جامعة مصراتة — كلية الهندسة

خريف 2015/2014 — القسم : هندسة النفط

الامتحان النهائي لمقرر :سريان الموائع في الأوساط المسامية(423) الزمن : 3 ساعات

تاريخ الامتحان :الخميس الموافق 2015/03/19 — أستاذ المادة : أحمد مصطفى بادي

أسم الطالب :

(open Book Exam)

Problem 1

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

$$Q = \frac{kh(\bar{p} - p_{wf})}{162.6B\mu \log(2.2458A/C_A r_w^2)}$$

By assuming a circular reservoir shape with a drainage radius r_e , verify that the previous equation will be ; *(5 marks)*

$$Q = \frac{0.00708kh(\bar{p} - p_{wf})}{B\mu[\ln(r_e/r_w) - 0.75]}$$

B). *An oil well is producing from the center of 40 acre square drilling pattern . The reservoir rock and fluid properties are: :*

$\phi = 20\%$	$h = 15$ ft.	$k = 60$ md	$S = 5$
$\mu_o = 1.5$ cp	$\beta_o = 1.4$ bbl/STB	$r_w = 0.25$ ft.	
$P_{avg.} = 2000$ psia	$P_{wf} = 1000$ psia	$C_t = 15 \times 10^{-6}$ psi^{-1}	

Assuming pseudo-steady state flow , calculate *(15 marks)*

a). *the oil flow rate.*

b). *the pressure decline rate .*

c). *make an equation to join between P_{wf} in psi and time t in hours, assuming $P_i = 3500$ psia*

d). *additional pressure drop around the wellbore due to skin .*

e). *When did this well end transient flow period, " t_{eia} " ?*

Problem 2

A). *If undamaged reservoir permeability is 100 md. And wellbore damage radius is 10 ft. that reduces the permeability to 10 md. The well radius is 0.25 ft, while the well drainage radius is 1000 ft.* *(5 marks)*

a). *What is the average permeability of the well drainage area ?*

b). *What is the skin factor?*

B). *Consider an oil reservoir producing under unsteady state flow conditions the equation used in the case of dimensionless pressure method when $t_D > 100$ would be: $P_{wf} = P_i - (141.2\ q_o \mu_o \beta_o / k h) \times P_D$*

From this equation verify the following transient straight line equation :

$$p_{wf} = p_i - \frac{162.6Q_oB_o\mu}{kh}\left[\log\left(\frac{kt}{\phi\mu c_t r_w^2}\right) - 3.23 + 0.87s\right]$$

(5 marks)

C). 1. *Diffusivity equation of steady-state flow conditions is ……* *(10 marks)*

2. *If a reservoir is undersatured , then : q_o =…… q_w = …. q_g = ……. in terms of relative permeabilities.*

3. *If $q_o = 0.001$ res.m^3/sec , then q_o = …… bbl /day .*

4. *For an infinite –acting reservoir when t_D is greater than 100 , then prove that : $P_D = 1.1515\ [\log t_D + 0.351]$.*

5. *In the transient flow (unsteady state flow) , the straight line equation is …… .*

Problem 3

A). *the equation of the pseudosteady state flow of a compressible fluid is :*

$$P_r^2 - P_{wf}^2 = 1422 \frac{q_g \mu_g z T}{k h} [\ ln\ (r_e / r_w) - 0.75 + s + D q_g\ ]$$

Re-arrange this equation to take the following form :

$P_r^2 - P_{wf}^2 = a\, q_g + b\, q_g^2$, *and find ;* *(5 marks)*

$a =$ ……

$b =$ ……

B). *a gas well with a wellbore radius of 0.333 ft is producing at a constant flow rate of 2000 mscf/day under transient flow conditions. The rock and fluid properties are :*

$K = 65$ md	$h = 15$ ft	$\varphi = 0.15$	$P_i = 4400$ psia
$T = 140\ ^oF$	$\mu_g = 0.02831$ cp	$z = 0.896$	$C_t = 3.0\times10^{-4}$ psi^{-1}

Calculate, at 1.5 hours: *(15 marks)*

a). *dimensionless pseudopressure " ψ_D ".*

b). *flowing bottom-hole pressure by using approximation pressure method.*

c). *$\psi(P_{wf})$ if $\psi(P_i) = 1089\times10^6$ psi^2/cp " pseudopressure method. "*

Good Luck

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