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The concentration instability of a sedimenting suspension of flexible fibers HARISHANKAR MANIKANTAN, University of California San Diego, LEI LI, SAVERIO SPAGNOLIE, University of Wisconsin-Madison, DAVID SAINTILLAN, University of California San Diego — The stability of a dilute suspension of sedimenting flexible fibers is studied theoretically. Fiber compliance causes individual particles to reorient while sedimenting in a quiescent fluid. We incorporate the rate of reorientation for weakly flexible fibers into a mean-field model to study the stability of a suspension of such fibers to perturbations in concentration. Fiber flexibility is shown to have two opposing effects on suspension stability. First, it establishes a base state that is anisotropic in orientation distribution. We show that such a base state is more prone to a concentration instability than an isotropic distribution, and we illustrate the underlying mechanism. Second, the proclivity of particles to reorient due to flexibility hinders horizontal migration - a key ingredient of the instability mechanism - and suppresses the growth of concentration fluctuations. We analyze this effect by extending our theory to the next order in fiber flexibility, and indeed the growth rate of perturbations is shown to decrease for more compliant fibers. In a Brownian suspension, the dominant effect depends on the relative scales of rotational diffusion and flexibility-induced reorientation.

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