Gradiomanometer @model

Mathematical model of Gradiomanometer G_p tool readings.

In case of stationary homogenous isothermal pipeline fluid flow the pressure gradient G_p can be correlated to volumetric flowrate q as (see model):

(1) $$G_p = G_{p0} + K \cdot q \cdot (1 + (q/q_\infty)^n)^{1/n}$$

where

q	volumetric flowrate around the gradiomanometer
G_{p0}	pressure gradient in static fluid column
K	a number defining the pipe flow productivity
q_∞	correction factor for strong-turbulent fluid flow
n	turbulence curvature with default value $n = 12$

Equation (1) suggests that pressure gradient depends on flowrate:

- linearly $\sim q$ from laminar to slightly turbulent flow regimes
- and develops a stronger almost quadratic dependence $\sim q^2$ at strong-turbulent fluid flow

The model parameters $\{G_{p0}, K, q_\infty\}$ should be calibrated in-situ as they strongly depend on fluid type and the location specifics of the tool in a pipe.

The parameter G_{p0} can be directly measure from static surveys if these are available.

Alternatively it maybe assessed as:

(2) $$G_{p0} = \rho \, g \, \cos\theta$$

where

ρ	Fluid density at a given location with pressure p and temperature T
g	standard gravity constant
$\cos\theta$	correction factor for trajectory deviation

The parameter K is very sensitive to in-situ conditions but can be roughly estimated as:

(3) $$K = \frac{8\pi\,\mu}{A^2}$$

where

μ	dynamic fluid viscosity	A	pipe cross-sectional area

For non-isothermal flow the model parameters $\{G_{p0}, K, q_\infty\}$ should be calibrated at different temperature values.

See also

Gradiomanometer

[Stationary Isothermal Homogenous Pipe Flow Pressure Profile @model]