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DESIGN OF A ELECTROPHORETIC DEVICE FOR DYE CHARACTERIZATION

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Abstract. Microfluidic paper-based analytical devices are now a well-established technology, although aspects related to the transport of chemical species need to be improved to reach higher levels of analytical precision, efficiency, and portability. This work focuses on modeling, numerical simulation, and experimental validation of a device for characterizing dyes. It is divided into two main parts, the study of capillary filling and electric transport. The model includes advective, diffusive, dispersive, and electrodispersive mechanisms, as well as the effects of porosity, tortuosity, and permeability of paper substrates and the solvent velocity profile due to the electroosmotic flow. The porous medium created by the cellulose fibers is considered as a network of tortuous capillaries and it is represented by macroscopic parameters following an effective medium approach. Numerical prototypes were implemented in OpenFOAM®software, using the `porousMicroTransport` and `electroMicroTransport` toolboxes. Next, physical prototypes were manufactured and tested. Consequently, the aforementioned numerical tools, which are considered valuable in any microfluidic pad design, were objectively validated. The results can be used in the near future to build a Lab-on-a-chip (LOC) device to quantify substances of medical and environmental interest trough direct optical methods.