Identification of viscoelastic properties using a 2D model impeller with viscoelastic flow simulations

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Measurement of viscoelastic properties of a complex fluid is of great importance in various industries such as polymer processing, lithium-ion battery manufacturing, etc. and it can be employed to identify information on molecular weight for polymeric materials and dispersion state for suspensions and emulsions. Unlike conventional viscoelastic measurement with standard fixtures, we attempted the measurement with non-rheometric flow, as it can provide a new tool for in-situ/on-line measurement particularly during mixing, dispersion, and reaction. In the present work, we employ a non-rheometric 2D model flow systems with two different rotating objects and analysed the torque response for a wide range of oscillation frequencies and amplitudes up to the non-linear regime. 2D viscoelastic flow simulations were conducted to analyse averaged behaviours between torque and oscillatory deformation to determine complex shear moduli and it was compared with a theoretical linear viscoelastic behaviour with the effective mechanistic model with effective second moment of inertia, effective spring coefficient and effective damping coefficient. In addition, local stress-strain behaviours will be investigated to understand the applicability and limitation of the viscoelastic identification with non-rheometric flow.

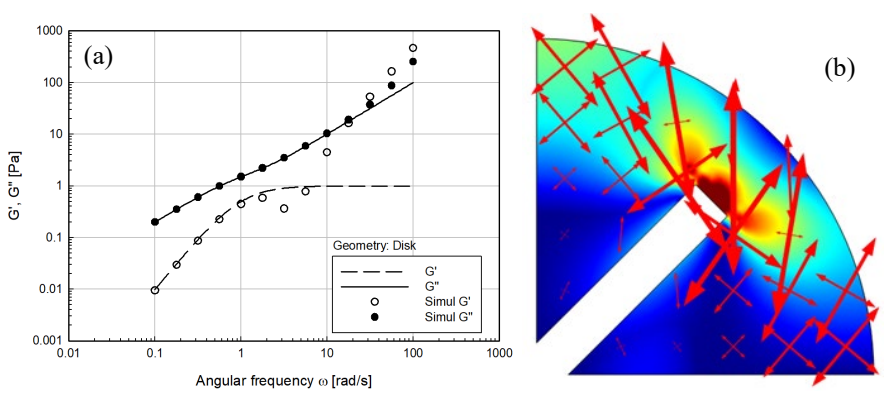

Figure 1: (a) Result of moduli at 2D model Impeller. (b) Stress-strain behaviours.

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