Fluid Flow in Porous Media
Spring Semester 2013-2014 / Final Exam
(Open Book Exam)
(time : 3 hours)

Date : Sun. 15 /06/ 2014

Problem 1 *(20 marks)*

A). *An oil well is producing at a constant flow rate of 200 STB /day from a center of 40 acre circular–pattern, the pressure decline rate was constant during the production period. The reservoir and fluid properties are as follows:*

$\phi = 0.2$ $\quad h = 15\ ft$ $\quad k = 60\ md$ $\quad \mu_o = 1.5\ cp$

$C_t = 15 \times 10^{-6}\ psi^{-1}$ $\quad r_w = 0.25\ ft$ $\quad \beta_o = 1.4\ bbl/STB$

$P_i = 4500\ psi$

Determine :

1). *The pressure decline rate , dp/dt.*

2). *Average well drainage area pressure when the bottom-hole flowing pressure is 4192 psi, assume no damage around the wellbore.*

3). *If the well damaged out and the flow rate decreased to100 STB/day. Find the additional pressure drop due that damage around the wellbore (Δp_{skin}) and the skin factor.*

4). *When did this well end transient flow period. ?*

5). *Flowing bottom- hole pressure after 100 hrs using the pseudosteady state flow straight line equation, assuming q_o = 200 STB/d.*

B). *The general Darcy' s equation for pseudosteady state flow conditions takes the following form :*

$$q = \frac{kh\,(P - Pwf)}{162.6\ B\,u\,[log(2.2458A/CA\,rw) + 0.87\,s]}$$

By assuming a circular reservoir shape with a drainage radius r_e , then verify that the previous equation will be ;

$$q = \frac{0.00708\,k\,h\,(P - Pwf)}{B\,u\,[ln\left(\frac{re}{rw}\right) - 0.75 + s\,]}$$

Problem 2

A). *An oil well drilled in a field with uniform 40-acre square drilling pattern has produced for 10 days with a constant pressure decline of 48 psi/day. The gas-oil ratio has been constant during the production. The well was damaged out due to build-up test analysis and skin factor estimated to be 2.43. The flowing bottom-hole and average reservoir pressures are 1123&1603 psia respectively. The reservoir data are as follows :*

$\phi = 0.1$ $\quad h = 40\ ft$ $\quad \mu_o = 2.0\ cp$

$C_t = 10 \times 10^{-6}\ psi^{-1}$ $\quad r_w = 4.0\ in.$ $\quad \beta_o = 1.31\ bbl/STB$

Estimate: *(9 marks)*

a). *effective permeability.* ***b).*** *pressure drop due to well damage.*

c). *flow efficiency .*

B). *A well is opened to flow at 150 STB/day for 24 hours. The flow rate is then increased to 360 STB/day and lasts for another 24 hours. The well flow rate is then reduced to 310 STB/day for 16 hours. Calculate the pressure drop in the well due to the changing of the flow rate, and the sand face pressure. The pertinent reservoir rock and fluid data are:* *(8 marks)*

$\varphi = 15\%$ $h = 20\ ft$ $k = 100\ md$ $\mu_o = 2\ cp$

$\beta_o = 1.2\ bbl/STB$ $r_w = 0.25\ ft$ $C_t = 12\times10^{-6}\ psi^{-1}$ $P_i = 3000\ psi$

C). *Estimate the flow efficiency using the following data:* *(3 marks)*

$\beta_o = 1.226\ bbl/STB$ $\mu_o = 3.75\ cp$ $k = 19.1\ md$

$h = 67\ ft$ $r_w = 0.3\ ft$ $p_{wf} = 2309\ psi$

$P_{avg} = 3137\ psi$ $q_o = 105\ STB/d$ $s = 8.2$

Problem 3

A). *A gas well is producing at 7 mm scf/day under unsteady state flow conditions . The following reservoir fluid and rock properties are given :*

$k = 20\ md$ $h = 40\ ft$ $\varphi = 0.16$

$p_i = 2000\ psia$ $T = 580^\circ R$ $\gamma_g = 0.759$

$r_w = 0.399\ ft$ $\mu_g = 0.052\ cp$ $z = 0.850$

$T_{sc} = 520^\circ R$ $P_{sc} = 14.7\ psia.$ $S_g = 0.73$

Calculate the flowing bottom-hole pressure after a flowing time of 24 hours, using pressure approximation method , assuming no exists. *(12 marks)*

B). *If gas flow rate has recorded against apparent skin factor as follows:*

q_g mmscf/day	S'
5	7
10	11
20	19

Calculate *(8 marks)*

1). the true skin factor" S", and

2). turbulent factor"D".

3). Apparent skin factor" S' " if q_g =15 mmscf/d

Good Luck

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