Число Рейнольдса

Ур-е Навье-Стокса при $\mu = const$, $\zeta = const$

$$\rho \frac{d\vec{v}}{dt} + \operatorname{grad} p = \mu \Delta \vec{v} + \left(\zeta + \frac{\mu}{3}\right) \operatorname{grad} \operatorname{div} \vec{v}$$

(+) $\rho = const \Rightarrow \rho \frac{d\vec{v}}{dt} + \operatorname{grad} p = \mu \Delta \vec{v}$

$\rho = \rho_0 \tilde{\rho}$, $p = p_0 \tilde{p}$, $v = v_0 \vec{\tilde{v}}$, $x = x_0 \tilde{x}$, $t = t_0 \tilde{t}$; $\rho_0, p_0, v_0, x_0, t_0$ - характерные размерные множители

$v_0 = \frac{x_0}{t_0}$; $\rho_0 \tilde{\rho} \cdot \frac{d\vec{\tilde{v}}}{d\tilde{t}} \cdot \frac{v_0}{t_0} + \frac{p_0}{x_0} \operatorname{grad} \tilde{p} = \mu \Delta \vec{\tilde{v}} \frac{v_0}{x_0^2}$;

$$\tilde{\rho} \frac{d\tilde{v}}{d\tilde{t}} \left(\frac{\rho_0 v_0}{t_0}\right) + \left(\frac{p_0}{x_0}\right) \operatorname{grad} \tilde{p} = \left(\frac{\mu v_0}{x_0^2}\right) \Delta \tilde{v};$$

$$v_0 = \frac{x_0}{t_0}; \quad \rho_0 = \frac{m_0}{x_0^2}; \quad p_0 = \frac{m_0 x_0}{t_0^2 \cdot x_0^2} = \frac{m_0}{t_0^2 x_0}$$

$$\left(\frac{m_0}{x_0^3} \cdot \frac{x_0}{t_0 t_0}\right) \tilde{\rho} \frac{d\tilde{v}}{d\tilde{t}} + \frac{m_0}{t_0^2 x_0^2} \operatorname{grad} \tilde{p} = \frac{\mu x_0}{t_0 x_0^2} \Delta \tilde{v};$$

$$\tilde{\rho} \frac{d\tilde{v}}{d\tilde{t}} + \operatorname{grad} \tilde{p} = \frac{\mu}{t_0 x_0} \cdot \frac{x_0^2 \cdot t_0^2}{m_0} \Delta \tilde{v};$$

$$\frac{\mu t_0 x_0}{m_0} = \mu \frac{x_0^2}{\rho_0 x_0 v_0} = \underbrace{\frac{\mu}{\rho_0 x_0 v_0}}_{= \frac{1}{Re}}$$

Re - число Рейнольдса

$$\tilde{\rho} \frac{d\tilde{v}}{d\tilde{t}} + \operatorname{grad} \tilde{p} = \frac{1}{Re} \Delta \tilde{v};$$

$$Re = \frac{v_0 x_0 \rho_0}{\mu};$$

$Re \ll 1 \Rightarrow$ вязкие силы преобладают

$Re \gg 1 \Rightarrow$ вязкостью можем пренебречь
(незначительно)
(но не внутри границы!)