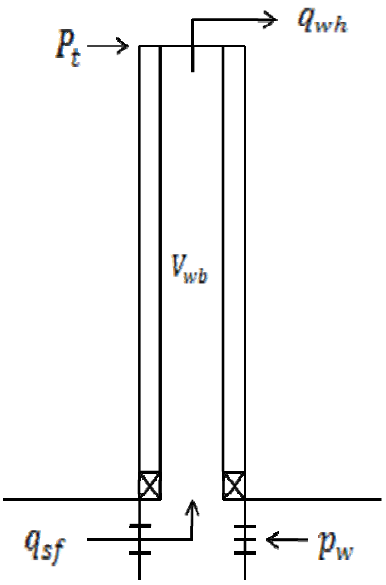
Problem 1- Consider a wellbore with volume of V_{wb}(cubic feet) that contains gas as a single phase fluid ,this well produces gas with constant surface flowrate q_{wh}(scf/day),and wellbore flowing pressure, P_w .



a) Develop a mathematical relationship between surface flowrate (q_{wh}) and sandface flowrate, q_{sf} (scf /day).
b) Define wellbore storage constant, C_s, in terms of compressibility of the gas in the wellbore (C_g) and volume of the wellbore (V_{wb}) then rewrite final formula versus it.
c) Rewrite final equation in terms of dimensionless parameters:

$$P_D = \frac{0.00708kh(p_i - p)}{q\mu B}$$

$$t_D = \frac{0.000264kt}{\emptyset\mu c r_w^2}$$

Problem 2-Consider an infinitely large oil reservoir (transient flow) with constant surface production rate ($q_{wh} = const$).

a) Specify required conditions (B.C and I.C) for solution of radial diffusivity equation. (**Assumption: we have no wellbore storage)
b) Transform diffusivity equation and its boundary and initial conditions into dimensionless form. (**Assumption: we have no wellbore storage)

$$P_D = \frac{0.00708kh(p_i - p)}{q\mu B}$$

$$t_D = \frac{0.000264kt}{\emptyset\mu c r_w^2}$$

$$r_D = \frac{r}{r_w}, r_{eD} = \frac{r_e}{r_w}$$

c) Reformulate required conditions (B.C and I.C) for solution of radial diffusivity equation when we have wellbore storage.
d) Modify Ideal solution of radial diffusivity equation when we have skin and wellbore storage.
[Hint: Ideal solution: $P_D = f(t_D, r_D, r_{eD})$
Non-Ideal solution: $P_{wD} = g(p_D, t_D, r_D, r_{eD}, c_D, s)$
C_D =Dimensionless wellbore storage constant
S =Skin factor
Just show the relationship between $P_D$and P_{wD}]

Notes:

1- Bring all steps involved in solution procedure of problems clearly.
2- Use engineering assumption/knowledge whenever required.
3- Clarify/simplify the results.

GOOD LUCK!

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