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Filtration by porous media: the role of flow disorder

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The understanding of colloid filtration, transport by fluid flow and their attachment to solid surfaces, is a long standing problem that affect the development of efficient strategies for bio-remediation, production and storage of fresh water. Classical approaches, like the Colloid Filtration Theory (CFT), do not capture the complex behaviors that has been often observed in colloid transport experiments through porous media. In particular, column experiments exhibits anomalous - long tailing - phenomena in Breakthrough curves (BTC) and power law decay in spatial deposition profile. However, on the one side: stochastic approaches are often invoked to recover consistency with experimental data, but often without a direct link with the pore-scale processes, where filtration takes place. On the other side: a proper characterization of such anomalous transport and retention is hard to obtain since most of the available data were collected over short temporal and spatial scales. We propose a novel theoretical model and a new experimental set-up for filtration by porous media. The derived model and our experimental data enable us to investigate how the microscopic processes of transport and attachment impact the macroscopic phenomenon of filtration.