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Connecting the Rheological Behavior of Clathrate Hydrate Slurries to Flow Performance MICHELA GERI, MIT, RAMA VENKATESAN, Chevron ETC, GARETH MCKINLEY, MIT, MIT TEAM, CHEVRON ETC TEAM — Clathrate hydrates represent a major flow assurance issue for deep water drilling operations. To develop a proper constitutive model, an extensive set of rheological measurements has been performed on a model hydrate forming emulsion. Upon hydrate formation a sharp increase in the fluid viscosity is observed (by a factor of 100 to 1000). Steady shear measurements show that the hydrate slurry has a shear thinning behavior as well as a yield stress on the order of 1-10 Pa which increases with aging of the fluid. Thixotropy becomes evident as a hysteretic behavior in the flow curve, even when no rheological aging has occurred. Creep tests also reveal that the fluid microstructure accumulates back stress. Oscillatory measurements show that in the linear viscoelastic region hydrate slurries develop viscoelastic gel-like behavior with the elastic modulus exceeding the viscous modulus. These characteristics guide the development of an elastoviscoplastic constitutive model that can capture the salient dynamic features in simple unidirectional flows (e.g. steady or transient Poiseuille) such as apparent wall slip, plug flow or excessive pressure drop in start-up flow.

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