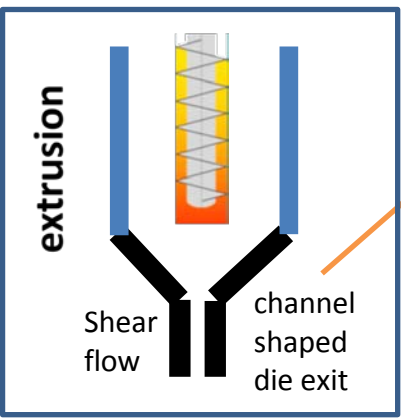


Molecular modelling of melt fiber spinning

1

Effect of the length/diameter ratio of the die on the molecular configuration at the die and on the filament properties.



∴ Momentum balance

$$W \frac{dv_z}{dz} = \frac{d}{dz} [A(\tau_{zz} - \tau_{rr})] - C_f \rho_a v_z^2 + \rho g A + \frac{1}{2} \pi \sigma \frac{dD}{dz}$$

inertia stresses Air drag gravity Interface tension

J. van Meerveld et al., J. Non-Newt. Fluid Mech., 150, 177, 2008.

Mathematical framework

∴ Energy equation

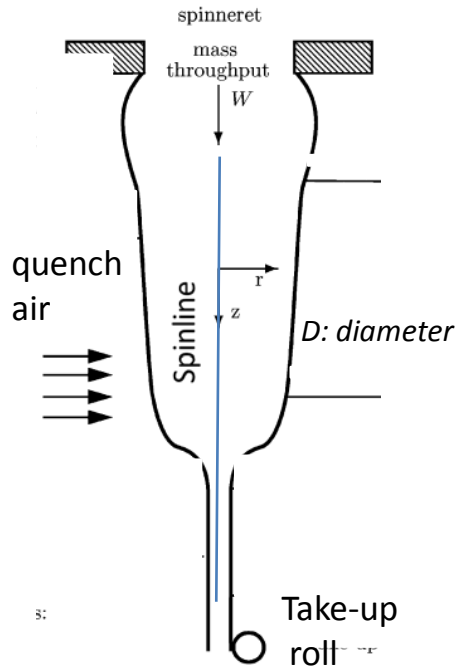
$$\rho C_p v_z \frac{dT}{dz} = -\frac{4}{D} h(T - T_a) + (\tau_{zz} - \tau_{rr}) \frac{dv_z}{dz} + \rho \Delta h(T) \phi_\infty v_z \frac{d\phi}{dz}$$

Heat exchange fiber and air Viscous heat dissipation Latent heat due to crystallisation

Output:

- Velocity
- Diameter
- Temperature
- Crystallinity
- Polymer configuration

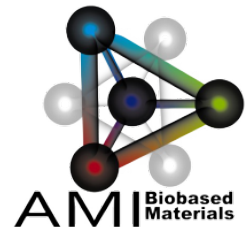
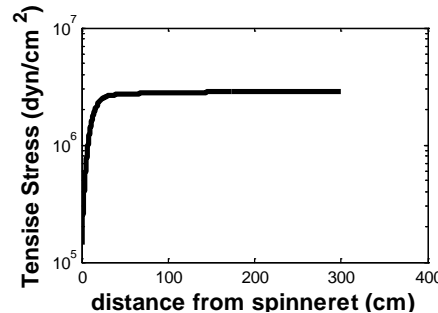
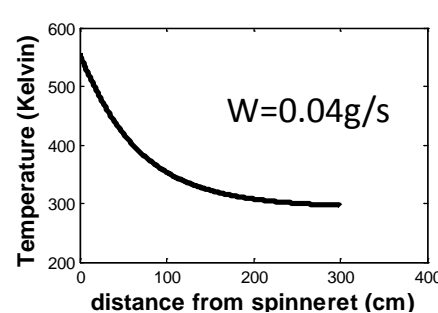
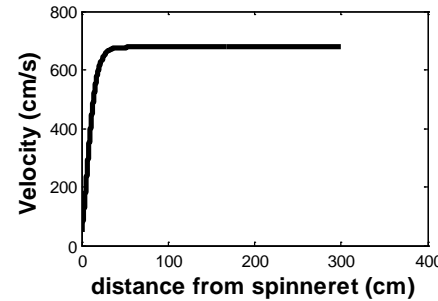
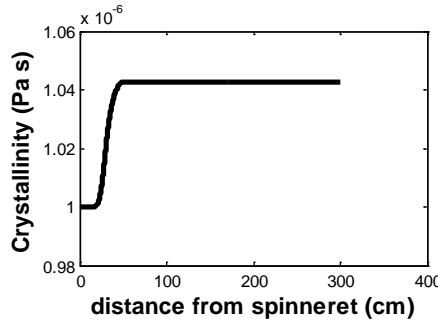
along the spinline



2

Effect of the take-up speed on the filament properties

Example calculations for PLA amorphous grade



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