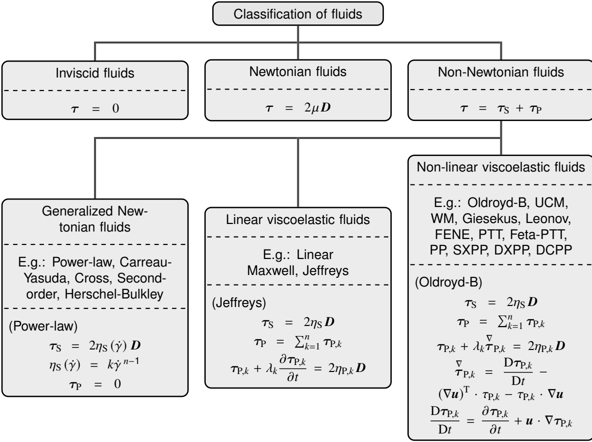
Classification of fluids
Inviscid fluids
$\boldsymbol{\tau} = 0$
Newtonian fluids
$\boldsymbol{\tau} = 2\mu \boldsymbol{D}$
Non-Newtonian fluids
$\boldsymbol{\tau} = \boldsymbol{\tau}_{\mathrm{S}} + \boldsymbol{\tau}_{\mathrm{P}}$
Generalized Newtonian fluids
E.g.: Power-law, Carreau-Yasuda, Cross, Second-order, Herschel-Bulkley
(Power-law)
$\boldsymbol{\tau}_{\mathrm{S}} = 2\eta_{\mathrm{S}}(\dot{\gamma})\,\boldsymbol{D}$
$\eta_{\mathrm{S}}(\dot{\gamma}) = k\dot{\gamma}^{\,n-1}$
$\boldsymbol{\tau}_{\mathrm{P}} = 0$
Linear viscoelastic fluids
E.g.: Linear Maxwell, Jeffreys
(Jeffreys)
$\boldsymbol{\tau}_{\mathrm{S}} = 2\eta_{\mathrm{S}} \boldsymbol{D}$
$\boldsymbol{\tau}_{\mathrm{P}} = \sum_{k=1}^{n} \boldsymbol{\tau}_{\mathrm{P},k}$
$\boldsymbol{\tau}_{\mathrm{P},k} + \lambda_k \dfrac{\partial \boldsymbol{\tau}_{\mathrm{P},k}}{\partial t} = 2\eta_{\mathrm{P},k} \boldsymbol{D}$
Non-linear viscoelastic fluids
E.g.: Oldroyd-B, UCM, WM, Giesekus, Leonov, FENE, PTT, Feta-PTT, PP, SXPP, DXPP, DCPP
(Oldroyd-B)
$\boldsymbol{\tau}_{\mathrm{S}} = 2\eta_{\mathrm{S}} \boldsymbol{D}$
$\boldsymbol{\tau}_{\mathrm{P}} = \sum_{k=1}^{n} \boldsymbol{\tau}_{\mathrm{P},k}$
$\boldsymbol{\tau}_{\mathrm{P},k} + \lambda_k \overset{\nabla}{\boldsymbol{\tau}}_{\mathrm{P},k} = 2\eta_{\mathrm{P},k} \boldsymbol{D}$
$\overset{\nabla}{\boldsymbol{\tau}}_{\mathrm{P},k} = \dfrac{\mathrm{D}\boldsymbol{\tau}_{\mathrm{P},k}}{\mathrm{D}t} - (\nabla \boldsymbol{u})^{\mathrm{T}} \cdot \tau_{\mathrm{P},k} - \tau_{\mathrm{P},k} \cdot \nabla \boldsymbol{u}$
$\dfrac{\mathrm{D}\boldsymbol{\tau}_{\mathrm{P},k}}{\mathrm{D}t} = \dfrac{\partial \boldsymbol{\tau}_{\mathrm{P},k}}{\partial t} + \boldsymbol{u} \cdot \nabla \boldsymbol{\tau}_{\mathrm{P},k}$