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Comparison of Regime Transition between Ellipsoidal and Spherical Particle Assemblies in a Model Shear Cell

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Abstract : This paper presents a numerical investigation of regime transition of flow of ellipsoidal particles and a comparison with that of spherical particle assembly. Particle assemblies constituting spherical and ellipsoidal particle of 2.5:1 aspect ratio are examined at separate instances in similar flow conditions in a shear cell model that is numerically developed based on the discrete element method. Correlations among elastically scaled stress, kinetically scaled stress, coordination number and volume fraction are investigated, and show important similarities and differences for the spherical and ellipsoidal particle assemblies. In particular, volume fractions at points of regime transition are identified for both types of particles. It is found that compared with spherical particle assembly, ellipsoidal particle assembly has higher volume fraction for the quasistatic to intermediate regime transition and lower volume fraction for the intermediate to inertial regime transition. Finally, the relationship between coordination number and volume fraction shows strikingly distinct features for the two cases, suggesting that different from spherical particles, the effect of the shear rate on the coordination number is not significant for ellipsoidal particles. This work provides a glimpse of currently running work on one of the most attractive scopes of research in this field and has a wide prospect in understanding rheology of more complex shaped particles in light of the strong basis of simpler spherical particle rheology.

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