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An osmotic method to measure particle normal stress in a sheared suspension JEFFREY MORRIS, Levich Institute, CCNY, ANGELIQUE DEBOEUF, GEORGES GAUTHIER, JEROME MARTIN, CNRS Lab. FAST; Orsay, FR — A method for measurement of the normal stress response in a sheared liquid-solid suspension of noncolloidal particles under low-Reynolds-number conditions is described. The approach is based on the osmotic concept in which the normal stress associated with the dispersed solid phase is determined by a measurement of the continuous liquid pressure. To demonstrate the method, results are presented from a case in which solid spherical particles are suspended in an equal density and highly viscous Newtonian liquid and subjected to shearing in a concentric cylinder Couette geometry. The key idea is to allow a connection of the suspending liquid to an external bath of the liquid while the particles are constrained to remain in the sheared zone by a screen. Using this design, two means of accessing the shear-rate dependent "particle pressure" (actually the radial normal stress, with independent normal stress difference measurements providing evidence of a mean isotropic particle stress) are presented. The first relies on the hydrostatic balance which occurs when liquid is sucked into the sheared zone and measuring the change in level of the bath; the second is more quantitative and simply uses a pressure transducer in the liquid bath outside the screen. The normal stress is found to be roughly linear in shear rate and strongly dependent on particle volume fraction over the range of 35-52% solids studied.

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