The effect of surface quality on the flow of aqueous kaolin suspensions

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Colloidal dispersions often manifest non-Newtonian behaviour in bulk flow and interfacial anomaly at confining walls. The most common interfacial anomaly is known as the apparent wall slip, caused by depletion of dispersed phase close to solid walls [1-3]. An opposite interfacial anomaly, analogous to the dilatancy phenomenon, was observed in our viscometric measurements with aqueous kaolin suspensions.

The rotational viscometry was carried out at a laboratory temperature (25°C) for samples with three kaolin concentrations (30, 35 and 40 wt.%). Four non-commercial KK-sensors [4] differing in materials and surface finalization were used. These sensors were made from stainless steel with smoothed or sand blasted surfaces, from titanium with smooth surfaces and from aluminium alloy with eloxal coated surfaces.

Apparent wall slip was detected in the sensors made from stainless steel and titanium. Its magnitude was found to be decreasing with increasing roughness of individual surfaces, but even in the case of sand blasted surface the apparent wall slip effect was still important.

In the case of eloxal coated surface, the interfacial anomaly depended on applied shear stress. At lower shear stresses the common apparent wall slip was detected. After exceeding some critical stress level, the standard data treatment detected “negative” apparent wall slip velocity. This fact can be interpreted as formation of a stagnant layer at the wall, whose thickness is independent of the sensor’s gap thickness. This highly anomalous wall effect is probably caused by electrochemical interactions of kaolin particles with eloxal coated surface.

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