Design and modelation of piping systems by means of use friction factor in the transition turbulent zone. Mathematical Modelling of Engineering Problems 4(4): 162-167. https://doi.org /10.18280/mmep.040404

[17] Medina YC, Khandy NH, Carlson KM, Fonticiella OMC, Morales OFG. (2018). Mathematical modeling of two-phase media heat transfer coefficient in air cooled condenser system. International Journal of Heat and Technology 36(1): 319-324. https://doi.org/10.18280/ijht.360142

[18] Camaraza-Medina Y, Hernández-Guerrero A, Luviano-Ortiz JL, Mortensen-Carlson K, Cruz-Fonticiella OM, García-Morales OF. (2019). New model for heat transfer calculation during film condensation inside pipes. International Journal of Heat and Mass Transfer 128: 344-353. https://doi.org/10.1016/j.ijheatmasstransfer.2018.09.012

[19] Mondal S, Field RW. (2018). Theoretical analysis of the viscosity correction factor for heat transfer in pipe flow. Chemical Engineering Science 187: 27–32. https://doi.org/10.1016/j.ces.2018.04.047

[20] Camaraza-Medina Y, Khandy NH, Carlson KM, Cruz-Fonticiella OM, García-Morales OF, Reyes-Cabrera D. (2018). Evaluation of condensation heat transfer in air-cooled condenser by dominant flow criteria. Mathematical Modelling of Engineering Problems 5(2): 76-82. https://doi.org /10.18280/mmep.050204

[21] Binu TV, Jayanti S. (2018). Heat transfer enhancement due to internal circulation within a rising fluid drop. Thermal Science and Engineering Progress 8: 385-396. https://doi.org/10.1016/j.tsep.2018.09.009

[22] Camaraza Y. (2017). Introducción a la termo transferencia, Editorial Universitaria, La Habana.

[23] Camaraza-Medina Y, Cruz-Fonticiella OM, Garcia-Morales OF. (2019). New model for heat transfer calculation during fluid flow in single phase inside pipes. Thermal Science and Engineering Progress. https://doi.org/10.1016/j.tsep.2019.03.014

NOMENCLATURE

a Thermal diffusivity, $m^2 \cdot s^{-1}$
A Constant, defined in Equation (74)
B Constant, defined in Equation (74)
C Constant, defined in Equation (74)
C_p Fluid specific heat, $J \cdot kg^{-1} \cdot K^{-1}$
C_W Drag coefficient
d Equivalent inner tube diameter, m
D Constant, defined in Equation (74)
f Darcy friction factor
l Length of the tube, m
L Initial section of hydrodynamic compensation, m
L_C Mixture length of the energy in the thicknessδ_3, m
L_M Mixture length of the thicknessδ_2, m
N Exponent of the Petukhov correction in Equation (63)
Nu Nusselt number
Pr Prandtl number for single-phase
q^* Total heat flux, $kg \cdot m^{-2} \cdot s^{-3}$
q_0^* Heat flux on the boundary layer surface, $kg \cdot m^{-2} \cdot s^{-3}$
q_{cond} Conductive component of the total heat flux, $kg \cdot m^{-2} \cdot s^{-3}$
q_{turb} Turbulent component of the total heat flux, $kg \cdot m^{-2} \cdot s^{-3}$
Re Reynolds number for single-phase
St Stanton number
T_F Mean fluid temperature, ˚C
T_I Instantaneous temperature used in Equation (5), ˚C
T_F^* Temperature fluctuation used in Equation (5), ˚C
T_P Wall temperature, ˚C
V_1 Velocity at the edge of the viscous layer, $m \cdot s^{-1}$
V_M Mean fluid velocity, $m \cdot s^{-1}$
V_X^* Fluctuation of the V_X^M, $m \cdot s^{-1}$
V_Y^* Fluctuation of the V_Y^M, $m \cdot s^{-1}$
V_X^M Instantaneous velocity in the coordinate axis *x* used in Equation (2), $m \cdot s^{-1}$
V_Y^M Instantaneous velocity in the coordinate axis *y* used in Equation (3), $m \cdot s^{-1}$

Greek symbols

α Heat transfer coefficient in single-phase, $kg \cdot m^{-1} \cdot K^{-1} \cdot s^{-1}$
ε_C Heat turbulent diffusivity, $m^2 \cdot s^{-1}$
ε_M Momentum turbulent diffusivity, $m^2 \cdot s^{-1}$
μ_F Fluid dynamic viscosity at T_F, $kg \cdot m^{-1} \cdot s^{-1}$
μ_P Fluid dynamic viscosity at T_P, $kg \cdot m^{-1} \cdot s^{-1}$
ρ Fluid density, $kg \cdot m^{-3}$
λ Fluid thermal conductivity, $W \cdot m^{-1} \cdot K^{-1}$
v Liquid kinematic viscosity, $m^2 \cdot s^{-1}$
δ_2 Film thickness of the momentum in boundary layer, m
δ_3 Film thickness of the thermal boundary layer, m
τ Shear stress in the turbulent boundary layer, $kg \cdot m \cdot s^{-2}$
τ_0 Shear stress on the surface of the turbulent boundary layer, $kg \cdot m \cdot s^{-2}$
τ_{Visc} Stress of the viscous forces, $kg \cdot m \cdot s^{-2}$
τ_{Turb} Stress of the turbulent strain, $kg \cdot m \cdot s^{-2}$
ΔP Pressure drop, m