

Reynolds Number for Multiphase Flow @model

@wikipedia

In multiphase flow the [Darcy friction factor](#) can be calculated as [Darcy friction factor Single-phase @model](#) with specific approximation of [Reynolds number](#):

$$(1) \quad \text{Re} = \frac{\sum_{\alpha} \rho_{\alpha} u_{\alpha}^2 A_{\alpha}}{\sum_{\alpha} \mu_{\alpha} u_{\alpha} \sqrt{A_{\alpha}}} = \frac{\sum_{\alpha} \rho_{\alpha} q_{\alpha}^2 / A_{\alpha}}{\sum_{\alpha} \mu_{\alpha} q_{\alpha} / \sqrt{A_{\alpha}}} = \frac{1}{\sqrt{A}} \cdot \frac{\sum_{\alpha} \rho_{\alpha} q_{\alpha}^2 / s_{\alpha}}{\sum_{\alpha} \mu_{\alpha} q_{\alpha} / \sqrt{s_{\alpha}}}$$

where

ρ_{α}	α -phase fluid density	s_{α}	volume share occupied by α -phase
μ_{α}	α -phase fluid viscosity	A_{α}	cross-sectional area occupied by α -phase
u_{α}	α -phase fluid velocity	A	total cross-sectional area

[Reynolds number](#) represent the ration of intertial forces to viscous forces:

$$\text{Re} = \frac{\text{Intertial Forces}}{\text{Viscocus Forces}}$$

Homogeneous Pipe Flow

Homogeneous Pipe Flow is characterized by the same phase velocities: $u_{\alpha} = u_t, \forall \alpha \in \Gamma$ (no slippage) and the multiphase [Reynolds number](#) takes simpler form:

$$(2) \quad \text{Re} = \frac{\sum_{\alpha} \rho_{\alpha} u_{\alpha} A_{\alpha}}{\sum_{\alpha} \mu_{\alpha} \sqrt{A_{\alpha}}} = \frac{\dot{m}}{\sum_{\alpha} \mu_{\alpha} \sqrt{A_{\alpha}}} = \frac{\dot{m}}{\sqrt{A}} \cdot \frac{1}{\sum_{\alpha} \mu_{\alpha} \sqrt{s_{\alpha}}}$$

2-phase Gas-Liquid flow

$$\text{Re} = \frac{\rho_L u_L^2 A_L + \rho_g u_g^2 A_g}{\mu_L u_L \sqrt{A_L} + \mu_g u_g \sqrt{A_g}}$$

where

ρ_L	liquid density	ρ_g	gas density
u_L	liquid velocity	u_g	gas velocity
A_L	cross-sectional area occupied by liquid	A_g	cross-sectional area occupied by gas
μ_L	liquid viscosity	μ_g	gas viscosity

See also

[Physics](#) / [Fluid Dynamics](#) / [Pipe Flow Dynamics](#) / [Darcy–Weisbach equation](#) / [Darcy friction factor](#)

Reference

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Shannak, B. A., 2008, Frictional Pressure Drop of Gas Liquid Two-Phase Flow in Pipes, Nuclear Engineering and Design, Vol. 238, pp. 3277-3284., doi.org/10.1016/j.nucengdes.2008.08.015