Evaluation of Antithixotropic Behavior

Keywords: thixotropy, ceramics, slurries, time dependent viscosity, suspension, creep, creep-recovery, flow testing, oscillatory testing

RH023

PROBLEM

Most real-world materials are not Newtonian in behavior. That is, they do not exhibit a linear and completely reversible relationship between applied stress and the resultant strain (shear) rate. Rather, most materials exhibit a time-dependent behavior where viscosity decreases with time at a constant stress, and structure is rebuilt more slowly after shearing than it is initially destroyed. These materials are designated as thixotropic. Although less common, materials can be designed to build structure during shearing. These materials are designated as antithixotropic. In both cases, the material's flow history must be considered when measuring viscosity and comparing similar, but different, formulations. Simple single point viscometers are not sufficient to evaluate thixotropic/antithixotropic materials.

SOLUTION

Controlled stress rheometers, which can subject a material to a reproducible profile of changing stress and/or strain, provide a better way to rapidly evaluate thixotropic/ antithixotropic materials. Controlled stress rheometers can evaluate materials using either flow, creep and/or oscillation modes. Figures 1-3 show the comparative results for two different coated calcium carbonate slurries evaluated in these three modes. These two materials are identical formulations, but material B was exposed to 85% relative humidity prior to evaluation. All three evaluation modes indicate that both slurries exhibit antithixotropic behavior. The flow curves, for example, show a higher stress is required to achieve a comparable shear rate when stress is decreased after initial shearing. Likewise, comparison of presheared versus as received material shows compliance (creep) decreases and elastic modulus (oscillation) increases as the amount of preshearing increases. All three rheology experiments show that the material exposed to the higher relative humidity is more antithixotropic.

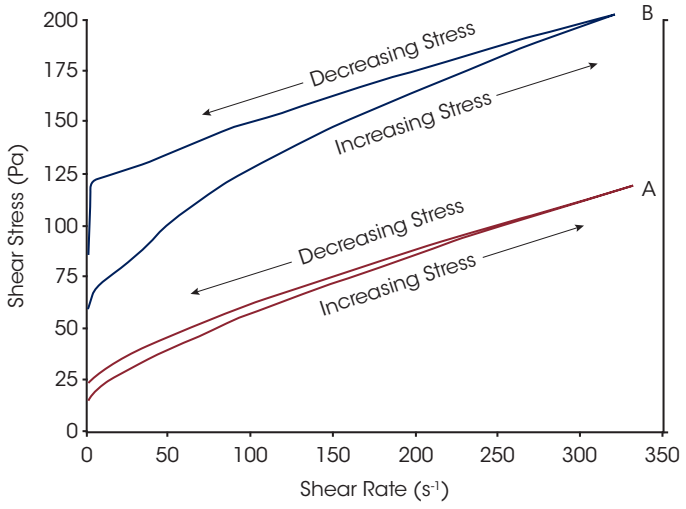

Figure 1: Flow results (Calcium Carbonate Slurries)

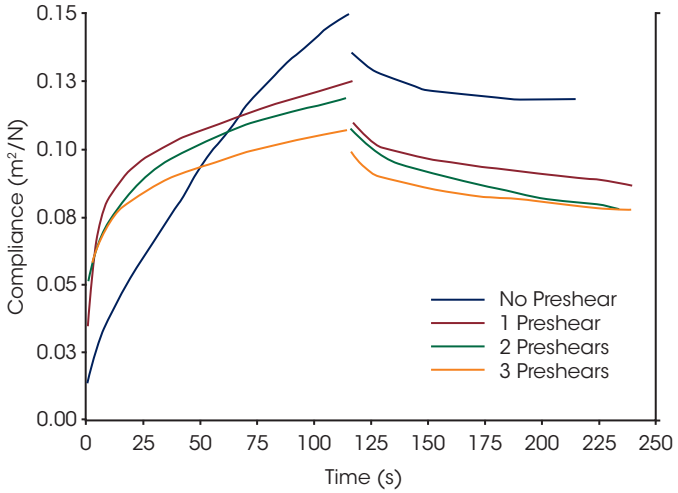

Figure 2: Creep results (Calcium Carbonate Slurry)

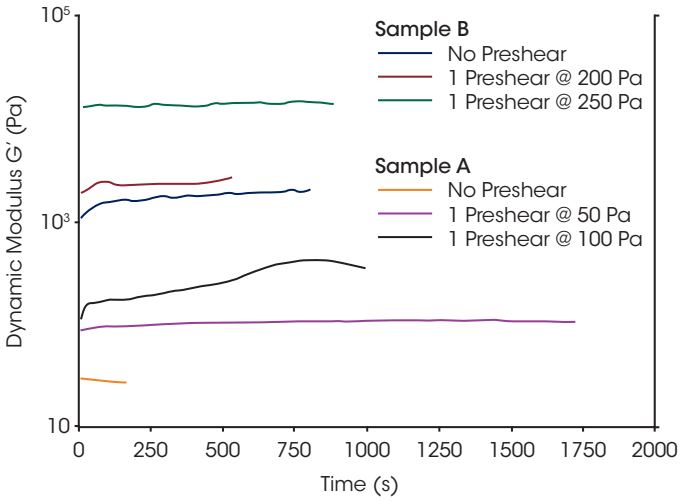

Figure 3: Oscillation results (Calcium Carbonate Slurries)

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