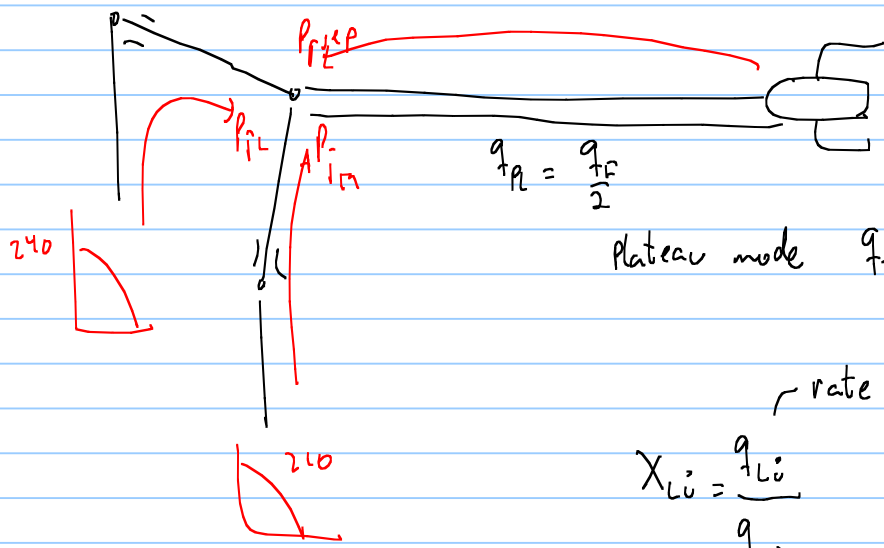
Problem 2 : Comments



q_{Fi} → field rate at 2009

→ 10E6 Sm³/d

$q_{fR} = \frac{q_{tF}}{2}$

Plateau mode $q_{TG} = 10$ E6 Sm³/d

$X_{Li} = \frac{q_{Li}}{q_{Fi}}$ ← rate of template L at initial time

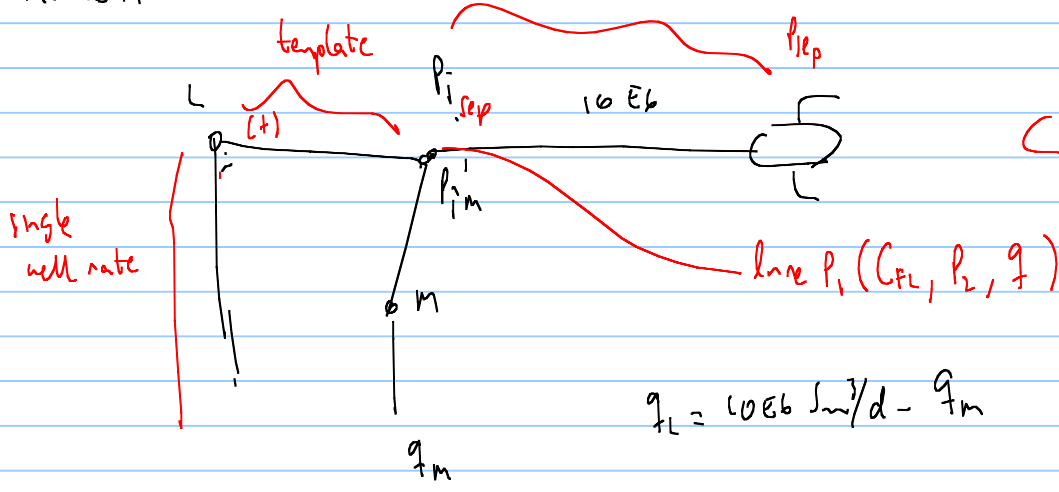
$X_{mi} = \frac{q_{mi}}{q_{Fi}}$ → rate of template m at initial time

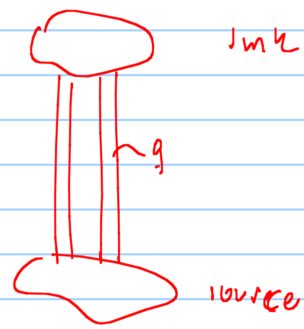
well rates

$q_L = \frac{10E6 \cdot X_{Li}}{N_{well\,L}} =$

$q_m = \frac{10E6 \cdot X_{mi}}{N_{wells\,m}} =$

Procedure when deltapchoke of one template <0

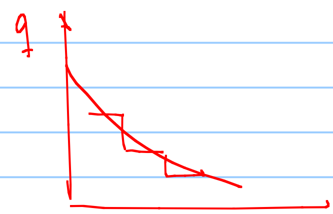




$q_L = 10E6$ Sm³/d $- q_m$

time	q_L	q_m	$\Delta p_{choke\,L}$	$\Delta p_{choke\,m}$
0				
1				
2				
⋮				
→ 6	q_L^*	q_m^*	(+)	(−)

• explicit coupling :



• implicit coupling

explicit coupling with small time step (months) $\underset{\text{same results as}}{\overset{\text{gives the}}{\approx}}$ implicit

b; P_{Rm}, P_{RL} $\rightsquigarrow$ run open choke network simulation $\sim q_F$) 10E6 Sm³/d

$\rightsquigarrow$ calculate the split factors X_m^i X_{Li}

→ calculate template rates at each time step.

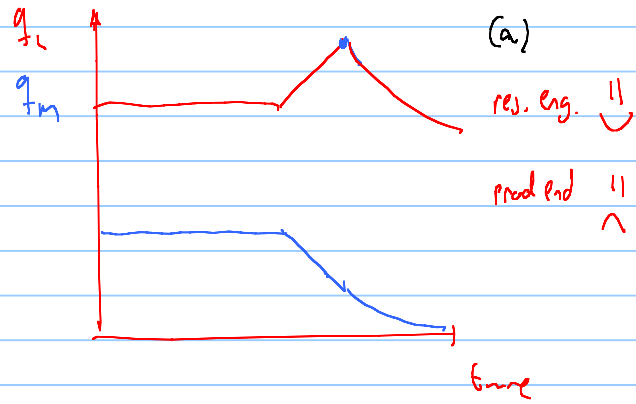
time

0

1

2

3

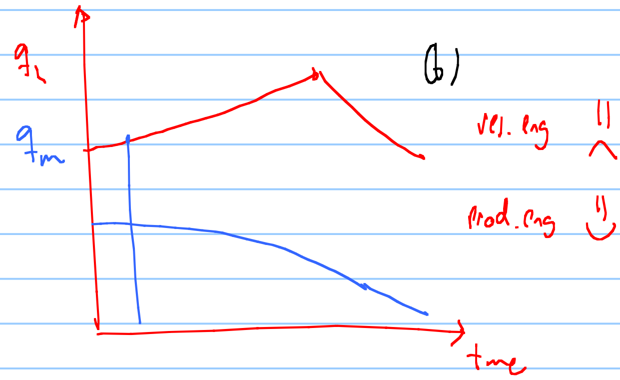


$IPR_{well} = f(G_p)$

$q_{well_{pot}} = f(G_p)$

in real life

$q_{wellpot} = f(G_p, q_{wel}(t))$

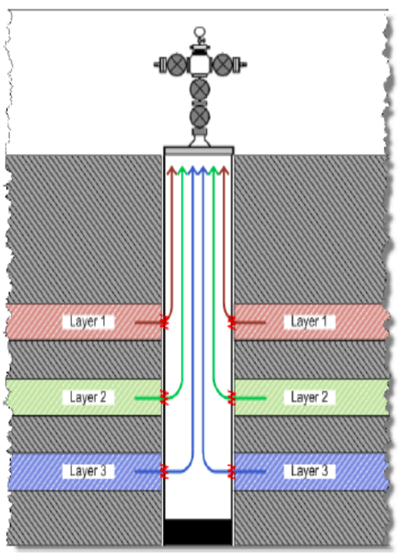


Problem 3

$$q_1 + q_2 + q_3 = C_{T_1, wh}\left(\frac{P_{wf_1}^2}{e^{S_3}} - P_{wh}^2\right)^{0.5}$$

$$q_2 + q_3 = C_{T_{21}}\left(\frac{P_{wf_2}^2}{e^{S_2}} - P_{wf_1}^2\right)^{0.5}$$

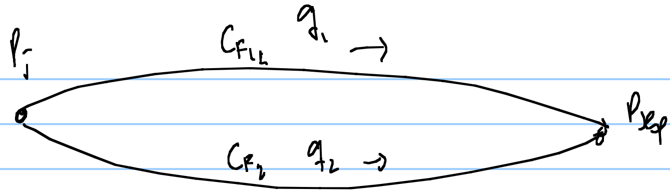
$$q_3 = C_{T_{23}}\left(\frac{P_{wf_3}^2}{e^{S_1}} - P_{wf_2}^2\right)^{0.5}$$



$\sim C_{R_1}(P_{R_1}^2 - P_{wf_1}^2)^n = q_1$

$\sim C_{R_2}(P_{R_2}^2 - P_{wf_2}^2)^n = q_2$

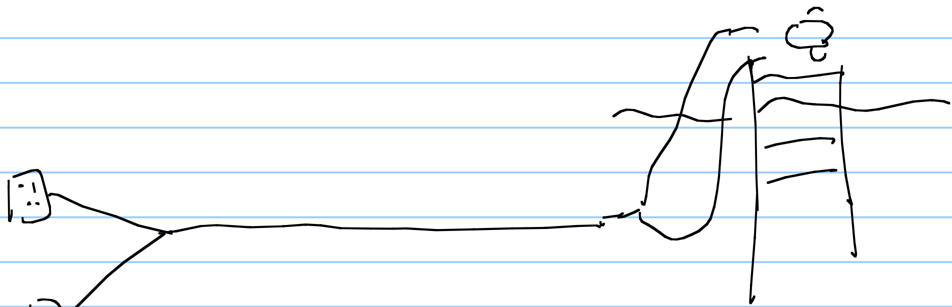
$\sim C_{R_3}(P_{R_3}^2 - P_{wf_3}^2)^n = q_3$



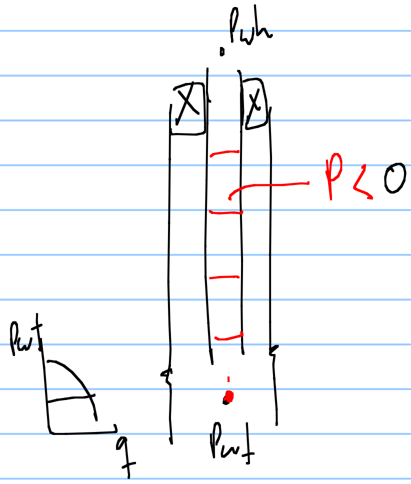
$$q_1 = C_{FL_1}\left(P_j^2 - P_{sep}^2\right)^{0.5} \qquad q_1 = q_2$$

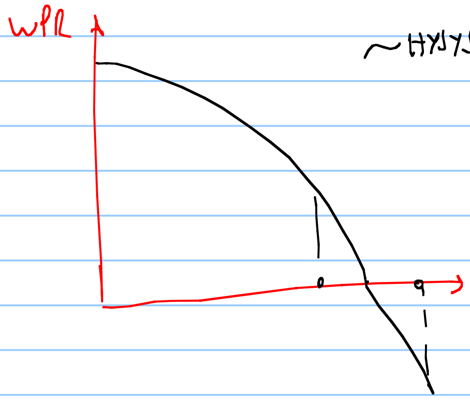
$$q_2 = C_{FL_2}\left(P_j^2 - P_{sep}^2\right)^{0.5} \qquad C_{FL_1} = C_{FL_2}$$

$$\cancel{2}\left(\frac{q_T}{2}\right) = \cancel{2}\, C_{FL}\left(P_j^2 - P_{sep}^2\right)^{0.5}$$



Unstable rate splitting on risers.





~HYSYS

$$\rho_m = H_L \rho_L + (1-H_L)\rho_g$$

dP =

$$-\frac{dp}{dL} = \frac{2}{d} f_{TP(F)}\,\rho_{TP}\, v_{TP}^2 + \rho_{TP}\, g \sin\theta + \rho_{TP}\, v_{TP}\frac{dv_{TP}}{dL},$$

How to match field measured pressure drop data to a mechanistic model:

Stick constants in your pressure drop expressions (equations) and tune the constants to the data!

→ point model

Multiphase Toolkit

File Edit Tools Help

Phases 2-phase | Flow Model OLGA | Input Mode Manual, Sup. Vel.

I/O Data

Input:

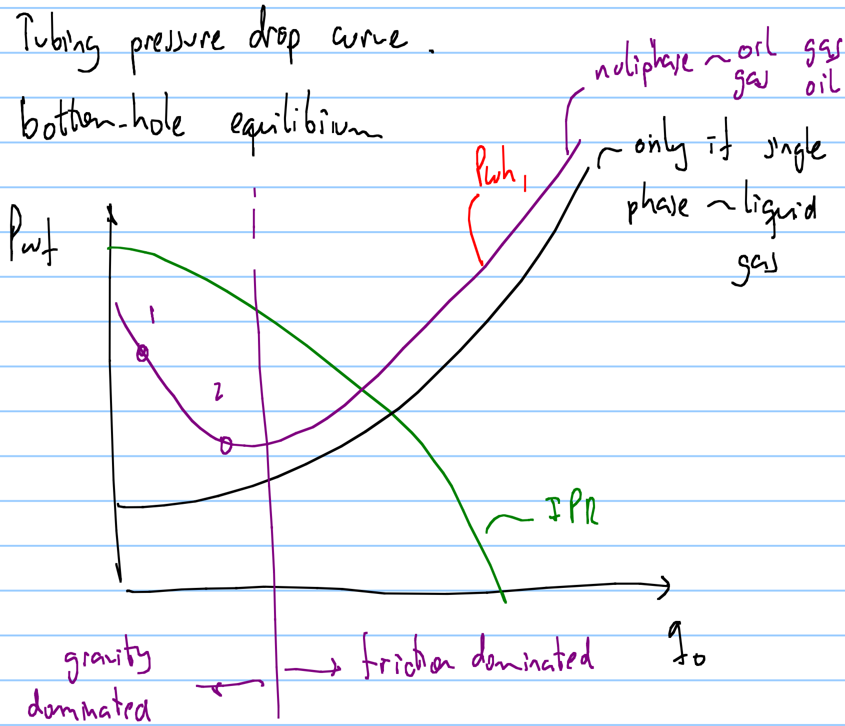
	hness	Pipeline Length [m]	Pressure [Pa]	Superficial Gas Velocity [m/s]	Superficial Oil/Liquid Velocity [m/s]	Gas Density [kg/m3]	Oil/Liquid Density [kg/m3]	Gas Viscosity [N-s/m2]	Oil/Liquid Viscosity [N-s/m2]	Oil/Gas Surface Tension [N/m]
		10	2000000	0.02	1.5	117	500	1E-05	0.001	0.008
*										

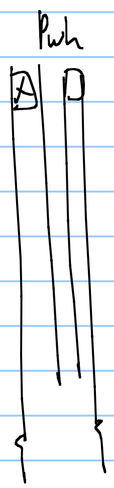
Output:

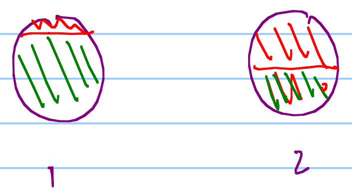
	Case #	Volfraction, Total Liquid [-]	Pressure Gradient, Total [Pa/m]	Pressure Gradient, Frictional Part [Pa/m]	Total Pressure Drop [Pa]	Wall Shear Stress, Gas [Pa]	Wall Shear Stress, Oil Film [Pa]	Flow Regimes, Gas/Liquid	Pressure Gradient, Gravitational Part [Pa/m]	Volfraction, Total Gas [-]
▸	1	0.987936636727...	-4949.11881968...	-89.4436500723...	49491.18819685...	0	2.683309502170...	4	-4859.67516961...	0.0120633632

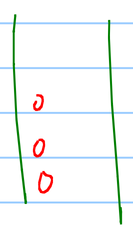
0 -> Stratified smooth
1 -> Stratified wavy
2 -> Annular
3 -> Slug flow
4 -> Bubble flow
5 -> Two-phase oil/water
6 -> Single phase gas
7 -> Single phase oil
8 -> Single phase water

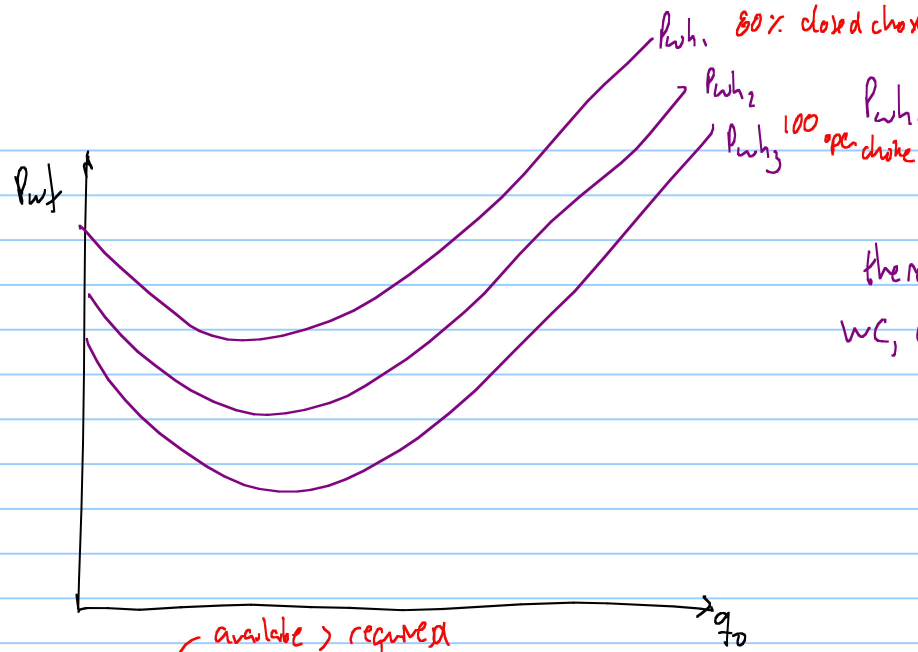
Tubing pressure drop curve.
bottom-hole equilibrium











$P_{wh_1} > P_{wh_2} > P_{wh_3}$

there is also a change with WC, GOR.