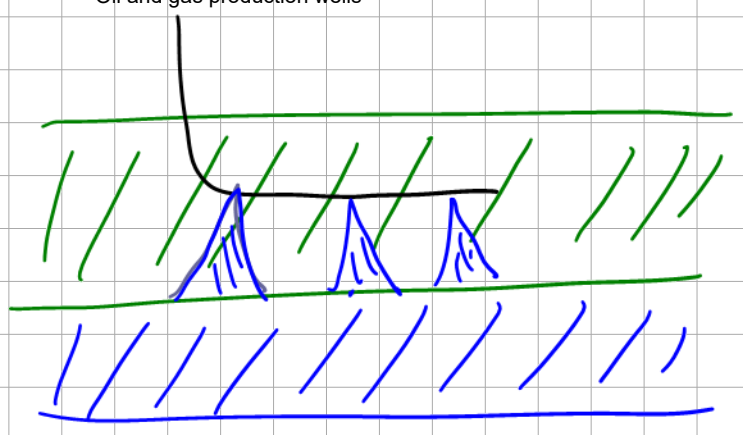
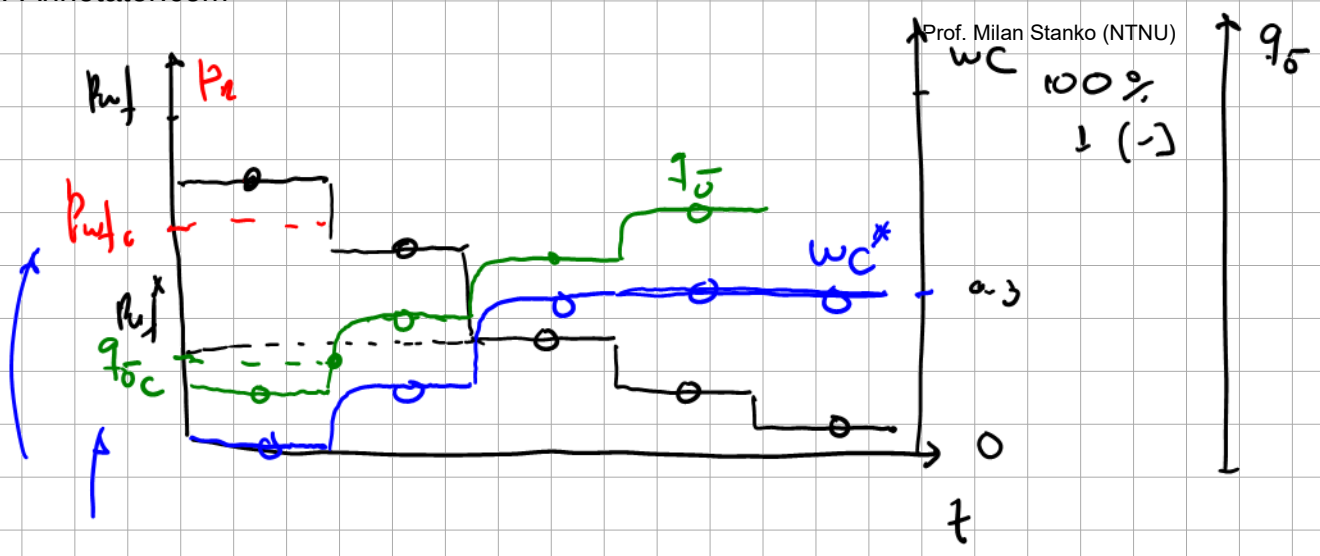
Prof. Milan Stanko (NTNU)

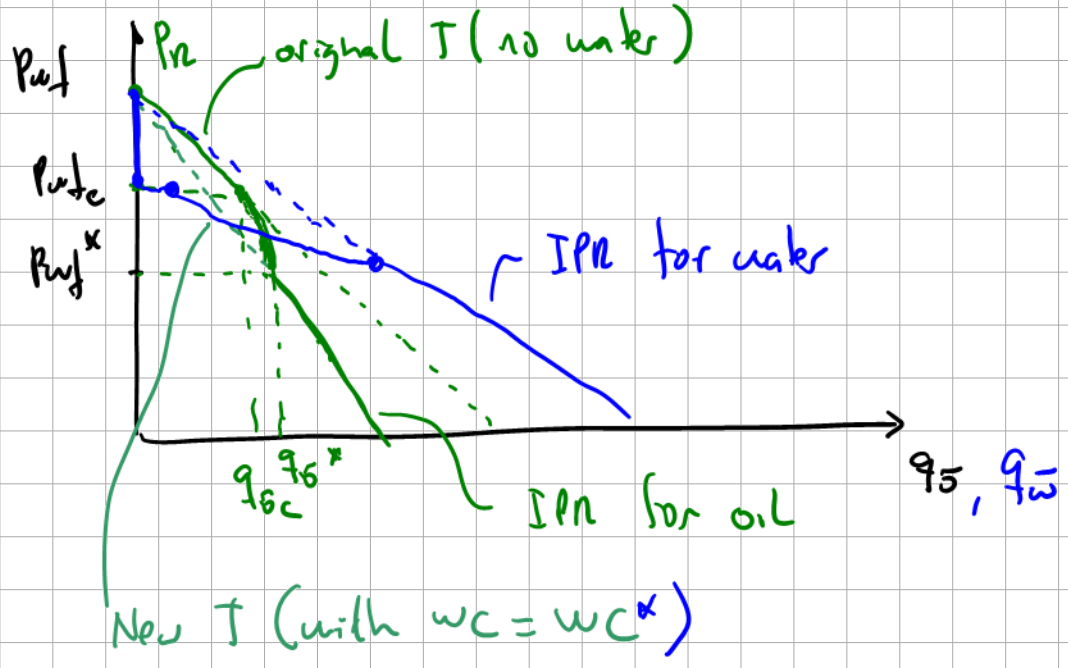
Oil and gas production wells





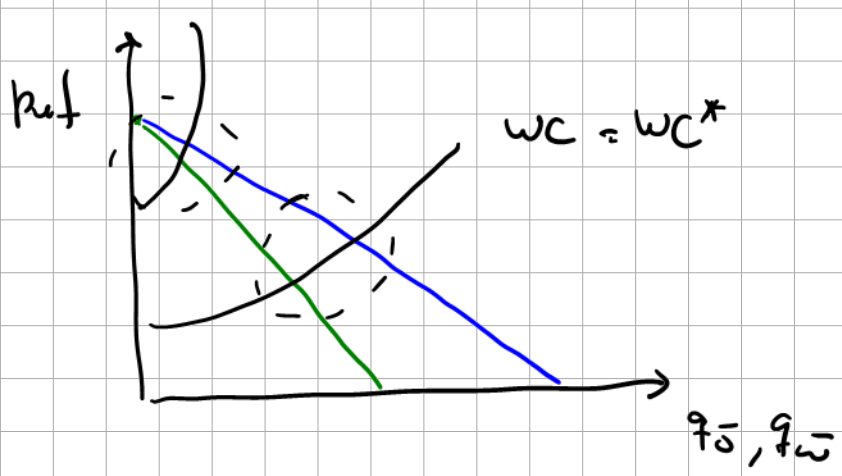
$q_o < q_{oc}$ $p_{wf_c} < p_{wf}$ ⇝ no coning

$q_o \geq q_{oc}$ $p_{wf_c} \geq p_{wf}$ ⇝ coning



in many cases q_{oc} is very small

q_o^* is very small



Example: one model for water coning from the literature:

Experimental Investigation of Cresting and Critical Flow Rate of Horizontal Wells

Tove Aulie, Evert Grødal, Harald Asheim, Norwegian Inst. of Technology, and Piet Oudeman, Koninklijke/Shell E&P Laboratorium

ABSTRACT

Cresting towards horizontal wells with bottom water drive and edge water drive has been experimentally investigated using a

$$h_o(x)^2 - h_e^2 + \frac{q_o}{\lambda_o \Delta\rho g D}\left(\frac{D}{2} - x\right)^2 = 0 \qquad (1)$$

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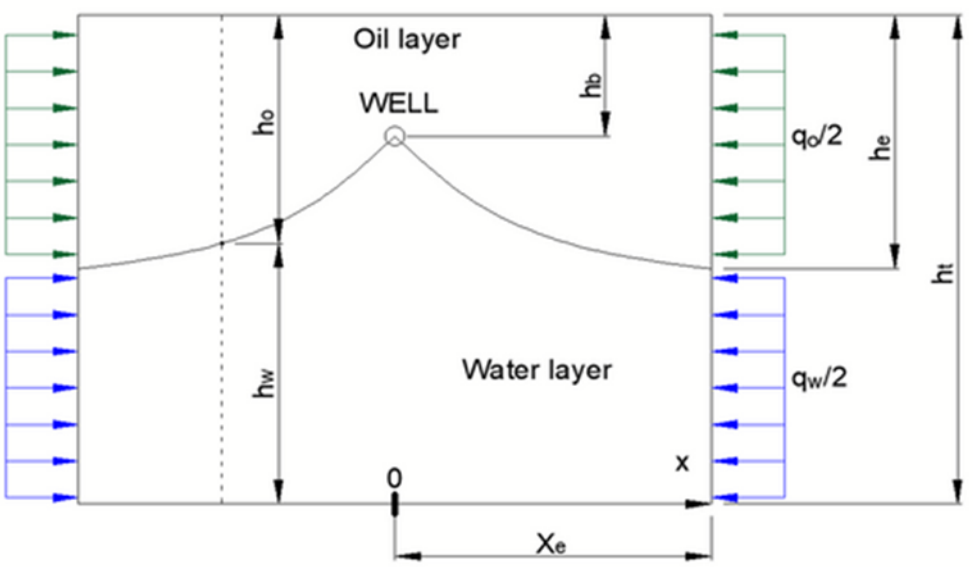
Total layer height, ht (oil plus water)	[m]	50
Initial water layer height, hw (ht-he)	[m]	10
Initial oil layer height, ho (he)	[m]	40
Horizontal distance from well to outer boundary, xe	[m]	300
Vertical distance between well and top of reservoir, hb	[m]	5
Horizontal permeability, k	[md]	100
Oil viscosity	[cp]	1.0
water viscosity	[cp]	0.6
Oil mobility	[md/cp]	100.0
water mobility	[md/cp]	166.7
Oil density	[kg/m^3]	800
Water density	[kg/m^3]	1024
Oil Bo	[m3/Sm3]	1.0
Water Bw	[m3/Sm3]	1.0
Well length, L, [m]	[m]	500
Critical oil flow to start producing water, qoc (ho=hb@x=0)	[Sm3/d]	49.19
Mobility ratio M (o/w)	[-]	0.6
upper limit of f (qw/qo)	[-]	0.42
upper limit for WC	[%]	29.4
deltaf (qw/qo) - for plotting	[-]	0.014

f (qw/qo)	WC	qo/qoc
[-]	[%]	[-]
0.00	0	1.0
0.01	1	1.0



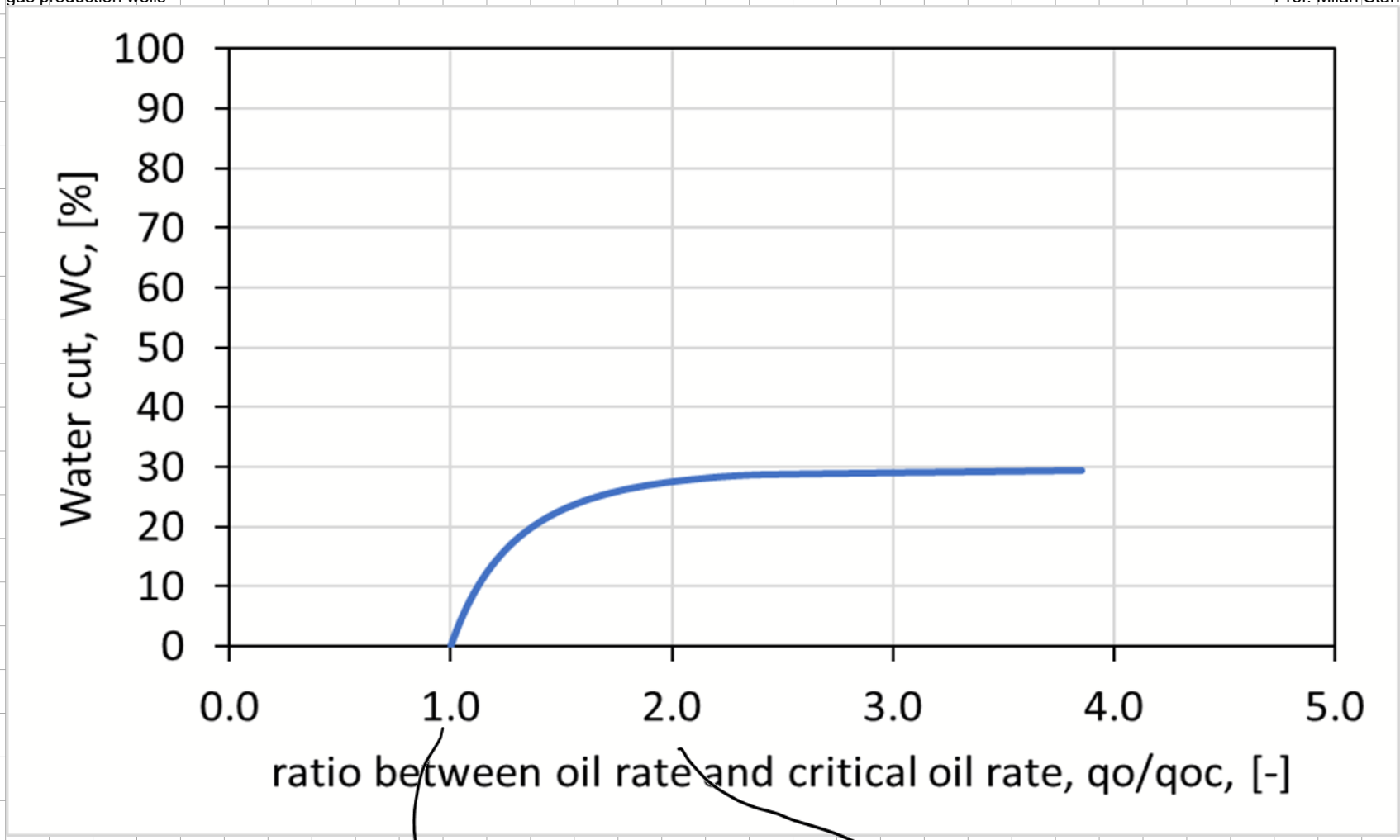
ASSUMPTIONS:

***Steady state flow, the oil and water volumetric flows in their layers**

***Dupuis-Forchheim assumption: the flow towards the well is primari**

***Capillary pressure is neglected**

$$q_{\bar{o}c} = \frac{(\rho_w - \rho_o) \cdot g \cdot \lambda_o \cdot \left(h_e{}^2 - h_b{}^2\right) \cdot L}{x_e \cdot B_o}$$



Ca 50 Sm³/d

Ca. 100 Sm³/d