WALL SLIP OF NOVEL MAGNETORHEOLOGICAL SUSPENSIONS BASED ON IONIC LIQUIDS

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Wall slip occurs in the flow of particulate suspensions due to the displacement of the disperse phase away of the solid boundaries [1]. This undesired phenomenon usually results in an underestimation of the viscosity [2]. In this work, wall slip in parallel-plate rheometry of magnetorheological (MR) suspensions is studied. With this aim, MR suspensions consisting of 50 vol.% of silica-coated iron microparticles dispersed in a common ionic liquid (1-ethyl-3-methylimidazolium diethylphosphate) were prepared. Ionic liquids (ILs) are substances composed entirely of ions that are in the liquid state at room temperature. ILs have been recently proposed as carrier liquids for the preparation of novel MR fluids [3]. The steady state rheological properties of the suspensions were characterized by subjecting them to a logarithmic ramp of shear rates, and by measuring the corresponding shear stresses. For this, a controlled stress rheometer with parallel-plate geometry was used. The appearance of wall slip was studied by contrasting the curves obtained using smooth surfaces with those obtained using rough surfaces. Experiments were performed at 25ºC, both in absence and presence of applied magnetic fields of different intensity. The results of these experiments showed that when smooth plates were used, the values of the viscosity at low shear rate were underestimated with respect to those obtained by using rough plates. Consequently, the values of the static yield stress obtained by using smooth plates were underestimated too, due to the slip of the field-induced structures at the smooth plate surface. Nevertheless, as the applied magnetic field was progressively increased, the underestimation of the yield stress tended to disappear, likely because of the appearance of normal forces that increased the friction of the field-induced structures with the plates.

References

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