Spreading Dynamics of Particle Dispersion Shear Thinning Fluids on Solid Substrate

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The spreading dynamics of non-Newtonian fluids plays an important role in many applications, such as dyeing, coating, and in the food and drug industry. Shear thinning fluids are the most common and useful kind of non-Newtonian fluids. In this paper, the spreading dynamics of a set of particle dispersion fluids are studied. The rheological results show that this kind of fluid show obvious shear thinning character, whose rheological index $n<1$. The spreading law and the dynamic contact angle versus the contact line moving velocity relationship were investigated both theoretically and experimentally. The experimental results indicate that the spreading exponent of completely wetting is related to the rheological index n, the experimental relationship was compared with Starov's theory. For partial wetting condition, a new spreading law was proposed to describe the power law relationship between spreading radius and time, in which drop volume is an important parameter. The experimental results agree well with the spreading power law. The experimental data of dynamic contact angle versus the contact line moving velocity were analyzed with different theoretical models proposed by previous researchers, the model parameters' physical meanings were also discussed, and the spreading mechanism of shear thinning fluids was studied.