**Task 1 Valve closing**

Free backflow speed: 

The outlet pressure will be near atmospheric.

When the valve is closing, this implies de-acceleration of the fluid: 

**a) When the shutdown has just begun**

Once the shutdown has just begun, speed and friction losses will be about as before, but the speed de-accelerates: a = 1.11 m/s2.

Pressure change due to the de-acceleration: 

Press upstream of shut-off valve: 

**b) Just before the valve is closed**

De-acceleration as before, but the speed will now be small and the friction therefore negligible. Pressure difference due to height difference and de-acceleration: . Pressure upstream at shut-off valve: 

**c) Pressure change while closing the valve**

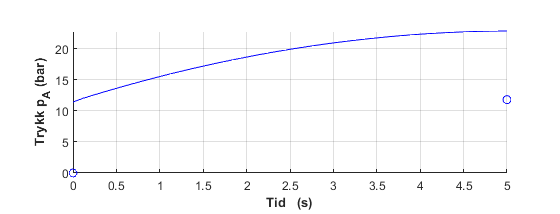
Transient equation (7), compressibility neglected: 

Speed ​​Reduction: 

Thus, during the shutdown, the speed changes: 



The script calculates pressure change from the equation above, plotted



**Script**

clf

clear

disp('---------------------Øving 3---------------')

% gitte data

pB=2e5;

d=0.2;

rho=1000;

vis=1e-3;

g=9.81;

eps=0.046/1000;

h=100;

L=1000;

gx=g\*h/L;

disp(' ')

Q=15000/86400; % Fri strømning tilbake -

vi=Q/(pi\*d^2/4);

delt=5;

a=-vi/delt;

f=0.015; % initiell friksjonsfaktor

n=50;

t=linspace(0,5,n);

i=1;

v(i)=vi;

pA(i)=pB+(rho\*(gx-a)-0.5\*f\*rho/d\*v(i)^2)\*L;

for i=2:n

v(i)=vi+a\*t(i);

Re=rho\*v(i)\*d/vis;

af=-1.8\*log10((eps/3.7/d)^1.11+6.9/Re);

f=1/af^2;

pA(i)=pB+(rho\*(gx-a)-0.5\*f\*rho/d\*v(i)^2)\*L;

end

pA1=0;

pAn=pB+rho\*g\*h;

subplot(2,1,1)

hold on

plot(t,pA\*1e-5,'b')

plot(t(1),pA1\*1e-5,'bo')

plot(t(n),pAn\*1e-5,'bo')

hold off

grid

xlabel('\bfTid (s)')

ylabel('\bfTrykk p\_A (bar)')

subplot(2,1,2)

plot(t,v)

grid

xlabel('\bfTid (s)')

ylabel('\bfFart (m/s)')

**Task 2**

**a) One, or 2-phase flow**

Producing gas/oil ratio: 250

Gas solubility predicted : Rs = 212 (script attached)

Rt> Rs 🡪All gas cannot be dissolved in oil, the flow consists of oil and free gas

**b) Densities**

Gas phase: 

Liquid phase: 

Mixture average: 

**c) Superficial velocities**

Cross-sectional area: 





Total : vm = vsg + vsl = 3.16m / s

**d) Gradient**



(About 70 % of static water gradient)

**Script: ( in addition z-factor script given in compendium)**

% Exercise 2.2

clear

% Gitt

p=307e5; % downhole pressure

T=90+273; % temperature

gg=0.7;

go=0.84;

%

p0=1.01e5; % reference pressure

T0=273+15; % reference temperature

% gass

Mg=gg\*28.97;

rhg0=p0\*Mg/(8314\*T0);

[ z ] = zfakgg( p,T,gg,0.8 );

rhg=p\*Mg/(z\*8314\*T)

Bg = rhg0/rhg ;

% Olje

Rs= 0.0059\*gg\*(10^(2.14/go))\*(10^(-0.00198\*T))\*(0.797e-5\*p +1.4)^1.205

Bo = 0.9759 + 0.952e-3\*((gg/go)^0.5\*Rs+0.401\*T-103.)^1.2

rho=(1000\*go+rhg0\*Rs)/Bo;

% flow

d=0.1;

qo=1194/86400;

Rt=250;

A=pi\*d^2/4;

Qo=qo\*Bo;

Qg=qo\*(Rt-Rs)\*Bg;

vsg=Qg/A

vso=Qo/A

vm=vsg+vso

rhm=(rhg\*vsg+rho\*vso)/vm

% pressure gradient

g=9.81;

L=2500;

D=3000;

fm=0.02;

gx=g\*D/L;

dpdx=rhm\*gx+0.5\*fm\*rhm/d\*vm^2