Supplementary Information

Negative normal stress differences N_1-N_2 in a low concentration capillary suspension

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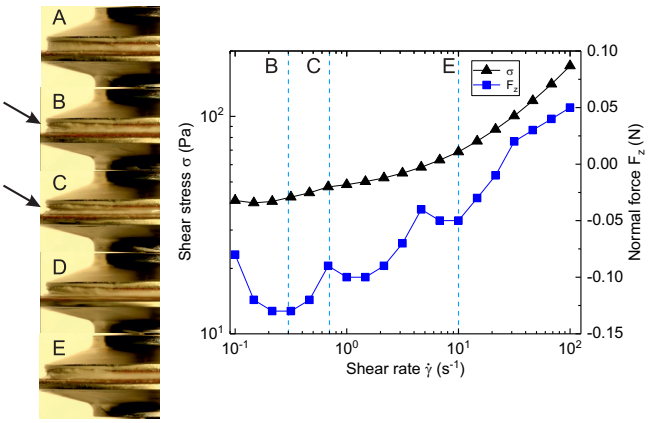

Figure S1: *(Left)* Edge fracture appears at the free surface of the sample during a flow sweep with increasing shear rate as shown with the arrows. This NP3-silicone oil-glycerol sample has $\phi_{solid} = 0.25$ and $\phi_{2nd}/\phi_{solid} = 0.2$. The images are taken at (A) quiescence ($\dot{\gamma} = 0\ s^{-1}$) prior to shearing. Sample is sheared with (B) $\dot{\gamma} = 0.2\ s^{-1}$, (C) $\dot{\gamma} = 0.5\ s^{-1}$, (D) $\dot{\gamma} = 10\ s^{-1}$, and (E) after the flow sweep is finished ($\dot{\gamma} = 0\ s^{-1}$). *(Right)* The corresponding shear stress and normal force for this flow sweep experiment. The measurement was executed with MCR 702 using parallel-plate geometry with 50 mm upper and 52 mm lower diameter. Lower geometry appears to be slightly larger than the upper one due to the recessed channel at the rim to place a solvent trap.

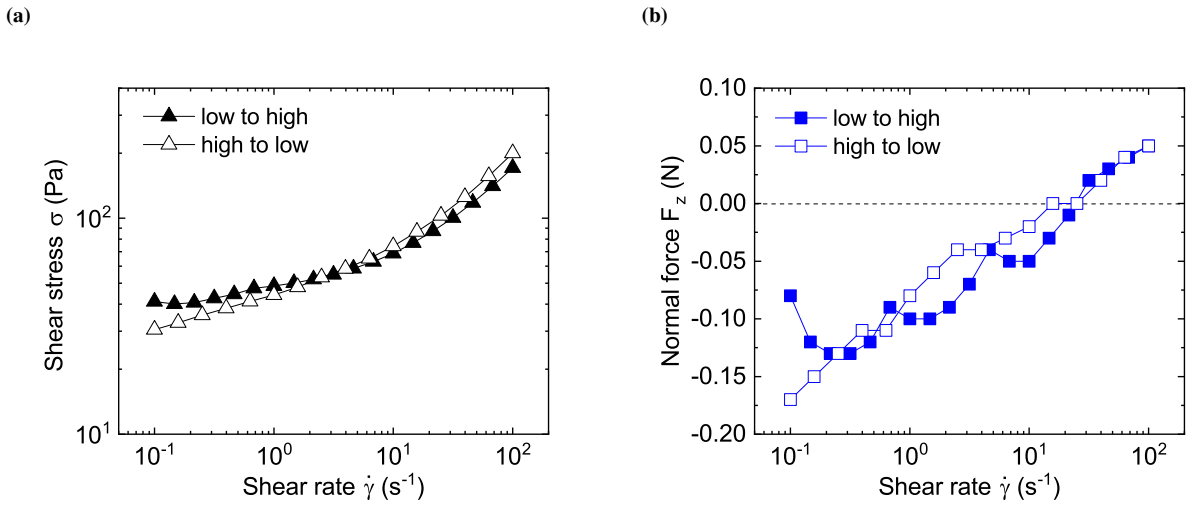

Figure S2: The flow curve (a) and normal force (b) for flow sweep measurements with increasing (close symbol) and decreasing shear rate (open symbol) for NP3-silicone oil-glycerol sample with $\phi_{solid} = 0.25$ and $\phi_{2nd}/\phi_{solid} = 0.2$. The sample was changed between the two measurements. Both flow curves with increasing and decreasing shear rates show similar values. The normal force trend for flow sweep measurement with increasing shear rates is not monotonic, implying that edge fracture occurs as the normal force drops. However, when a flow sweep measurement with decreasing shear rates was run, the normal force shows monotonic trend with no observed edge fracture. Therefore, for the calculation of normal stress differences only the data from the flow sweep measurements with decreasing shear rates are used. The measurement was executed with MCR 702 using parallel-plate geometry with 50 mm upper and 52 mm lower diameter and the gap size was 1 mm.

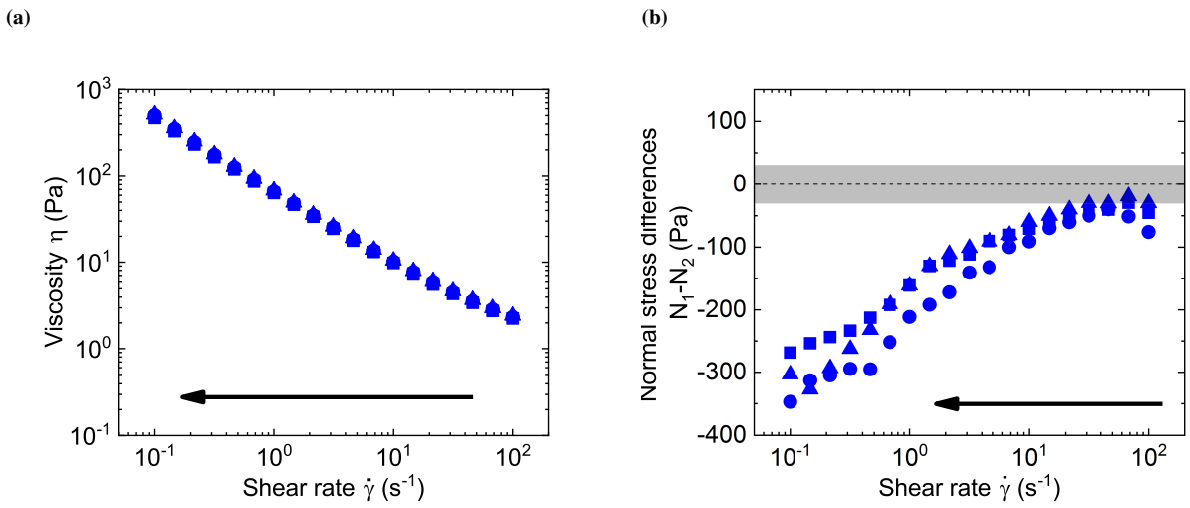

Figure S3: Example of viscosity (a) and normal stress differences curves (b) from three different measurement repititions using NP3-silicone oil-glycerol with $\phi_{solid} = 0.25$ and $\phi_{2nd}/\phi_{solid} = 0.05$. The viscosity curves show excellent reproducibility between the different repetitions, while the normal stress differences values are more sensitive and deviate between the different loadings. The gap height was set to 250 μm. The flow sweep measurements were executed with decreasing shear rate as shown by the arrow. The gray area denotes the experimental limit.

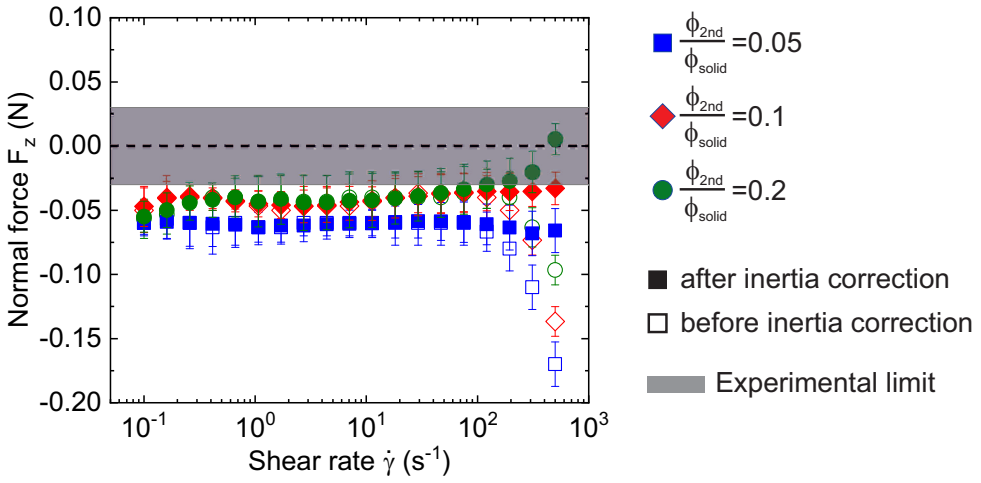

Figure S4: The difference between the normal force values before (open symbol) and after inertia correction for samples in the capillary state.