Appendix

E

Appendix E – Scilab Thermal-Hydraulic Library

Thermal-hydraulic calculations can be performed with the following Scilab functions, available for download from http://www.sh2701.blogspot.se. The Scilab software can be obtained freely from http://www.scilab.org.

FUNCTION DESCRIPTION	CALL FORMATS

Fanning friction factor using the Blasius correlation.
 	
Two calling formats are available, with the following input parameters:
 	
Re – Reynolds number
 	
or:
 	
G – mass flux, [kg/m^2.s]
 	
Dh – hydraulic diameter, [m]
 	
vis – dynamic viscosity, [Pa.s]
	`Cf_Blasius(Re)`
	
	`Cf_Blasius(G,Dh,vis)`

Fanning friction factor using the Filonenko correlation.
 	
Two calling formats are available, with the following input parameters:
 	
Re – Reynolds number
 	
or:
 	
G – mass flux, [kg/m^2.s]
 	
Dh – hydraulic diameter, [m]
 	
vis – dynamic viscosity, [Pa.s]
	`Cf_Filonenko(Re)`
	
	`Cf_Filonenko(G,Dh,vis)`

Fanning friction factor using the Haaland correlation.
 	
Two calling formats are available, with the following input parameters:
 	
Re – Reynolds number
 	
or:
 	
G – mass flux, [kg/m^2.s]
 	
Dh – hydraulic diameter, [m]
 	
vis – dynamic viscosity, [Pa.s]
	`Cf_Haaland(Re)`
	
	`Cf_ Haaland (G,Dh,vis)`

Heat transfer coefficient using the Dittus-Boelter correlation.
 	
Two calling formats are available, with the following input parameters:
 	
Re – Reynolds number
 	
Pr – Prandtl number
 	
or:
 	
G – mass flux, [kg/m^2.s]
 	
Dh – hydraulic diameter, [m]
 	
vis – dynamic viscosity, [Pa.s]
 	
con – thermal conductivity, [W/m.K]
 	
cp – specific heat, [J/kg.K]
	`Nu=HTC_DittusBoelter(Re, Pr)`
	
	`htc=HTC_DittusBoelter(G, Dh,vis,con,cp)`
	
	Nu – Nusselt number
	
	htc – heat transfer coefficient, [W/m^2.K]

Heat transfer coefficient using the Chen correlation. One calling format is available, with the following input parameters: G – mass flux, [kg/m^2.s] q2p – heat flux, [W/m^2] p – pressure, [bar] x – equilibrium quality	`htc=HTC_Chen(G,q2p,p,x, Dh)` htc – heat transfer coefficient, [W/m^2.K]

Dh – hydraulic diameter, [m]	

Heat transfer coefficient using the Gnielinski correlation.
 	
Two calling formats are available, with the following input parameters:
 	
Re – Reynolds number
 	
Pr – Prandtl number
 	
Cf – Fanning friction factor
 	
or:
 	
G – mass flux, [kg/m^2.s]
 	
Dh – hydraulic diameter, [m]
 	
vis – dynamic viscosity, [Pa.s]
 	
con – thermal conductivity, [W/m.K]
 	
cp – specific heat, [J/kg.K]
 	
Cf – fanning friction factor
	`Nu=HTC_Gnielinski(Re, Pr,Cf)`
	
	`htc=HTC_Gnielinski(G, Dh,vis,con,cp,Cf)`
	
	Nu – Nusselt number
	
	htc – heat transfer coefficient, [W/m^2.K]

Heat transfer coefficient using the Jackson correlation.
 	
Two calling formats are available, with the following input parameters:
 	
Re – Reynolds number
 	
Pr – Prandtl number
 	
cp – bulk specific heat, [J/kg.K]
 	
rho – bulk density, [kg/m^3]
 	
h – bulk enthalpy, [J/kg]
 	
t – bulk temperature, [°C]
 	
tw – wall temperature, [°C]
 	
p – pressure, [bar]
 	
or:
	`Nu=HTC_Jackson(Re, Pr,cp,rho,h,t,tw,p)`
	
	`htc=HTC_Jackson(G, Dh,vis,con,cp,rho,h,t,tw, p)`
	
	Nu – Nusselt number
	
	htc – heat transfer coefficient, [W/m^2.K]

G – mass flux, [kg/m^2.s] Dh – hydraulic diameter, [m] vis – dynamic viscosity, [Pa.s] con – thermal conductivity, [W/m.K] The rest of the parameters have the same meaning as in the first call format.	

Heat transfer coefficient using the Petukhov-Kirillov correlation.
 	
Two calling formats are available, with the following input parameters:
 	
Re – Reynolds number
 	
Pr – Prandtl number
 	
Cf – Fanning friction factor
 	
or:
 	
G – mass flux, [kg/m^2.s]
 	
Dh – hydraulic diameter, [m]
 	
vis – dynamic viscosity, [Pa.s]
 	
con – thermal conductivity, [W/m.K]
 	
cp – specific heat, [J/kg.K]
	`Nu = HTC_PetukhovKirillov(Re, Pr, Cf)`
	
	`htc=HTC_PetukhovKirillov(G, Dh,vis,con,cp,)`
	
	Nu – Nusselt number
	
	htc – heat transfer coefficient, [W/m^2.K]

Wall temperature in subcooled boiling using the Jens-Lottes correlation.
 	
Two calling formats are available, with the following input parameter:
 	
q2p – wall heat flux, [W/m^2]
 	
p – pressure, [bar]
 	
or:
 	
q2p – wall heat flux, [W/m^2]
 	
p – pressure, [bar]
 	
Tsat – saturation temperature, [°C]
	`Tw = TW_JensLottes(q2p,p)`
	
	`Tw = TW_JensLottes(q2p,p,Tsat)`

Wall temperature in subcooled boiling using the Thom correlation.
 	
Two calling formats are available, with the following input parameter:
 	
q2p – wall heat flux, [W/m^2]
 	
p – pressure, [bar]
 	
or:
 	
q2p – wall heat flux, [W/m^2]
 	
p – pressure, [bar]
 	
Tsat – saturation temperature, [°C]
	`Tw = TW_Thom(q2p,p)`
	
	`Tw = TW_Thom(q2p,p,Tsat)`

Specific enthalpy distribution in a heated channel. Input parameters: z – axial coordinate, [m] Axs – channel cross-section area at z-locations, [m^2] Ph – heated perimeter, [m] hin – inlet specific enthalpy, [J/kg] G – mass flux, [kg/m^2.s] q2p – heat flux, [W/m^2]	`h=EnergyEquation1D(z,Axs,Ph,hin,G,q2p)` h – specific enthalpy distribution in channel
Pressure distribution in a channel. Input parameters: z – axial coordinate, [m] Dh – channel hydraulic diameter, [m] G – mass flux, [kg/m^2.s] pin – inlet pressure, [Pa] rho – bulk fluid density, [kg/m^3] vis – bulk fluid dynamic viscosity, [Pa.s]	`[p]=MomentumEquation1D(z,Dh,G,pin,rho,vis,Cf,gvec)` p – pressure distribution in a channel, [Pa]

Cf – Fanning friction factor gvec – gravity vector projected on the channel axis, [m/s^2]	
Pressure and specific enthalpy distribution in a heated channel with single-phase flow. Input parameters: z – axial coordinate, [m] Axs – channel cross-section area, [m^2] Pw – wetted perimeter, [m] Ph – heated perimeter, [m] pin – inlet pressure, [Pa] Gin – inlet mass flux, [kg/m^2.s] tin – inlet temperature, [°C] twin – wall temperature at inlet, [°C] q2p – heat flux, [W/m^2] gvec – gravity vector projected on the channel axis, [m/s^2] htc_opt – heat transfer coefficient option ; string ('DittusBoelter', or 'PetukhovKirillov', or 'Jackson') Cf_opt – friction factor option; string ('Haaland' or 'Blasius')	`[h,p]=ChannelSolver(z,Axs,Pw,Ph,pin,Gin,tin,twin,q2p,gvec,htc_opt,Cf_opt)` `h` – specific enthalpy `p` – pressure distribution in a channel, [Pa]