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Reactivity of porous media under continuous injection

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High flow rates within reactive porous media occur both in industrial applications and in natural media, e.g. in permeable soil substrates subjected to extreme weather events [1,2]. The reactive surfaces of the soil grains interact with the transported species, determining the overall porous media reactivity and capacity of retaining nutrient and contaminants. We show via pore-scale lattice-Boltzmann simulations in a packed bed column that, under the conditions of uniform injection, the uniformity of porous surface reactions is determined by the mixing of the low concentration wakes forming behind the reactive soil grains. Scaling arguments are proposed to extract analytical models for the probability distributions of concentrations at the reactive surfaces.

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References

[1] Pettersson, Kaj, et al. Journal of Hydrology 603 (2021): 126851. [2] Maggiolo, Dario, et al. Physical Review Fluids 8.2 (2023): 024502.

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