Pressure BUILDUP Behavior — Schematic History Plot: Blasingame (324 Notes)
Pressure BUILDUP Behavior — Schematic HORNER Plot: Blasingame (324 Notes)

\[ \Delta t (hr) \]

\[ m = P_2 - P_1 \]

\[ P^* (p = p_i \text{ in an infinite system}) \]

\[ ETR = \text{Wellbore Storage} \]
\[ MTR = \text{Radial Flow} \]
\[ LTR = \text{Boundary Effects} \]

\[ \frac{P_{ws, 1/hr}}{P_{ws}} \]

\[ \frac{tp + 1}{1} \]

\[ \frac{tp + \Delta t}{\Delta t} \]
Pressure BUILDUP Behavior — Schematic MDH Plot: Blasingame (324 Notes)

- \( P_{ws} \) (psia)
- \( m = P_2 - P_1 \)
- \( P_1 \)
- \( P_2 \)
- \( p \) estimate
- ETR = Wellbore Storage
- NTR = Radial Flow
- LTR = Boundary Effects

\[ \Delta t \text{ (hr)} \]

\[ 10^{-1} \quad 10^0 \quad 10^1 \quad 10^2 \quad 10^3 \]
Pressure BUILDUP Behavior — Semilog Plot: Matthews and Russell


$p_{wf} = 3534$
Pressure BUILDUP Behavior — Various Plots: Earlougher

**Plot Inventory:**
- History (or Strip) Plot.
- Log-Log Plot.
- Semilog Plot.

**History Plot:**

**Log-Log Plot:**

**Semilog Plot:**
Plot Inventory:
- Semilog Plot.
- Schematic "Modified Muskat" Plot.
- Example "Modified Muskat" Plot.

Semilog Plot:

Example "Modified Muskat" Plot:
**Constant Rate Pressure BUILDUP Behavior — Flow Equations:**

**Transient RADIAL Flow BUILDUP Relations:**

**Horner Equation**

\[ p_{ws} = p_i - 162.6 \frac{qB\mu}{kh} \log \left( \frac{tp + \Delta t}{\Delta t} \right) \]

\[ = p_i - m_{rf} \log \left( \frac{tp + \Delta t}{\Delta t} \right) \]

**Agarwal Equation**

\[ p_{ws} = p_{wf} (\Delta t = 0) + 162.6 \frac{qB\mu}{kh} \log \left( \frac{tp\Delta t}{tp + \Delta t} \right) + 162.6 \frac{qB\mu}{kh} \left[ \log \left( \frac{k}{\phi \mu c_t r_w^2} \right) - 3.2275 + 0.8686s \right] \]

\[ = p_{wf} (\Delta t = 0) + 162.6 \frac{qB\mu}{kh} \log[\Delta t_e] + 162.6 \frac{qB\mu}{kh} \left[ \log \left( \frac{k}{\phi \mu c_t r_w^2} \right) - 3.2275 + 0.8686s \right] \]

where \( \Delta t_e = \frac{tp\Delta t}{tp + \Delta t} = \frac{\Delta t}{1 + \frac{\Delta t}{tp}} \)

**Miller - Dyes - Huchinson (MDH) Equation**

\[ p_{ws} = p_{wf} (\Delta t = 0) + 162.6 \frac{qB\mu}{kh} \log[\Delta t] + 162.6 \frac{qB\mu}{kh} \left[ \log \left( \frac{k}{\phi \mu c_t r_w^2} \right) - 3.2275 + 0.8686s \right] \]

**Pressure Buildup Equation for Developed Reservoirs:**

**Arps - Smith - Muskat Equations**

\[ p_{ws} = \bar{p} - a \exp(-b\Delta t) \quad \text{(Muskat Equation)} \]

\[ p_{ws} = \bar{p} - \frac{1}{b} \frac{d}{\Delta t} p_{ws} \quad \text{(Arps - Smith Equation)} \]
Average Reservoir Pressure — Example: Matthews and Russell/Earlougher

\[ p_{ws} = \bar{p} - a \exp(-b\Delta t) \]

\[ p_{ws} = \bar{p} - \frac{1}{b \Delta t} \frac{d}{P_{WS}} \]
Pressure BUILDUP Behavior — Schematic Diagrams: Matthews and Russell

- IDEAL — Sec. 3.1
- SKIN AND/OR WELL FILLUP — Sec. 3.2, 3.6
- DEEP PENETRATING HYDRAULIC FRACTURE — Sec. 10.5
- BOUNDARY (one well in a bounded reservoir) — Sec. 3.3
- INTERFERENCE (multiple wells in a bounded reservoir) — Sec. 7.2
- PHASE SEPARATION IN TUBING — Sec. 3.6
- FAULT OR NEARBY BOUNDARY — Sec. 10.1
- STRATIFIED LAYERS OR FRACTURES WITH TIGHT MATRIX — Sec. 10.3, 10.4
- LATERAL INCREASE IN MOBILITY — Sec. 10.2