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Shear-Induced Normal Stress Differences in Aqueous Foams

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Using a special purpose rheometer equipped with a cone-plate geometry, we have studied the first normal stress difference N1 of aqueous foams of different physico-chemical characteristics, subjected to an oscillatory shear strain. We show that for small strains, N1 depends on the rheological history of the foam sample, and that this memory effect can be at least partially suppressed by pre-shearing. Our results are compatible with the relation N1=s g, known to hold for any nonlinear elastic material, where s and g denote the shear stress and strain. This agreement is non trivial since aqueous foams are viscoelastic. Moreover, we observe that this relationship is approximately valid even in the viscoplastic regime, close to the yield strain. These findings are discussed in the context of recent numerical simulations and constitutive models.

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