Simplifications In the case of a *homogeneous* fluid with [3]

$$\partial_t \varrho = 0 \qquad \text{and} \qquad \nabla \varrho = 0, \tag{5.5}$$

the associated flow is *incompressible* (isochoric)

$$\nabla \cdot \boldsymbol{u} = 0. \tag{5.6}$$

A *Newtonian* fluid is a fluid that can, by definition, be described by

$$\hat{T}_{ij} := \lambda \, (\nabla \cdot \boldsymbol{u}) \, \delta_{ij} + \mu \, (\partial_i u_j + \partial_j u_i). \tag{5.7}$$

where λ the first coefficient of viscosity (related to *bulk* viscosity), and μ is the second coefficient of viscosity (shear viscosity). Thus, for an incompressible Newtonian fluid, the Navier-Stokes system (5.4) simplifies to

$$\begin{aligned} 0 &= \nabla \cdot \boldsymbol{u}, & \text{(5.8a)} \\ \varrho \, [\partial_t \boldsymbol{u} + (\boldsymbol{u} \cdot \nabla) \boldsymbol{u}] &= -\nabla p + \mu \nabla^2 \boldsymbol{u} + \boldsymbol{f}. & \text{(5.8b)} \end{aligned}$$