Drain-area formation pressure @model

Average reservoir pressure over the drainage volume V_e:

(1) $$p_r = \frac{1}{V_e} \iiint_{A_e} p(x,y,z)dV$$

For the Steady State Radial Flow in finite reservoir the relationship between Boundary-average formation pressure p_e and Drainarea formation pressure p_r is going to be:

(2) $$p_r = p_i - \frac{q_t}{4\pi\sigma}$$

(3) $$V_e = \pi r_e^2 h, \quad dV = 2\pi r\, h dr$$

(4) $$p_r = \frac{1}{V_e} \int p(r)dV = \frac{2}{r_e^2} \int p(r)\, r\, dr$$

For the Steady State Radial Flow in finite reservoir the reservoir pressure is going to be:

(5) $$p(t,r) = p_e(t) + \frac{q_t}{2\pi\sigma} \ln \frac{r}{r_e} = p_i + \frac{q_t}{2\pi\sigma} \ln \frac{r}{r_e}$$

and substituting the above to (4) and integrating:

(6) $$p_r = \frac{2}{r_e^2} \int \left[p_i + \frac{q_t}{2\pi\sigma} \ln \frac{r}{r_e} \right] r\, dr = p_i - \frac{q_t}{4\pi\sigma}$$

For the Pseudo-Steady State Radial Flow in finite reservoir the relationship between Boundary-average formation pressure p_e and Drainarea formation pressure p_r is going to be:

(7) $$p_r(t) = p_e(t) - 0.75 \cdot \frac{q_t}{2\pi\sigma}$$

(8) $$V_e = \pi r_e^2 h, \quad dV = 2\pi r\, h dr$$

(9) $$p_r = \frac{1}{V_e} \int p(r)dV = \frac{2}{r_e^2} \int p(r)\, r\, dr$$

For the Pseudo-Steady State Radial Flow in finite reservoir the reservoir pressure is going to be:

(10) $$p(r) = p_i + \frac{q_t}{4\pi\sigma} \left[2 \ln \frac{r}{r_e} - \frac{r^2}{r_e^2} \right]$$

and substituting the above to (4) and integrating:

(11) $$p_r(t) = \frac{2}{r_e^2} \int \left[p_e(t) + \frac{q_t}{4\pi\sigma} \left[2 \ln \frac{r}{r_e} - \frac{r^2}{r_e^2} \right] \right] r\, dr = p_i - 0.75 \cdot \frac{q_t}{2\pi\sigma}$$

See Also

Petroleum Industry / Upstream / Production / Subsurface Production / Well & Reservoir Management / Formation pressure (Pe)

Subsurface E&P Disciplines / Production Technology

[Reservoir pressure] [Initial formation pressure, P_i] [Drilled formation pressure, P_d] [Startup formation pressure, P_0] [Multiphase formation pressure]