Écoulement et stabilité d'un rideau liquide viscoélastique

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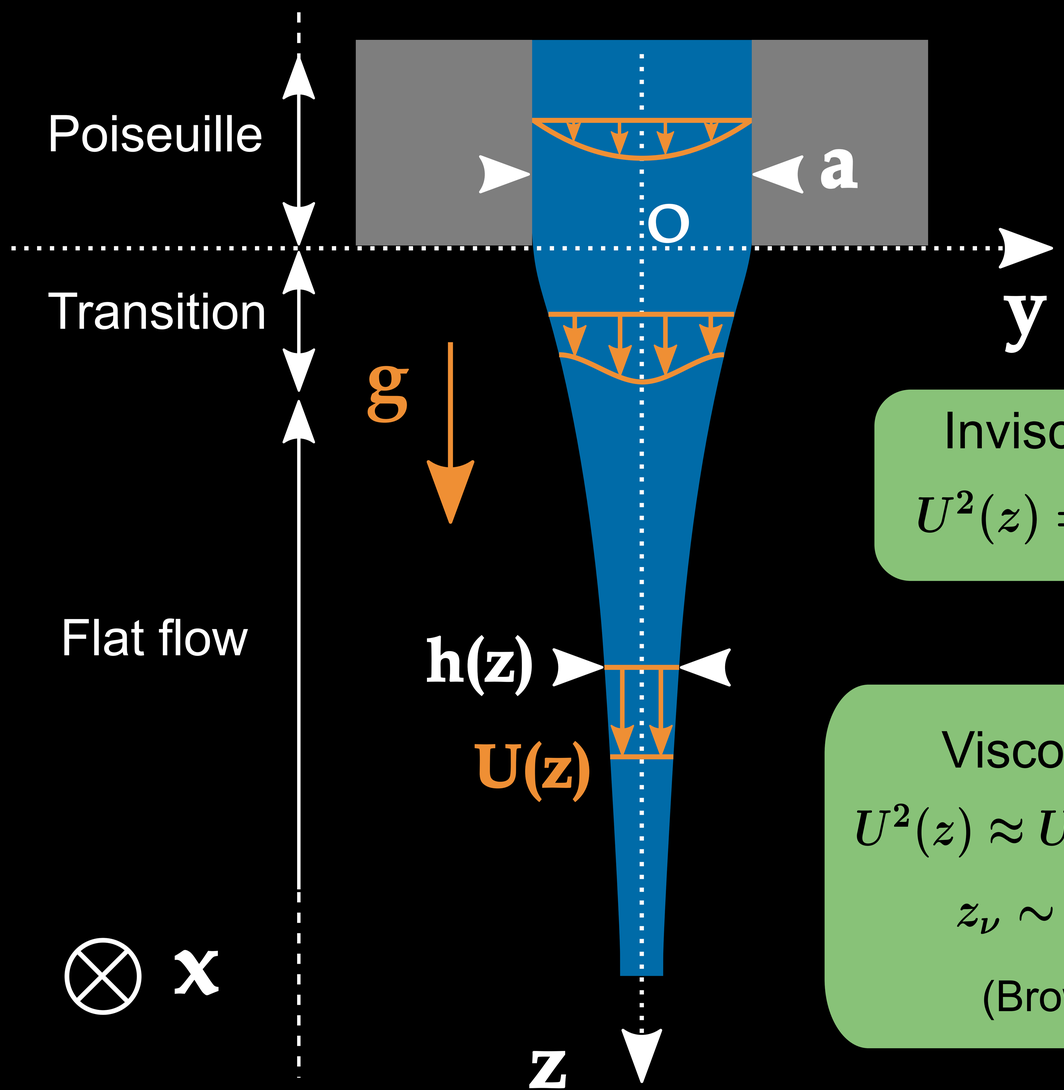


Inviscid liquid :

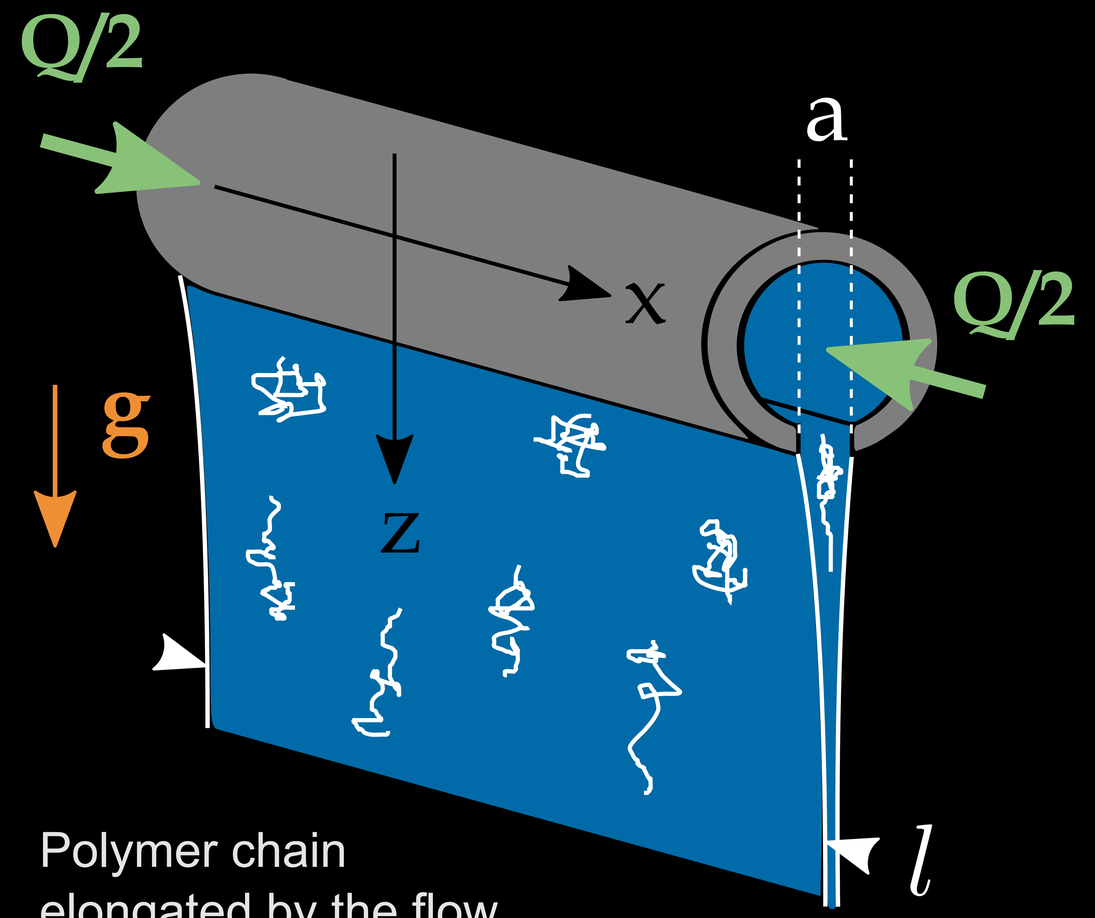
$$U^2(z) = U_0^2 + 2gz$$

Viscous liquid :

$$U^2(z) \approx U_0^2 + 2g(z - z_\nu)$$

$$z_\nu \sim (\nu^2/g)^{1/3}$$

(Brown 1961)



Polymer chain
elongated by the flow
⇒ Elastic stress

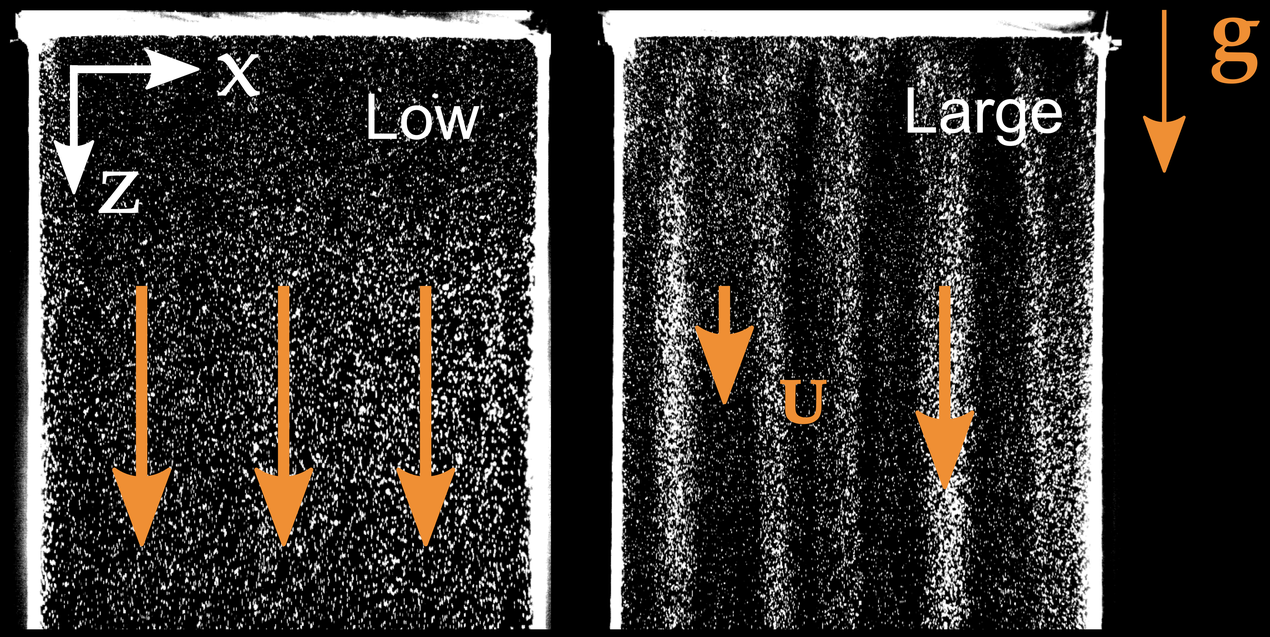
Pb: What is the behaviour
of a viscoelastic curtain?

Linear flow rate :

$$\Gamma = Q/l$$

Flow

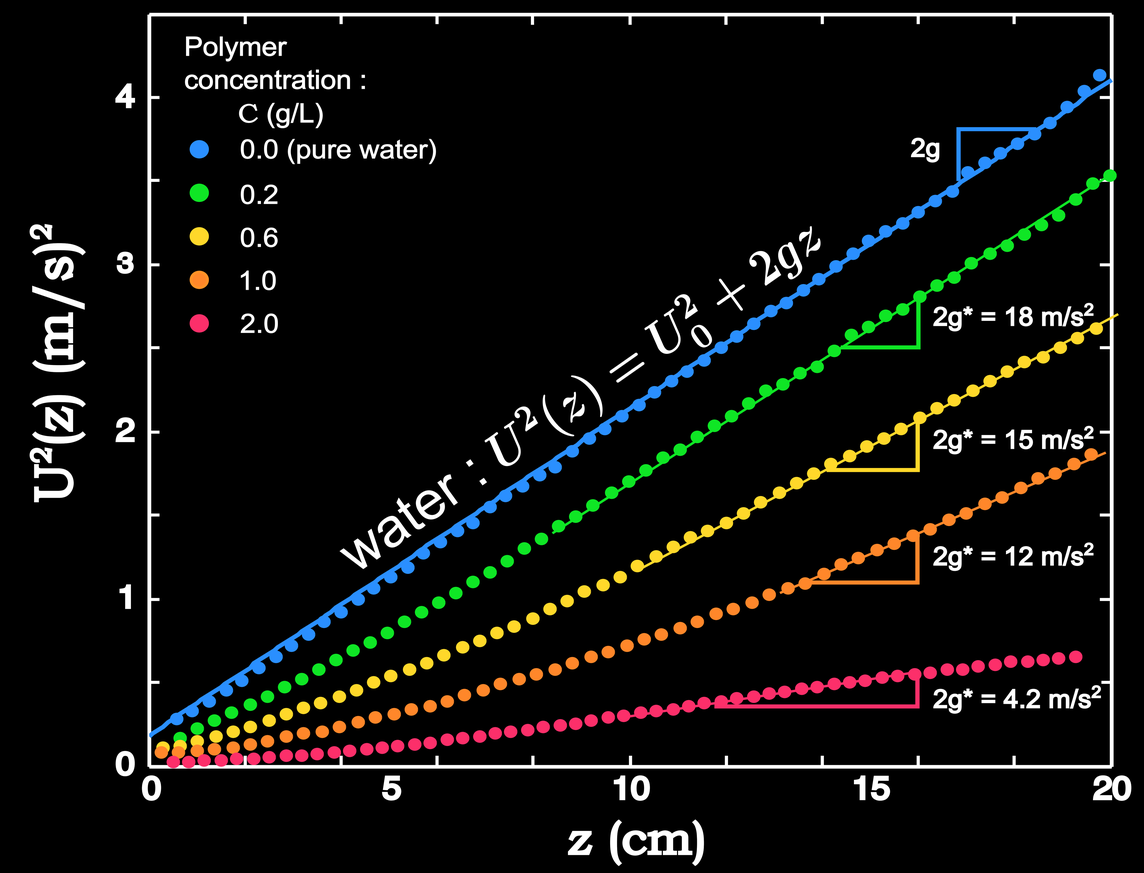
Polymer concentration :



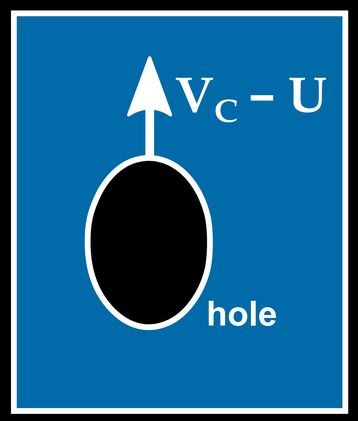
h(z,x) and U(z,x) **New !**

Constant acceleration $g^* < g$ **New !**

⇒ The presence of polymers slows down the liquid fall all over the curtain



Stability



Taylor-Culick velocity :

$$V_C = \sqrt{\frac{2\gamma}{\rho h}}$$

$V_C < U$: hole advected by the flow

$$We = \left(\frac{U}{V_c}\right)^2 = \frac{\rho \Gamma U(z)}{2\gamma}$$