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The Role of Deformation in the Rheology and Orientaiton of Noncolloidal Fiber Suspension CYRUS AIDUN, JINGSHU WU, Georgia Institute of Technology — The microstructure and rheology of noncolloidal fibers suspended in Newtonian fluid are investigated with direct numerical simulation based on the external boundary force lattice-Boltzmann method. In this method, the flow is computed on a fixed regular "lattice", where each solid particle, or fiber in this case, is mapped onto a Lagrangian frame moving continuously through the domain. The motion and orientation of the fiber are obtained from Newtonian dynamics equations. The fiber bending ratio (BR) has significant influence on the flow rheology in the range BR < 3, where for BR > 3, the fiber can be considered as rigid. We show that in fiber suspension under shear, the relative viscosity decreases significantly as BR increases in the range of volume fraction from 1.7 to 12.4 percent considered in this study. This variation in relative viscosity appears to be well-correlated with the mean "contact" number. The effect of BR on the relative viscosity can also be explained based on the fiber orientation distribution. For increasing BR (more rigid fiber), the orientation distribution becomes narrower showing fibers oriented in the vicinity of the shear plane for a longer time, thus reducing the suspension shear viscosity. A small asymmetry of the fiber distribution is observed in the small BR regime, indicating the importance of fiber–fiber interaction and fiber deformation at BR<3.

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