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Dynamics of viscoelastic films in reverse squeeze flows BAVAND KESHAVARZ, ERICA LAI, GARETH MCKINLEY, NIELS HOLTEN-ANDERSEN, MIT, MECHE/DMSE COLLABORATION — In many industrial and biological applications thin films of complex fluids act as lubricating layers between solid boundaries. Upon the separation of these boundaries, the kinematics of the flow generates large pressure gradients leading to high values of adhesive forces. We perform a detailed study on the dynamics of these phenomena for a general class of viscoelastic liquids with different relaxation times and elastic moduli. The liquid is initially at rest in the gap between two circular discs. The discs are then separated from each other with an exponentially increasing velocity, ensuring a constant nominal value of stretch rate during the test. Adhesion force measurements show a rate-dependent peak force that scales with the elastic modulus of the liquid followed by an exponentially decaying tail. We show that with a proper scaling all of the measured peak forces for different viscoelastic liquids follow a single master curve. Coupling the simplified kinematics of this reverse squeeze flow with the viscoelastic constitutive equation leads to a simple lubrication model. We show that the predictions from the model agree well with the experimental measurements. Results from this study can shed light on the dynamics of liquid adhesion in complex fluids.

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