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Mixing properties of stationary flows in porous media MIHKEL KREE, EMMANUEL VILLERMAUX, Aix Marseille University — The interplay between stretching of fluid particles and molecular diffusion leads to enhanced mixing of scalar concentration fields, like in random, turbulent flows. Similarly, the flow in a porous medium develops high strain rates due to the no-slip boundary condition at solid surfaces, altering substantially molecular mixing. We report here on experiments of mixing by a stationary flows in a three-dimensional random stack of solid spheres. Two distinctive fluorescent dyes (with concentrations C_1 and C_2) are injected from separate sources and their evolution through the medium is directly observed, this being made possible by matching the refractive indices of the spheres and of the flowing liquid. We quantify the dispersion, concentration distributions, and correlation between the two fields as a function of downstream distance. The value of initially negative correlation coefficient asymptotically reaches zero, meaning that the overall field $C_1 + C_2$ is a random superposition of the individual fields. The relevant time (distances) scales for mixing are identified.

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