PET-342E Reservoir Engineering-I
Ö.İ.Türeyen
Homework#1
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İTÜ

Given: 18 Feb 2008
Due : 25 Feb 2008

Problem-1 (40 points)
The definition of isothermal compressibility of a porous media is given as:

$$c_r = \frac{1}{\phi}\left(\frac{d\phi}{dp}\right)_T$$

Similarly the thermal expansion coefficient of a porous media is given as:

$$\beta_r = \frac{1}{\phi}\left(\frac{d\phi}{dT}\right)_p$$

Show that the porosity at any given pressure and temperature can be computed using the following equation:

$$\phi(p,T) = \phi(p_r,T_r)e^{c_r(p-p_r)-\beta_r(T-T_r)}$$

where p_r and T_r are any reference pressure and temperature.

Problem-2 (30 points)
The isothermal compressibility of water is given as:

$$c_w = -\frac{1}{V}\left(\frac{dV}{dp}\right)_T$$

The thermal expansion coefficient of water is given as:

$$\beta_w = \frac{1}{V}\left(\frac{dV}{dT}\right)_p$$

Assume that we have a liter of water in a completely closed container at p=1bar and T=40°C. Assume that the container is strong enough to withstand any pressure. If the temperature of the water was to be raised to T=80°C, *approximate* what the pressure would become inside the container. You can assume that the water has a constant compressibility of $c_w=4.5\times10^{-5}$ bar^{-1}, and that the thermal expansion coefficient is $\beta_w=5.2\times10^{-4}$ 1/°C . Although the thermal expansion coefficient changes considerably with temperature, you can assume it is constant for this problem.

Problem-3 (30 points)
The aim of this exercise is to give you an idea about how much oil we can produce under 1 psi pressure difference only from expansion as the drive mechanism. Assume that the oil is slightly compressible and that the compressibility is $c_o=8\times10^{-5}$ psi^{-1}. For the following two cases *approximate* the amount of recovery:

a-) Assume that there is 1 bbl of fluid. How much production would we gain from 1 psi pressure drop?
b-) Assume that there is 600 MMbbl of fluid. How much production would we gain from 1 psi pressure drop?