function P=pressure(flowrate, viscosity, ODH, N, rho)

% ODH= pore size of the SNU

% N= no of pores of the SNU

%rho=density of the liquid

%gamma=surface tension of the liquid

%L=thickness of the membrane

gamma=72E-3;

L=0.85E-6;

%qppore=flowrate through a single pore

%v =velocity of the liquid

%3.6=conversion of ml/hr to ul/sec

%1E-9=ul/s to m3/s

%ODH=in micrometers

%V=flowateperpore/area(m/s)

qppore=flowrate/N;

v=(qppore/3.6\*1E-9)/(pi\*((ODH\*1E-6/2)^2));

Pvis=(6\*viscosity\*pi\*(1+(16/3\*L)/(pi\*ODH\*1E-6)))\*v/(ODH\*1E-6);

Pkin=2.25\*0.5\*rho\*v^2;

P=(Pvis+Pkin)\*1E-5;

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% modified following Andreas Volk's latest modifications

% this code takes VOLUME fraction as input - try Andreas's code if you

% prefer mass fraction

% This version 20 Dec 2017.

function[rho,eta]=density\_viscosity\_glycerine\_mix(fraction\_glyc,T)

volume\_glycerol=fraction\_glyc;

volume\_water=1-fraction\_glyc;

% Calculations:

total\_volume=volume\_glycerol+volume\_water;

volume\_fraction=volume\_glycerol/total\_volume;

%density\_glycerol=1277-0.654\*T; % kg/m^3, equation 24

density\_glycerol=1273.3-0.6121\*T; % UPDATED following Andreas Volkâ€™s suggestion

density\_water=1000\*(1-((abs(T-3.98))/615)^1.71); % UPDATED following A.V.'s suggestion

mass\_glycerol=density\_glycerol\*volume\_glycerol; % kg

mass\_water=density\_water\*volume\_water; % kg

total\_mass=mass\_glycerol+mass\_water; % kg

mass\_fraction=mass\_glycerol/total\_mass;

viscosity\_glycerol=0.001\*12100\*exp((-1233+T)\*T/(9900+70\*T)); % equation 22. Note factor of 0.001 -> converts to Ns/m^2

viscosity\_water=0.001\*1.790\*exp((-1230-T)\*T/(36100+360\*T)); % equation 21. Again, note conversion to Ns/m^2

a=0.705-0.0017\*T;

b=(4.9+0.036\*T)\*a^2.5;

alpha=1-mass\_fraction+(a\*b\*mass\_fraction\*(1-mass\_fraction))/(a\*mass\_fraction+b\*(1-mass\_fraction));

A=log(viscosity\_water/viscosity\_glycerol); % Note this is NATURAL LOG (ln), not base 10.

viscosity\_mix=viscosity\_glycerol\*exp(A\*alpha); % Ns/m^2, equation 6

% Andreas Volk polynomial:

c=1.78E-6\*T.^2-1.82E-4\*T+1.41E-2;

contraction=1+(c.\*sin((mass\_fraction).^1.31.\*pi).^0.81);

density\_mix=(density\_glycerol\*fraction\_glyc+density\_water\*(1-fraction\_glyc))\*contraction; % equation 25

eta=viscosity\_mix;

rho=density\_mix;

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P=pressure(10,0.01,2,85,1000);

[rho,eta]=density\_viscosity\_glycerine\_mix(0.5,25);

T=20

N=85

ODH=2

plt.close()

testbaseflows=range(10,20,2)

#testbaseflows=[10]

colors\_w=plt.cm.copper(np.linspace(0,1,len(testbaseflows)))

colors=plt.cm.spring(np.linspace(0,1,len(testbaseflows)))

fig, ax = plt.subplots()

for i,baseflow in enumerate(testbaseflows):

glycflow=np.linspace(0.5,20)\*baseflow

[rhoW,etaW]=density\_viscosity\_glycerine\_mix(0,T)

[rhoG,etaG]=density\_viscosity\_glycerine\_mix(glycflow/(glycflow+baseflow),T)

Pw=pressure((glycflow+baseflow),etaW,ODH,N,rhoW)

Pmix=pressure((baseflow),etaG,ODH,N,rhoG)

ax.plot(glycflow/baseflow,Pmix,color=colors\_w[i],label=str(baseflow)+' ml/h')

ax.plot(glycflow/baseflow,Pw,'--',color=colors\_w[i],label=str(baseflow)+' ml/h')