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The rheology of a semi-dilute suspension of swimming cells
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— In this paper, a swimming micro-organism is modelled as a squirming sphere with prescribed tangential surface velocity, in which the centre of mass of the sphere may be displaced from the geometric centre. The three-dimensional movement of 64 identical squirmers in a simple shear flow field, contained in a cube with periodic boundary conditions, is computed, for random initial positions and orientations, by the Stokesian- dynamics method. The results for non-bottom-heavy squirmers show that the squirming causes a slight decrease in the apparent viscosity. In the case of bottom-heavy squirmers, on the other hand, the suspension shows strong non-Newtonian properties. When the background simple shear flow is directed vertically, the apparent viscosity becomes smaller than that of inert spheres. When the shear flow is horizontal and varies with the vertical coordinate, however, the apparent viscosity becomes larger than that of inert spheres. In addition, significant normal stress differences appear for all relative orientations of gravity and the shear flow, in the case of bottom-heavy squirmers.

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