```
"Humidity corresponding to the partial pressure of water vapor on the surface of a solution"
Function p_sol(t_sol,c)
A=0.9083-0.569*c+0.1945*c^2-3.736*c^3+2.82*c^4
B=-0.0669+0.0582*c-0.1668*c^2+0.6761*c^3-2.091*c^4
D=(7.541-5.143*c+6.482*c^2-52.62*c^3+115.7*c^4)*10^(-3)
E=(-0.0922+0.0649*c-0.1313*c^2+0.8024*c^3-1.986*c^4)*10^(-3)
F=(1.237-0.753*c+0.1448*c^2-6.964*c^3+14.61*c^4)*10^(-6)
p_sol=A+B*t_sol+D*t_sol^2+E*t_sol^3+F*t_sol^4
End

"Density of the aqueous solution of sodium chloride"
Function rho_sol(t_sol,c)
A=(1.001+0.7666*c-0.0149*c^2-0.2663*c^3+0.8845*c^4)*10^3
B=-0.0214-3.496*c+10.02*c^2-6.56*c^3-31.37*c^4
D=(-5.263+39.87*c-176.2*c^2+363.5*c^3-7.784*c^4)*10^(-3)
E=(15.42-167*c+980.7*c^2-2573*c^3+876.6*c^4)*10^(-6)
F=(-0.0276+0.2978*c-2.017*c^2+6.345*c^3-3.914*c^4)*10^(-6)
rho_sol=A+B*t_sol+D*t_sol^2+E*t_sol^3+F*t_sol^4
End

"Enthalpy of the aqueous solution of sodium chloride"
Function h_sol(t_sol,c)
A=(0.0005+0.0378*c-0.3682*c^2-0.6529*c^3+2.89*c^4)*10^3
B=4.145-4.973*c+4.482*c^2+18.31*c^3-46.41*c^4
D=0.0007-0.0059*c+0.0854*c^2-0.4951*c^3+0.8255*c^4
E=(-0.0048+0.0639*c-0.714*c^2+3.273*c^3-4.85*c^4)*10^(-3)
F=(0.0202-0.2432*c+2.054*c^2-8.211*c^3+11.43*c^4)*10^(-6)
h_sol=A+B*t_sol+D*t_sol^2+E*t_sol^3+F*t_sol^4
End

"Entropy of the aqueous solution of sodium chloride"
Function s_sol(t_sol,c)
A=0.0012 +2.854*c -8.677*c^2 + 23.77*c^3-30.94*c^4
B=0.0154-0.0244*c+0.0686*c^2 -0.1232*c^3+0.0616*c^4
D=(-0.0295+0.1551*c-0.9586*c^2+2.541*c^3-2.078*c^4)*10^(-3)
E=(0.0738-0.9527*c+6.969*c^2-21.37*c^3+20.94*c^4)*10^(-6)
F=(-0.0982+2.104*c-16.89*c^2 +56.06*c^3-58.71*c^4)*10^(-9)
s_sol=(A+B*t_sol+D*t_sol^2+E*t_sol^3+F*t_sol^4)
End

"Entropy of the sodium chloride"
"Chase, M.W., Jr., NIST-JANAF Themochemical Tables, Fourth Edition, J. Phys. Chem. Ref. Data, Monograph 9, 1998, 1-1951."
Function s_nacl(t_sol)
A=50.72389
B=6.672267
Cx=-2.517167
D=10.15934
E=-0.200675
G=130.3973
s_nacl=(A*ln(t_sol/1000)+B*(t_sol/1000)+Cx*(t_sol/1000)^2/2+D*(t_sol/1000)^3/3-E/(2*(t_sol/1000)^2)+G)/58.44
End


"Liquid-phase evaporation"
Subprogram dropletsliquid(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0
,d_ad0_w,u_ad0,u_a,H,i,A_pipey,u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad,rh_a2
,m_e,dQ_w,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad,e_ad,g_a0
,g_a2,g_ad0,g_ad2)
"Modelling momentum exchange between atomised droplets and the air"
m_ad*du_ad/dtime=F_B+F_G+F_D+F_M+F_Basset
F_B+F_G+F_D+F_M+F_Basset=F
```

```
m_ad=4/3*3.1415926*(d_ad/2)^3*rho_ad
F_B=m_ad*rho_a*g/rho_ad
F_G=-m_ad*g
F_D=0.5*C_D*rho_a*3.1415926*(d_ad/2)^2*(u_a-u_ad)*Delta_u
Delta_u=abs(u_a-u_ad)
F_M=3.1415926*(d_ad/2)^2*rho_a*(u_a-u_ad)*dd_ad/dtime+2/3*3.1415926*(d_ad/2)^3*rho_a*du_ad/dtime
F_Basset=6*(d_ad/2)^2*(3.1415926*mu_a*rho_a)^0.5*du_ad/dtime*2*dtime^0.5
C_D=24*(1+18.5*Re_ad^3.6+(Re_ad/2)^11)^(1/30)/Re_ad+4*Re_ad^0.8/(2970+9*Re_ad^0.8)
Re_ad=rho_a*d_ad*Delta_u/mu_a
dd_ad=(d_ad2-d_ad0)
dtime*u_ad=dH
u_ad=(u_ad0+u_ad2)/2
dH=H/i
u_ad2=u_ad0+du_ad
rho_a=density(AirH2O,T=t_a,w=w_a,P=101.325)
rho_ad=rho_sol(t_ad,c_ad)
mu_a=viscosity(AirH2O,T=t_a,w=w_a,P=101.325)
g=9.81
d_ad=d_ad0
"Modelling mass transfer between atomised droplets and the air"
dm_ad=beta_1*4*3.1415926*(d_ad0/2)^2*rho_a_ad*(Y_a-Y_ad)*dtime
Y_a=w_a/(1+w_a)
Y_ad=w_ad/(1+w_ad)
w_ad=0.622*P_ad/(101.325-P_ad)
P_ad=p_sol(t_ad,c_ad)
rho_a_ad=density(AirH2O,T=t_ad,w=w_ad,P=101.325)
Sh_ad=beta_1*d_ad/D_ad_1
B_M=(Y_ad-Y_a)/(1-Y_ad)
Sh_ad=(1+B_M)^(-2/3)*(2+0.552*Re_ad^(1/2)*Sc_ad^(1/3))
Sc_ad=mu_a_ad/(D_ad_1*rho_a_ad)
mu_a_ad=viscosity(AirH2O,T=t_ad,w=w_ad,P=101.325)
D_ad_1=3.564*10^(-10)*(t_a+273.15+t_ad+273.15)^1.75
n_ad=m_w0*dtime/m_ad
m_d*(w_a0-w_a2)=n_ad*dm_ad/dtime
n_ad*dm_ad=(4/3*3.1415926*(d_ad2/2)^3-4/3*3.1415926*(d_ad0/2)^3)*rho_ad*n_ad
m_w2-m_w0=n_ad*dm_ad/dtime
c_ad=c_ad0
c_ad2=m_w0*c_ad0/m_w2
e_ad=1
"Modelling heat transfer between atomised droplets and the air"
m_d*h_a0+m_w0*h_ad0+dQ_w/dtime=m_d*h_a2+m_w2*h_ad2
h_a0=enthalpy(AirH2O,T=t_a0,w=w_a0,P=101.325)
h_a2=enthalpy(AirH2O,T=t_a2,w=w_a2,P=101.325)
h_ad0=h_sol(t_ad0,c_ad0)
h_ad2=h_sol(t_ad2,c_ad2)
dQ_w=alpha_wall*H/i*n_pipe*2*(l_channel+d_channel)*(t_wall-(t_a0+t_a2)/2)*dtime
dQ_w=lambda_wall*H/i*n_pipe*2*(l_channel+d_channel)*(t_wallout-t_wall)*dtime/d_wall
d_wall=0.001
lambda_wall=k_('Stainless_AISI316', t_wall)/1000
dQ_w/dtime=m_supply*(h_supply2-h_supply)
h_supply=Enthalpy(Water,T=t_supply,P=101.325)
t_supply2=Temperature(Water,h=h_supply2,P=101.325)
dQ_w=alpha_wallout*H/i*n_pipe*2*(l_channel+d_channel)*(t_supply-t_wallout)*dtime
1000*alpha_wallout*d_out/lambda_out=Nuwallout
d_out=4*((d_supply-2*d_wallo)*(l_channels-2*d_wallo)-(l_channel+2*d_wall)*(2*d_channel+2*d_wall)*n_pipe)/(2*(d_supply-2
*d_wallo+l_channels-2*d_wallo)+2*(l_channel+2*d_wall+d_channel+2*d_wall)*n_pipe)
Re_supply=rho_supply*u_supply*d_out/mu_supply
Nuwallout=1.86*(Re_supply*Pr_supply)^(1/3)*(d_out/H)^(1/3)*(mu_supply/mu_wall)^0.14
lambda_out=Conductivity(Water,T=t_supply,P=101.325)
rho_supply=Density(Water,T=t_supply,P=101.325)
```

```
mu_supply=Viscosity(Water,T=t_supply,P=101.325)
Pr_supply=Prandtl(Water,T=t_supply,P=101.325)
u_supply=L_supply/((d_supply-2*d_wallo)*(l_channels-2*d_wallo)-(l_channel+2*d_wall)*(d_channel+2*d_wall)*n_pipe)
d_wallo=0.002
l_channels=0.210
d_supply=0.24
L_supply=m_supply/1000
d_pipe=4*l_channel*d_channel/(2*(l_channel+d_channel))
1000*alpha_wall*d_pipe/lambda_a=Nuwall
Re_a=rho_a*u_a*d_pipe/mu_a
Nuwall=1.86*(Re_a*Pr_a)^(1/3)*(mu_a/mu_wall)^0.14/((H/d_pipe)^(1/3))
mu_wall=viscosity(AirH2O,T=t_wall,w=w_a,P=101.325)
dQ_ad=m_d*(h_a0-h_a2s)+dQ_w/dtime
dQ_ad=n_ad*4*3.1415926*(d_ad/2)^2*alpha_1*((t_a0+t_a2)/2-(t_ad0+t_ad2)/2)/1000
h_a2s=enthalpy(AirH2O,T=t_a2,w=w_a0,P=101.325)
h_ad=h_sol(t_ad,c_ad)
dQ_m=-n_ad*dm_ad*h_ad
Nuad=alpha_1*d_ad/lambda_a
lambda_a=conductivity(AirH2O,T=t_a,w=w_a,P=101.325)
lambda_ad=conductivity(water,T=t_ad,P=101.325)
Nuad=(1+B_T)^(-2/3)*(2+0.552*Re_ad^(1/2)*Pr_a^(1/3))
Pr_a=prandtl(Air,T=t_a)
B_T=Cp_ad*(t_a-t_ad)/La_v
h_adup=h_sol(t_ad+1,c_ad)
h_addown=h_sol(t_ad-1,c_ad)
Cp_ad=(h_adup-h_addown)/2
La_v=2501
t_ad=t_ad0
t_a=t_a0
w_a=w_a0
m_w=(m_w0+m_w2)/2
m_e=(m_w0-m_w2)*3600*1000
m_d*rho_a2=u_a2*A_pipey
rho_a2=density(AirH2O,T=t_a2,w=w_a2,P=101.325)
rh_a2=relhum(AirH2O,T=t_a2,w=w_a2,P=101.325)
d_ad2_w=d_ad2
Bi_ad=alpha_1*d_ad0/(lambda_ad*6)
Pe_ad=Re_ad*Sc_ad
s_a0=Entropy(AirH2O,T=t_a0,w=w_a0,P=101.325)
s_a2=Entropy(AirH2O,T=t_a2,w=w_a2,P=101.325)
s_vapor=Entropy(Steam,T=t_a2,P=p_vapor)
w_a2=0.622*p_vapor/(101.325-p_vapor)
s_ad0=s_sol(t_ad0,c_ad0)
s_ad2=s_sol(t_ad2,c_ad2)
dS_supply=dQ_w/((t_supply+273.15)*dtime)
dS=(m_d*s_a2+m_w2*s_ad2)-dS_supply-m_d*s_a0-m_w0*s_ad0
dS_a=(m_d*s_a2-m_d*s_a0)
dS_ad=(m_w2*s_ad2-m_w0*s_ad0)
g_a0=h_a0-(t_enviro+273.15)*s_a0
g_a2=h_a2-(t_enviro+273.15)*(s_a2)
g_ad0=h_ad0-(t_enviro+273.15)*s_ad0
g_ad2=h_ad2-(t_enviro+273.15)*s_ad2
End

"Droplet drying"
Subprogram dropletssolid(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0
,d_ad0_w,u_ad0,u_a,H,i,A_pipey,c_ad_sat,u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad
,rh_a2,m_e,dQ_w,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad
,e_ad,g_a0,g_a2,g_ad0,g_ad2)
"Modelling momentum exchange between atomised droplets and the air"
```

```
m_ad*du_ad/dtime=F_B+F_G+F_D+F_M+F_Basset
F_B+F_G+F_D+F_M+F_Basset=F
m_ad=4/3*3.1415926*(d_ad/2)^3*rho_ad
F_B=m_ad*rho_a*g/rho_ad
F_G=-m_ad*g
F_D=0.5*C_D*rho_a*3.1415926*(d_ad/2)^2*(u_a-u_ad)*Delta_u
Delta_u=abs(u_a-u_ad)
F_M=3.1415926*(d_ad/2)^2*rho_a*(u_a-u_ad)*dd_ad/dtime+2/3*3.1415926*(d_ad/2)^3*rho_a*du_ad/dtime
F_Basset=6*(d_ad/2)^2*(3.1415926*mu_a*rho_a)^0.5*du_ad/dtime*2*dtime^0.5
C_D=24*(1+18.5*Re_ad^3.6+(Re_ad/2)^11)^(1/30)/Re_ad+4*Re_ad^0.8/(2970+9*Re_ad^0.8)
Re_ad=rho_a*d_ad*Delta_u/mu_a
dd_ad=(d_ad2-d_ad0)
dtime*u_ad=dH
u_ad=(u_ad0+u_ad2)/2
dH=H/i
u_ad2=u_ad0+du_ad
rho_a=density(AirH2O,T=t_a,w=w_a,P=101.325)
rho_ad=rho_sol(t_ad,c_ad_sat)
mu_a=viscosity(AirH2O,T=t_a,w=w_a,P=101.325)
g=9.81
d_ad=d_ad0
dd_ad=0
"Modelling mass transfer between atomised droplets and the air"
dm_ad=beta_s*4*3.1415926*(d_ad_w/2)^2*rho_a_ad*(Y_a-Y_ad)*dtime
Y_a=w_a/(1+w_a)
Y_ad=w_ad/(1+w_ad)
w_ad=0.622*P_ad/(101.325-P_ad)
P_ad=p_sol(t_ad,c_ad_sat)
rho_a_ad=density(AirH2O,T=t_ad,w=w_ad,P=101.325)
beta_s=1/(d_ad/(Sh_ad*D_ad_1)+d_ad^2/(2*D_ad_1*e_ad^2)*(1/d_ad_w-1/d_ad))
e_ad=1-((m_w2*dtime*(c_ad2-c_ad_sat)/(1-c_ad_sat))/(4/3*3.1415926*(d_ad2/2)^3-4/3*3.1415926*(d_ad2_w/2)^3))/(2165*n_ad
)
B_M=(Y_ad-Y_a)/(1-Y_ad)
Sh_ad=(1+B_M)^(-2/3)*(2+0.552*Re_ad^(1/2)*Sc_ad^(1/3))
Sc_ad=mu_a_ad/(D_ad_1*rho_a_ad)
D_ad_1=3.564*10^(-10)*(t_a+273.15+t_ad+273.15)^1.75
mu_a_ad=viscosity(AirH2O,T=t_ad,w=w_ad,P=101.325)
n_ad=m_w0*(1-c_ad0)/(1-c_ad_sat)*dtime/m_ad0
m_ad0=4/3*3.1415926*(d_ad0_w/2)^3*rho_ad
m_d*(w_a0-w_a2)=n_ad*dm_ad/dtime
n_ad*dm_ad/(1-c_ad_sat)=(4/3*3.1415926*(d_ad2_w/2)^3-4/3*3.1415926*(d_ad0_w/2)^3)*rho_ad*n_ad
m_w2-m_w0=n_ad*dm_ad/dtime
d_ad_w=d_ad0_w
c_ad2=m_w0*c_ad0/m_w2
"Modelling heat transfer between atomised droplets and the air"
m_d*h_a0+m_w0*h_ad0+dQ_w/dtime=m_d*h_a2+m_w2*h_ad2
h_a0=enthalpy(AirH2O,T=t_a0,w=w_a0,P=101.325)
h_a2=enthalpy(AirH2O,T=t_a2,w=w_a2,P=101.325)
h_ad0=Cp_ad*t_ad0
h_ad2=Cp_ad*t_ad2
dQ_w=alpha_wall*H/i*n_pipe*2*(l_channel+d_channel)*(t_wall-(t_a0+t_a2)/2)*dtime
dQ_w=lambda_wall*H/i*n_pipe*2*(l_channel+d_channel)*(t_wallout-t_wall)*dtime/d_wall
d_wall=0.001
lambda_wall=k_('Stainless_AISI316', t_wall)/1000
dQ_w/dtime=m_supply*(h_supply2-h_supply)
h_supply=Enthalpy(Water,T=t_supply,P=101.325)
t_supply2=Temperature(Water,h=h_supply2,P=101.325)
dQ_w=alpha_wallout*H/i*n_pipe*2*(l_channel+d_channel)*(t_supply-t_wallout)*dtime
1000*alpha_wallout*d_out/lambda_out=Nuwallout
d_out=4*((d_supply-2*d_wallo)*(l_channels-2*d_wallo)-(l_channel+2*d_wall)*(2*d_channel+2*d_wall)*n_pipe)/(2*(d_supply-2
```

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*d_wallo+l_channels-2*d_wallo)+2*(l_channel+2*d_wall+d_channel+2*d_wall)*n_pipe)
Re_supply=rho_supply*u_supply*d_out/mu_supply
Nuwallout=1.86*(Re_supply*Pr_supply)^(1/3)*(d_out/H)^(1/3)*(mu_supply/mu_wall)^0.14
d_tot=0.325
lambda_out=Conductivity(Water,T=t_supply,P=101.325)
rho_supply=Density(Water,T=t_supply,P=101.325)
mu_supply=Viscosity(Water,T=t_supply,P=101.325)
Pr_supply=Prandtl(Water,T=t_supply,P=101.325)
u_supply=L_supply/((d_supply-2*d_wallo)*(l_channels-2*d_wallo)-(l_channel+2*d_wall)*(d_channel+2*d_wall)*n_pipe)
d_wallo=0.002
l_channels=0.210
d_supply=0.24
L_supply=m_supply/1000
d_pipe=4*l_channel*d_channel/(2*(l_channel+d_channel))
1000*alpha_wall*d_pipe/lambda_a=Nuwall
Re_a=rho_a*u_a*d_pipe/mu_a
Nuwall=1.86*(Re_a*Pr_a)^(1/3)*(mu_a/mu_wall)^0.14/((H/d_pipe)^(1/3))
mu_wall=viscosity(AirH2O,T=t_wall,w=w_a,P=101.325)
dQ_ad=m_d*(h_a0-h_a2s)+dQ_w/dtime
dQ_ad=n_ad*4*3.1415926*(d_ad/2)^2*alpha_s*(t_a0+t_a2-t_ad0-t_ad2)/2000
h_a2s=enthalpy(AirH2O,T=t_a2,w=w_a0,P=101.325)
h_ad=h_sol(t_ad,c_ad_sat)
dQ_m=-n_ad*dm_ad*h_ad
Nuad=alpha_s*d_ad/lambda_a
lambda_a=conductivity(AirH2O,T=t_a,w=w_a,P=101.325)
lambda_ad=conductivity(water,T=t_ad,P=101.325)
Nuad=(1+B_T)^(0.7)*(2+0.6*Re_ad^(1/2)*Pr_a^(1/3))
Pr_a=prandtl(Air,T=t_a)
B_T=Cp_ad*(t_a-t_ad)/La_v
h_adup=h_sol(t_ad+1,c_ad_sat)
h_addown=h_sol(t_ad-1,c_ad_sat)
Cp_ad_l=(h_adup-h_addown)/2
Cp_ad_s=0.864
Cp_ad=(Cp_ad_l*m_ad_l+m_ad_s*Cp_ad_s)/m_ad
m_ad_l+m_ad_s=m_ad
c_ad*m_ad=m_ad_s+m_ad_l*c_ad_sat
La_v=2501
m_w=(m_w0+m_w2)/2
m_e=(m_w0-m_w2)*3600*1000
c_ad=c_ad0
t_ad=t_ad0
t_a=t_a0
w_a=w_a0
m_d*rho_a2=u_a2*A_pipey
rho_a2=density(AirH2O,T=t_a2,w=w_a2,P=101.325)
rh_a2=relhum(AirH2O,T=t_a2,w=w_a2,P=101.325)
Bi_ad=alpha_s*d_ad0/(lambda_ad*6)
Pe_ad=Re_ad*Sc_ad
s_a0=Entropy(AirH2O,T=t_a0,w=w_a0,P=101.325)
s_a2=Entropy(AirH2O,T=t_a2,w=w_a2,P=101.325)
s_vapor=Entropy(Steam,T=t_a2,P=p_vapor)
w_a2=0.622*p_vapor/(101.325-p_vapor)
s_adsat0=s_sol(t_ad0,c_ad_sat)
s_adsat2=s_sol(t_ad2,c_ad_sat)
dS_supply=dQ_w/((t_supply+273.15)*dtime)
dS=((m_d)*s_a2-m_d*s_a0)-dS_supply+dS_ad
dS_a=((m_d)*s_a2-m_d*s_a0)
dS_ad=(m_w2*s_adsat2*(1-c_ad2)/(1-c_ad_sat)-m_w0*s_adsat0*(1-c_ad0)/(1-c_ad_sat))+((m_w2-m_w2*(1-c_ad2)/(1-c_ad_sat)
)*s_nacl2-(m_w0-m_w0*(1-c_ad0)/(1-c_ad_sat))*s_nacl0)
s_nacl0=s_nacl(t_ad0+273.15)
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```
s_nacl2=s_nacl(t_ad2+273.15)
s_ad0=s_adsat0*(1-c_ad0)/(1-c_ad_sat)+(1-(1-c_ad0)/(1-c_ad_sat))*s_nacl0
s_ad2=s_adsat2*(1-c_ad2)/(1-c_ad_sat)+(1-(1-c_ad2)/(1-c_ad_sat))*s_nacl2
g_a0=h_a0-(t_enviro+273.15)*s_a0
g_a2=h_a2-(t_enviro+273.15)*(s_a2)
g_ad0=h_ad0-(t_enviro+273.15)*s_ad0
g_ad2=h_ad2-(t_enviro+273.15)*s_ad2
End

"Drying completion"
Subprogram dropletsover(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0
,d_ad0_w,u_ad0,u_a,H,i,A_pipey,c_ad_sat,u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad
,rh_a2,m_e,dQ_w,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad
,e_ad,g_a0,g_a2,g_ad0,g_ad2)
"Modelling momentum exchange between atomised droplets and the air"
m_ad*du_ad/dtime=F_B+F_G+F_D+F_M+F_Basset
F_B+F_G+F_D+F_M+F_Basset=F
m_ad=4/3*3.1415926*(d_ad/2)^3*rho_ad
F_B=m_ad*rho_a*g/rho_ad
F_G=-m_ad*g
F_D=0.5*C_D*rho_a*3.1415926*(d_ad/2)^2*(u_a-u_ad)*Delta_u
Delta_u=abs(u_a-u_ad)
F_M=3.1415926*(d_ad/2)^2*rho_a*(u_a-u_ad)*dd_ad/dtime+2/3*3.1415926*(d_ad/2)^3*rho_a*du_ad/dtime
F_Basset=6*(d_ad/2)^2*(3.1415926*mu_a*rho_a)^0.5*du_ad/dtime*2*dtime^0.5
C_D=24*(1+18.5*Re_ad^3.6+(Re_ad/2)^11)^(1/30)/Re_ad+4*Re_ad^0.8/(2970+9*Re_ad^0.8)
Re_ad=rho_a*d_ad*Delta_u/mu_a
dd_ad=(d_ad2-d_ad0)
dtime*u_ad=dH
u_ad=(u_ad0+u_ad2)/2
dH=H/i
u_ad2=u_ad0+du_ad
rho_a=density(AirH2O,T=t_a,w=w_a,P=101.325)
rho_ad=rho_sol(t_ad,c_ad_sat)
mu_a=viscosity(AirH2O,T=t_a,w=w_a,P=101.325)
g=9.81
d_ad=d_ad0
dd_ad=0
"Modelling mass transfer between atomised droplets and the air"
dm_ad=0
w_ad=w_a
n_ad=m_w0*dtime/m_ad0
m_ad0=4/3*3.1415926*(d_ad0_w/2)^3*rho_ad
m_d*(w_a0-w_a2)=n_ad*dm_ad/dtime
n_ad*dm_ad=(4/3*3.1415926*(d_ad2_w/2)^3-4/3*3.1415926*(d_ad0_w/2)^3)*rho_ad*n_ad
D_ad_1=3.564*10^(-10)*(t_a+273.15+t_ad+273.15)^1.75
m_w2-m_w0=n_ad*dm_ad/dtime
d_ad0_w=d_ad_w
c_ad2=m_w0*c_ad0/m_w2
e_ad=0
"Modelling heat transfer between atomised droplets and the air"
m_d*h_a0+m_w0*h_ad0+dQ_w/dtime=m_d*h_a2+m_w2*h_ad2
h_a0=enthalpy(AirH2O,T=t_a0,w=w_a0,P=101.325)
h_a2=enthalpy(AirH2O,T=t_a2,w=w_a2,P=101.325)
h_ad0=Cp_ad*t_ad0
h_ad2=Cp_ad*t_ad2
dQ_w=alpha_wall*H/i*n_pipe*2*(l_channel+d_channel)*(t_wall-(t_a0+t_a2)/2)*dtime
dQ_w=lambda_wall*H/i*n_pipe*2*(l_channel+d_channel)*(t_wallout-t_wall)*dtime/d_wall
d_wall=0.001
lambda_wall=k_('Stainless_AISI316', t_wall)/1000
dQ_w/dtime=m_supply*(h_supply2-h_supply)
```

```
h_supply=Enthalpy(Water,T=t_supply,P=101.325)
t_supply2=Temperature(Water,h=h_supply2,P=101.325)
dQ_w=alpha_wallout*H/i*n_pipe*2*(l_channel+d_channel)*(t_supply-t_wallout)*dtime
1000*alpha_wallout*d_out/lambda_out=Nuwallout
d_out=4*((d_supply-2*d_wallo)*(l_channels-2*d_wallo)-(l_channel+2*d_wall)*(2*d_channel+2*d_wall)*n_pipe)/(2*(d_supply-2
*d_wallo+l_channels-2*d_wallo)+2*(l_channel+2*d_wall+d_channel+2*d_wall)*n_pipe)
Re_supply=rho_supply*u_supply*d_out/mu_supply
Nuwallout=1.86*(Re_supply*Pr_supply)^(1/3)*(d_out/H)^(1/3)*(mu_supply/mu_wall)^0.14
d_tot=0.325
lambda_out=Conductivity(Water,T=t_supply,P=101.325)
rho_supply=Density(Water,T=t_supply,P=101.325)
mu_supply=Viscosity(Water,T=t_supply,P=101.325)
Pr_supply=Prandtl(Water,T=t_supply,P=101.325)
u_supply=L_supply/((d_supply-2*d_wallo)*(l_channels-2*d_wallo)-(l_channel+2*d_wall)*(d_channel+2*d_wall)*n_pipe)
d_wallo=0.002
l_channels=0.210
d_supply=0.24
L_supply=m_supply/1000
d_pipe=4*l_channel*d_channel/(2*(l_channel+d_channel))
1000*alpha_wall*d_pipe/lambda_a=Nuwall
Re_a=rho_a*u_a*d_pipe/mu_a
Nuwall=1.86*(Re_a*Pr_a)^(1/3)*(mu_a/mu_wall)^0.14/((H/d_pipe)^(1/3))
mu_wall=viscosity(AirH2O,T=t_wall,w=w_a,P=101.325)
dQ_ad=m_d*(h_a0-h_a2s)+dQ_w/dtime
dQ_ad=n_ad*4*3.1415926*(d_ad/2)^2*alpha_s*(t_a0+t_a2-t_ad0-t_ad2)/2000
h_a2s=enthalpy(AirH2O,T=t_a2,w=w_a0,P=101.325)
h_ad=h_sol(t_ad,c_ad_sat)
dQ_m=-n_ad*dm_ad*h_ad
Nuad=alpha_s*d_ad/lambda_a
lambda_a=conductivity(AirH2O,T=t_a,w=w_a,P=101.325)
lambda_ad=conductivity(water,T=t_ad,P=101.325)
Nuad=(1+B_T)^(0.7)*(2+0.6*Re_ad^(1/2)*Pr_a^(1/3))
Pr_a=prandtl(Air,T=t_a)
B_T=Cp_ad*(t_a-t_ad)/La_v
h_adup=h_sol(t_ad+1,c_ad_sat)
h_addown=h_sol(t_ad-1,c_ad_sat)
Cp_ad_l=(h_adup-h_addown)/2
Cp_ad_s=0.864
Cp_ad=(Cp_ad_l*m_ad_l+m_ad_s*Cp_ad_s)/m_ad
m_ad_l+m_ad_s=m_ad
c_ad*m_ad=m_ad_s+m_ad_l*c_ad_sat
La_v=2501
m_w=(m_w0+m_w2)/2
m_e=(m_w0-m_w2)*3600*1000
c_ad=c_ad0
t_ad=t_ad0
t_a=t_a0
w_a=w_a0
m_d*rho_a2=u_a2*A_pipey
rho_a2=density(AirH2O,T=t_a2,w=w_a2,P=101.325)
rh_a2=relhum(AirH2O,T=t_a2,w=w_a2,P=101.325)
Bi_ad=alpha_s*d_ad0/(lambda_ad*6)
Pe_ad=0
s_a0=Entropy(AirH2O,T=t_a0,w=w_a0,P=101.325)
s_a2=Entropy(AirH2O,T=t_a2,w=w_a2,P=101.325)
s_ad0=s_nacl(t_ad0+273.15)
s_ad2=s_nacl(t_ad2+273.15)
"s_ad0=0.864*ln((t_ad0+273.15)/(25+273.15))+72.11/58.44
s_ad2=0.864*ln((t_ad2+273.15)/(25+273.15))+72.11/58.44"
dS_supply=dQ_w/((t_supply+273.15)*dtime)
```

```
dS=((m_d+m_w0-m_w2)*s_a2+m_w2*s_ad2)-dS_supply-m_d*s_a0-m_w0*s_ad0
dS_a=((m_d+m_w0-m_w2)*s_a2-m_d*s_a0)
dS_ad=(m_w2*s_ad2-m_w0*s_ad0)
s_ag2=Entropy(AirH2O,T=t_a2,w=w_a2,P=101.325)
g_a0=h_a0-(t_enviro+273.15)*s_a0
g_a2=h_a2-(t_enviro+273.15)*(s_a2)
g_ad0=h_ad0-(t_enviro+273.15)*s_ad0
g_ad2=h_ad2-(t_enviro+273.15)*s_ad2

End

"Code for determining droplet stage"
PROCEDURE droplets1(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0
,d_ad0_w,u_ad0,u_a,H,i,A_pipey:u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad,rh_a2
,c_ad_sat,m_e,dQ_w,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad
,e_ad,g_a0,g_a2,g_ad0,g_ad2)
c_ad_sat=0.2628+62.75*10^(-6)*t_ad0+1.084*10^(-6)*t_ad0^2
if (c_ad0<0.99995) then
Call dropletssolid(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0,d_ad0_w
,u_ad0,u_a,H,i,A_pipey,c_ad_sat,u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad,rh_a2
,m_e,dQ_w,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad,e_ad,g_a0
,g_a2,g_ad0,g_ad2)
else
Call dropletsover(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0,d_ad0_w
,u_ad0,u_a,H,i,A_pipey,c_ad_sat,u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad,rh_a2
,m_e,dQ_w,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad,e_ad,g_a0
,g_a2,g_ad0,g_ad2)
endif
end
"Integrated call procedure for control bodies of microelements"
PROCEDURE droplets(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0
,d_ad0_w,u_ad0,u_a,H,i,A_pipey:u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad,rh_a2
,c_ad_sat,m_e,dQ_w,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad
,e_ad,g_a0,g_a2,g_ad0,g_ad2)
c_ad_sat=0.2628+62.75*10^(-6)*t_ad0+1.084*10^(-6)*t_ad0^2
if (c_ad0>c_ad_sat) then
Call droplets1(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0,d_ad0_w,u_ad0
,u_a,H,i,A_pipey:u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad,rh_a2,c_ad_sat,m_e,dQ_w
,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad,e_ad,g_a0,g_a2
,g_ad0,g_ad2)
else
Call dropletsliquid(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0,d_ad0_w
,u_ad0,u_a,H,i,A_pipey,u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad,rh_a2,m_e,dQ_w
,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad,e_ad,g_a0,g_a2
,g_ad0,g_ad2)
endif
end

Call droplets(t_enviro,n_pipe,l_channel,d_channel,t_supply,t_a0,t_ad0,c_ad0,m_d,m_w0,m_supply,w_a0,d_ad0,d_ad0_w,u_ad0
,u_a,H,i,A_pipey:u_ad2,d_ad2,d_ad2_w,F,dtime,t_a2,w_a2,t_ad2,t_supply2,c_ad2,m_w2,n_ad,dm_ad,rh_a2,c_ad_sat,m_e,dQ_w
,t_wall,alpha_wallout,Re_supply,t_wallout,alpha_wall,Nuwall,w_ad,Bi_ad,Pe_ad,dS_supply,dS,dS_a,dS_ad,e_ad,g_a0,g_a2
,g_ad0,g_ad2)
s_vapor=Entropy(Steam,T=t_a2,P=P_vapor)
P_vapor=101.325*(w_a2/(1+w_a2))
S_vaporg=s_vapor*m_e/(3600*1000)
m_eg=abs(m_e)
dS_sep=-(s_vapor*m_e/(3600*1000)+dS_ad)
s_water=Entropy(Water,T=t_enviro,P=101.325)
s_nacl=s_nacl(t_enviro+273.15)
s_sol=s_sol(t_enviro,c_0)
```

```
dS_sep_sol=m_eg/((1-c_0)*(3600*1000))*(s_sol-s_nacl*c_0-(1-c_0)*s_water)

G_supply=dQ_w/dtime-(t_enviro+273.15)*dS_supply
deltaG=m_d*(g_a2-g_a0)+m_w2*g_ad2-m_w0*g_ad0-G_supply
deltaG_a=m_d*(g_a2-g_a0)
deltaG_ad=m_w2*g_ad2-m_w0*g_ad0

h_sol=h_sol(t_enviro,c_0)
h_nacl=Cp_nacl*t_a2
h_water=Enthalpy(Water,T=t_enviro,P=101.325)
g_sol=h_sol-(t_enviro+273.15)*s_sol
g_nacl=h_nacl-(t_enviro+273.15)*s_nacl
g_water=h_water-(t_enviro+273.15)*s_water
deltaG_sep_sol=m_eg/((1-c_0)*(3600*1000))*(g_sol-g_nacl*c_0-(1-c_0)*g_water)


"Boundary conditions"
"t_supply=61
t_a0=30.41
m_d=0.001223"
rh_0=0.9421
t_0=30.49
c_0=0.06
m_supply=0.663888889
w_0=humrat(AirH2O,T=t_0,R=rh_0,P=101.325)
rho_a0=density(AirH2O,T=t_a0,w=w_0,P=101.325)
m_d*rho_a0=u_a*A_pipey
H=0.6
i=60000
A_pipey=(n_pipe)*d_channel*l_channel
n_pipe=5
Cp_nacl=0.864
d_channel=0.01
l_channel=0.2
t_enviro=11.40833333


"Tabular output code for all control bodies of microelements"

"Initialisation code"
"d_ad0=d_adx
d_ad0_w=d_adx
d_adx=1*0.34*(8*3.1415926*sigma_adx/(rho_adx*f_v^2))^(1/3)
rho_adx=p_sol(t_ad0,c_ad0)
sigma_adx=sigma_water+1.46*c_ad0*rho_adx/58.44
sigma_water=SurfaceTension(Water,T=t_ad0)
f_v=2.4*10^6
t_ad0=15.39166667
c_ad0=0.06
m_w0=0.000029923
u_ad0=0.0001
w_a0=humrat(AirH2O,T=t_0,R=rh_0,P=101.325)"

"Table Iterative Calculation Code"
t_a0=Tablevalue (TableRun#-1,'t_a2')
t_supply=Tablevalue (TableRun#-1,'t_supply2')
d_ad0=Tablevalue (TableRun#-1,'d_ad2')
d_ad0_w=Tablevalue (TableRun#-1,'d_ad2_w')
t_ad0=Tablevalue (TableRun#-1,'t_ad2')
c_ad0=Tablevalue (TableRun#-1,'c_ad2')
```

```
m_w0=Tablevalue (TableRun#-1,'m_w2')
w_a0=Tablevalue (TableRun#-1,'w_a2')
u_ad0=Tablevalue (TableRun#-1,'u_ad2')
```