

Temperature Profile in Homogenous Stationary Pipe Flow

@model

Motivation

One of the key challenges in [Pipe Flow Dynamics](#) is to predict the along-hole [temperature](#) distribution during the [stationary fluid transport](#).

[Pipeline Flow Temperature Model](#) is addressing this problem with account of the varying [pipeline trajectory](#), [pipeline](#) schematic and [heat transfer](#) with the matter around [pipeline](#).

In many practical cases the along-hole [temperature](#) distribution during the [stationary fluid flow](#) can be approximated by [homogenous fluid flow](#) model.

Outputs

$T(t, l)$	along-pipe temperature distribution and evolution in time
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Inputs

$\mathbf{r}(l)$	pipeline trajectory , $\mathbf{r}(l) = \{x(l), y(l), z(l)\}$	$\rho(T, p)$	fluid density
$A(l)$	pipeline cross-section area	$\mu(T, p)$	fluid viscosity
$T_0(t)$	intake temperature	$T_{e0}(l)$	initial temperature of the medium around the pipeline
p_0	intake pressure	$c_p(l)$	specific heat capacity of the medium around pipeline
q_0	intake flowrate	$\lambda_e(l)$	thermal conductivity of the medium around pipeline
$U(l)$	heat transfer coefficient based on pipeline schematic		

Assumptions

Stationary fluid flow	Axial symmetry around the pipe	Homogenous fluid flow
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Equations

(1) $\rho c \frac{\partial T}{\partial t} = \frac{d}{dl} \left(\lambda \frac{dT}{dl} \right) - \rho c v \frac{dT}{dl} + \frac{U}{r_w} \cdot (T_e(t, l, r_w) - T)$	(2) $\rho_e c_e \frac{\partial T_e}{\partial t} = \nabla(\lambda_e \nabla T_e)$
(3) $T(t = 0, l) = T_{e0}(l)$	(4) $T_e(t = 0, l, r) = T_{e0}(l)$
(5) $T(t, l = 0) = T_0(t)$	(6) $T_e(t, l, r \rightarrow \infty) = T_{e0}(l)$
(7) $2\pi \lambda_e r_w \left. \frac{\partial T_e}{\partial r} \right _{r=r_w} = 2\pi r_f U \cdot \left(T_e \Big _{r=r_w} - T \right)$	

Approximations

[Temperature Profile in Homogenous Stationary Pipe Flow Analytical Ramey @model](#)

See also

[Physics](#) / [Fluid Dynamics](#) / [Pipe Flow Dynamics](#) / [Pipe Flow Simulation](#) / [Temperature Profile in Pipe Flow @model](#)

[[Heat Transfer](#)] [[Heat Transfer Coefficient \(HTC\)](#)]

[[Stationary Isothermal Homogenous Pipe Flow Pressure Profile @model](#)] [[Pipe Flow Temperature Analytical Ramey @model](#)]

References

https://en.wikipedia.org/wiki/Darcy_friction_factor_formulae

https://neutrium.net/fluid_flow/pressure-loss-in-pipe/

