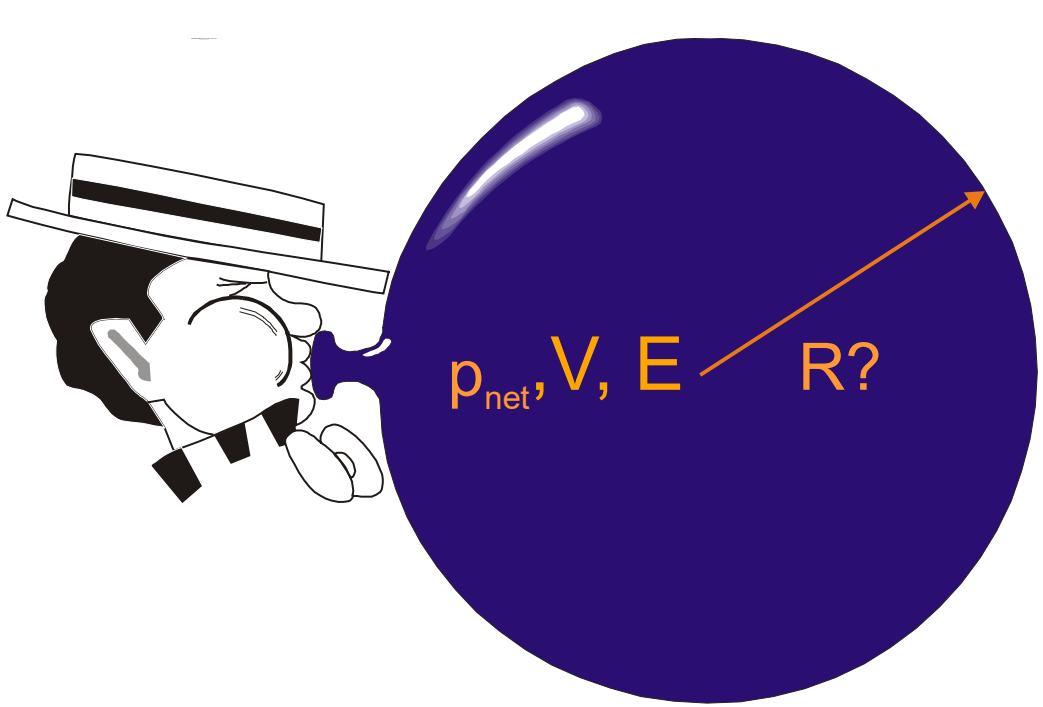
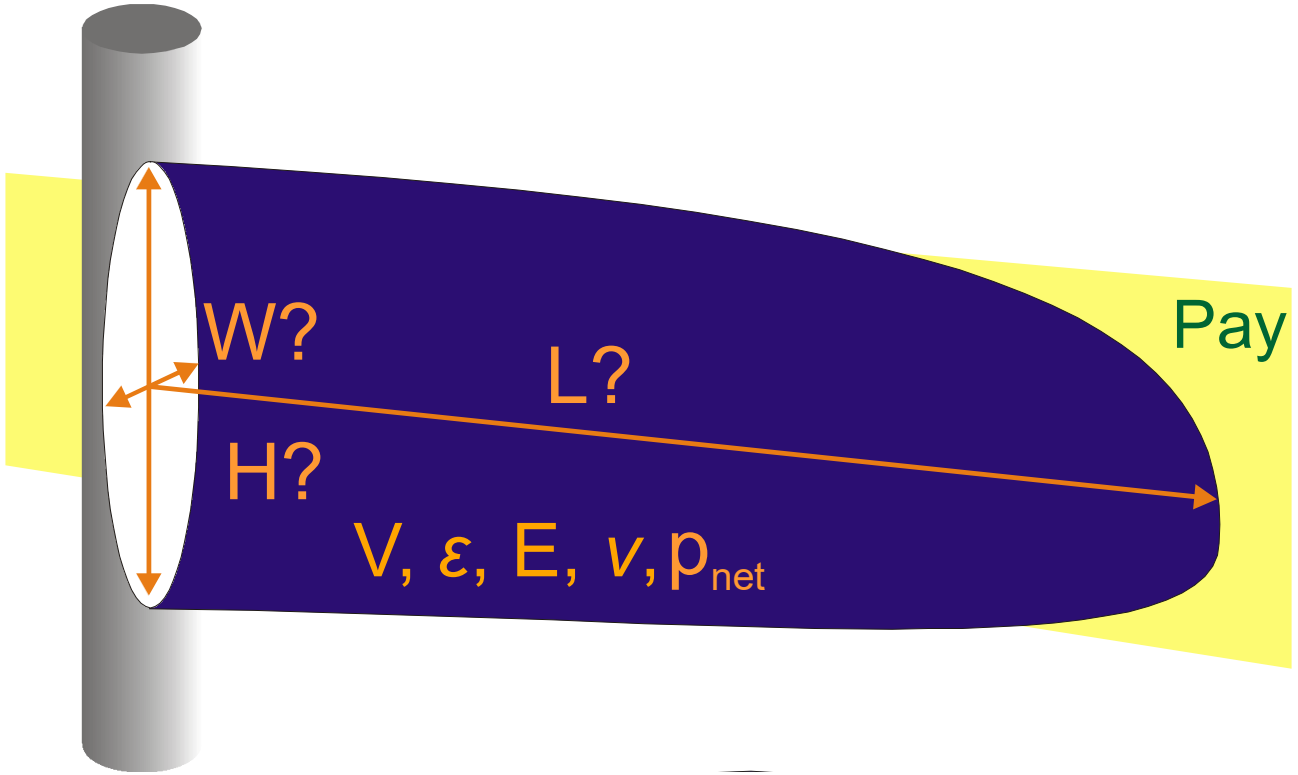
Net Fracturing Pressure and Slurry Efficiency

Liberty Engineering Concepts

Indirect Measurements to Determine Frac Dimensions





Injected Volume
Balloon Elasticity
Net Pressure P_{net}

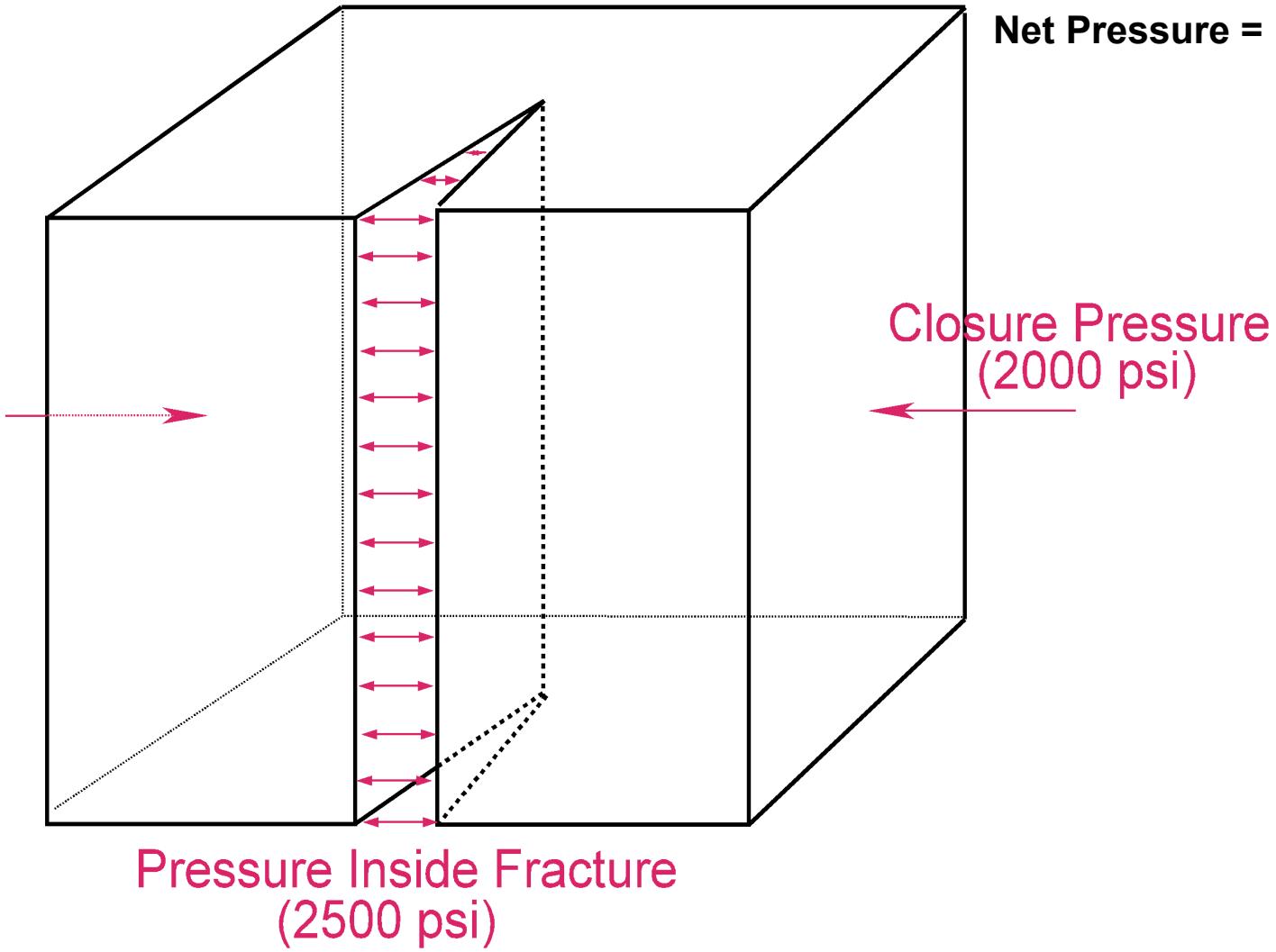
→ Radius R

Injected Volume, Efficiency
Layer Rock Properties
Net Pressure p_{net}

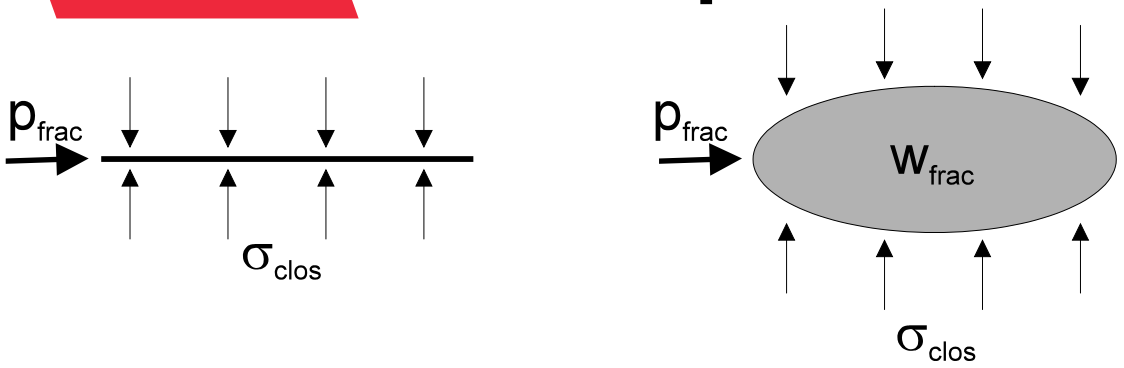
→ Length L,
Height H,
Width w

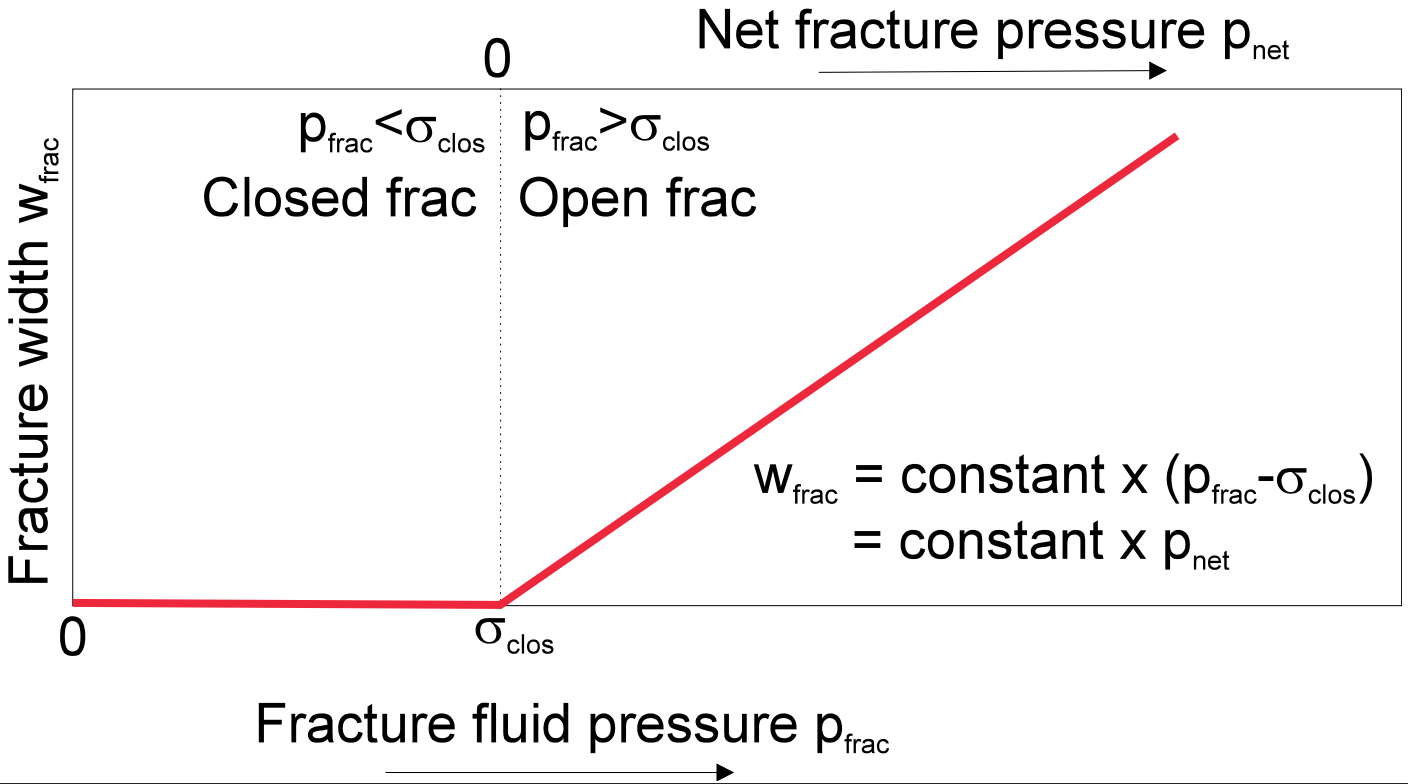
Critical Concepts – Net Pressure

Net Pressure = Pressure Inside Fracture – Closure Pressure



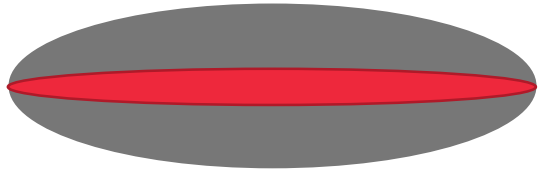
Critical Concepts – Net Pressure & Fracture Width





Critical Concepts – Slurry Efficiency

Low Slurry Efficiency



Smaller dimensions; higher leakoff

High Slurry Efficiency

Larger dimensions; lower leakoff

Definition

$$\text{efficiency}\ (t) = \frac{V_{frac}\ (t)}{V_{pumped}\ (t)}$$

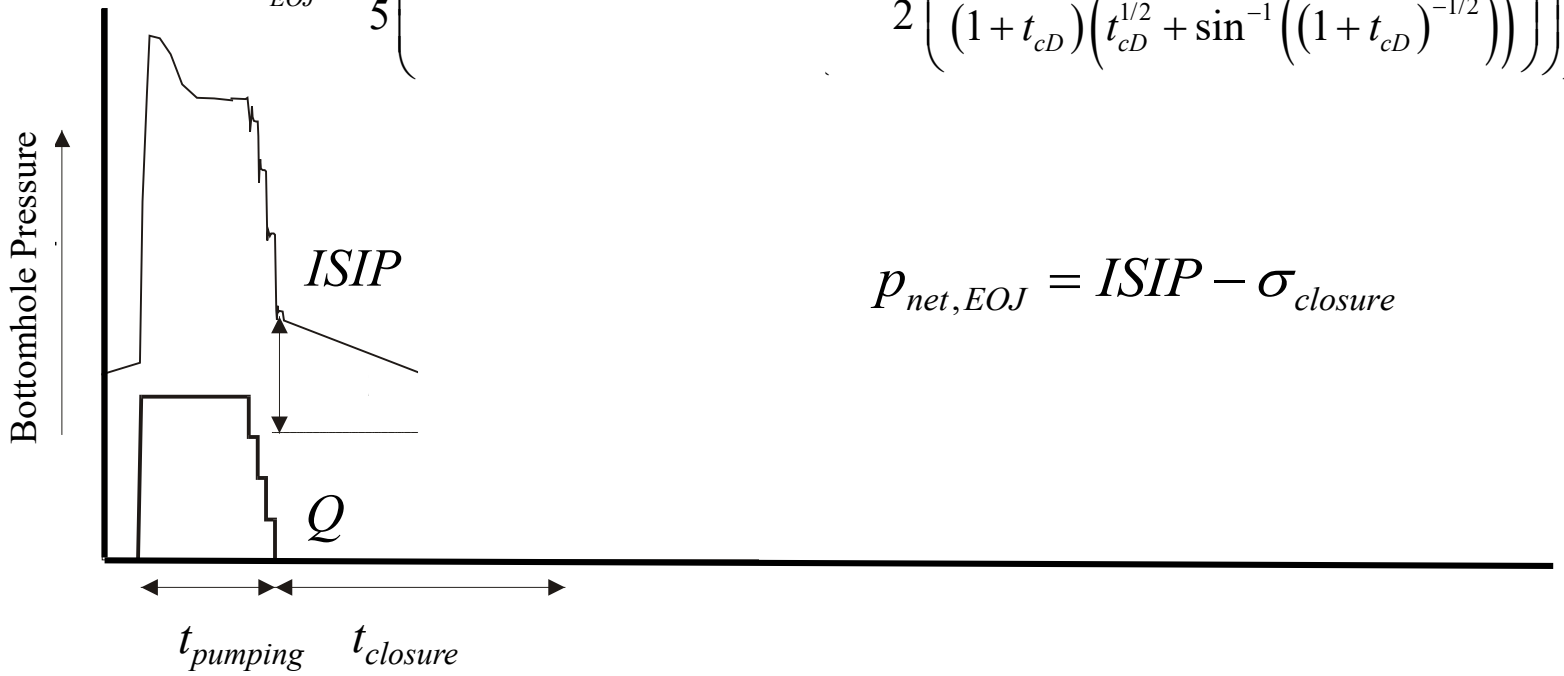
Important at the end of pumping, as frac volume, and thus dimensions, are likely at their maximum

Basic Measurements - Pressure Decline Analysis

What is obtained?

- Instantaneous Shut-In Pressure (ISIP)
- Fracture closure stress (minimum stress)
- Net pressure (at the end of job)
- Fluid efficiency (at the end of job)
- Reservoir permeability and pore pressure

$$\varepsilon_{EOJ} = \frac{1}{5}\left(1 - \frac{\pi}{2}\left(\frac{1}{(1+t_{cD})\left(t_{cD}^{1/2} + \sin^{-1}\left((1+t_{cD})^{-1/2}\right)\right)} \right) \right)$$



$$p_{net,EOJ} = ISIP - \sigma_{closure}$$

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