

Pressure Control Homework

Data

Depth 12,125'	Hole size 7 7/8"	Drill Pipe 4 1/2"
6" Drill Collars 1000'		
P_a 600 psi	P_{dp} 400 psi	Pit Gain 21 bbls
Mud 9.8 #/gal	T_{sur} 70F	Temp Grad 1.5F/100'

Bottom hole to be maintained 100 psi over reservoir pressure

Calculate @ the Casing seat 4500' and at the surface

Find h

$$h = \text{Pit gain} * C_a \quad h = 21 \times 39.6 \quad h = 832' \text{ or } 835'$$

Find P_b

$$P_b = P_{dp} + D\rho_m \quad P_b = 400 + 12125 \cdot .51 = 6580 \text{ psi}$$

$$P_b \text{ for operations } P_b = 100 + 6580 = 6680$$

Find P_f For this use reservoir pressure.

$$P_a = P_b - (D - h)\rho_m - P_f \quad P_f = P_b - (D - h)\rho_m - P_a$$

$$P_f = 6580 - (12125 - 835) \cdot .51 - 600 \quad P_f = 222 \text{ psi}$$

Pressure @ casing seat 4500'

$$A = P_b - (D - X)\rho - P_f \quad A = 6680 - (12125 - 4500) \cdot .51 - 222$$

$$A = 2570 \text{ psi}$$

$$P_x = \frac{A}{2} + \left[\frac{A^2}{4} + \frac{P_b \rho_m z T h_b}{z T_b} \right]^{.5} \quad P_{4545} = \frac{2570}{2} + \left[\frac{2520^2}{4} + \frac{6680 \cdot .51 \cdot 595 \cdot 835}{710} \right]^{.5}$$

$$P_{4500} = 3442 \text{ psi}$$

$$h_{4500} = \frac{6680 \cdot 595 \cdot 835}{3442 \cdot 710}$$

$$h_{4500} = 1358 \text{ ft}$$

$$P_{a4500} = P_{4500} - X\rho_m$$

$$P_{a4500} = 3442 - 4500 \cdot .51 = 1147 \text{ psi}$$

Pressure @ surface

$$A = 6680 - (12125 - 0) \cdot .51 - 222$$

$$A = 275 \text{ psi}$$

$$P_{sur} = \frac{275}{2} + \left[\frac{275^2}{4} + \frac{6680 \cdot .51 \cdot 530 \cdot 835}{710} \right]^{.5} \quad P_{sur} = 1600 \text{ psi}$$

$$h_{sur} = \frac{6680 \cdot 530 \cdot 835}{1600 \cdot 710} \quad h_{sur} = 2600 \text{ ft}$$

$$P_{4500sur} = (4500 - 2600) \cdot .51 + 222 + 1600 \quad P_{4500sur} = 2790 \text{ psi}$$

$$P_b = 2790 + (12125 - 4500) \cdot .51 = 6680 \text{ psi}$$

Pressures with weighted mud

$$\text{Mud required } MW = P_b / .052 \cdot TD \quad 10.6 = 6680 / .052 \cdot 12125$$

$$D^* = 170 \text{ bbl} / .0406 \text{ bbl} / \text{ft} = 4187 \text{ ft} \quad \text{Drill pipe capacity } 170 \text{ bbls}$$

Pressures @ 4500'

$$A = P_b - (D - X)\rho_{m1} - P_f + D^*(\rho_{m1} - \rho_m)$$

$$A = 6680 - (12125 - 4500) \cdot .55 - 222 + 4187 \cdot (.55 - .51)$$

$$A = 2431 \text{ psi}$$

$$P_x = \frac{A}{2} + \left[\frac{A^2}{4} + \frac{P_b \rho_{m1} z T h_b}{z T_b} \right]^{.5} \quad P_{4500} = \frac{2430}{2} + \left[\frac{2430^2}{4} + \frac{6680 \cdot .55 \cdot 595 \cdot 835}{710} \right]^{.5}$$

$$P_{4500} = 3225 \text{ psi}$$

$$h_{4500} = \frac{6680 \cdot 595 \cdot 835}{3225 \cdot 710} \quad h_{4500} = 1450 \text{ ft}$$

$$P_{a4500} = P_{4500} - X\rho_m$$

$$P_{a4500} = 3225 - 4500 \cdot .51 = 930 \text{ psi}$$

Pressure @ surface

$$A = 6680 - (12125 - 0) \cdot 55 - 222 + 4187 \cdot (.55 - .51)$$

$$A = -43 \text{ psi}$$

$$P_{sur} = \frac{-43}{2} + \left[\frac{-43^2}{4} + \frac{6680 \cdot .55 \cdot 530 \cdot 835}{710} \right]^{.5}$$

$$P_{sur} = 1490 \text{ psi}$$

$$h_{sur} = \frac{6680 \cdot 530 \cdot 835}{1490 \cdot 710}$$

$$h_{sur} = 2795 \text{ ft}$$

$$P_{4500sur} = (4500 - 2795) \cdot 51 + 222 + 1490$$

$$P_{4500sur} = 2580 \text{ psi}$$

$$P_b = 1490 + 4187 \cdot .51 + (12125 - 4187 - 2795) \cdot 55 + 222 = 6680 \text{ psi}$$

Drill Pipe Schedule

P_{cir} 500 psi Kill Rate 3 BPM @ 30 SPM

Initial Pump Pressure

$$P_{PI} = P_{cir} + P_{dp} + 100 = 1000 \text{ psi}$$

Final Pump Pressure

$$P_{PF} = P_{PI} \cdot MW_n / MW_o = 1000 \cdot 10.6 / 9.8 = 541 \text{ psi}$$

Time to reach bit

$$Time = TD \cdot C_{dp} / PR = 12125 \cdot .014 / 3 = 57 \text{ min}$$

$$Strokes = Rate \cdot Time = 30 \cdot 57 = 1710$$