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Taylor Dispersion in Osmotically Driven Laminar Flows[1] MAZEN NAKAD, Student, JEAN-CHRISTOPHE DOMEC, THOMAS P. WITELSKI, GABRIEL KATUL, Professor — Sucrose is among the main products of photosynthesis that are deemed necessary for plant growth and survival. It is produced in the mesophyll cells and translocated under positive pressure to different parts of the plant through a hydraulic network (phloem). Progress in understanding this transport mechanism remains fraught with experimental difficulties thereby prompting interest in theoretical approaches and laboratory studies. The Munch's pressure flow model is considered one of the most commonly accepted hypotheses for describing the physics of sucrose transport in such systems. It is based on osmosis to build an energy potential difference between the source (leaf) and the sink (root). The flow responding to this energy potential is assumed laminar and described by the Hagen-Poiseulle equation. The work here will revisit such osmotically driven flow in tubes by including the effects of Taylor dispersion (TD) on mass transport. It is demonstrated that the time scale for sucrose transport is reduced when adding TD for low Munch number (defined by the ratio of axial to membrane resistance) whereas its effect will decrease for high Munch number. Comparisons with published laboratory experiments suggest that the inclusion of TD improves the prediction of sucrose transport speed.

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Mazen Nakad
Student

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