conditions in I and pH. We conclude that electrokinetics could explain, at least partially, the observed changes in K, and propose experiments to test this hypothesis.

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