# ESTIMATING FORMATION BREAKDOWN PRESSURE

| if density and thickness of all layers above the target formation is known | | |
|---|---|---|
| overburden stress = | 7056.618056 | psi/ft |

| Type of sand | density of rocks(lb/ft^3) | 6986.888889 |
|---|---|---|
| Dirt, loose dry | 76 | 1789 |
| Dirt, loose moist | 78 | 1142 |
| Clay, wet | 110 | 1790 |
| Gravel, Wet | 125 | 768 |
| Limestone | 160 | 935 |
| Loam | 80 | 1143 |
| Sand, dry | 97 | 973 |
| Sand, wet | 119 | 1368 |

| effective horizontal stress = | 2907.444444 | psi/ft |
|---|---|---|

| Poisson's ratio | 0.25 |
|---|---|

| minimum horizontal stress | 5643.444444 | psi/ft |
|---|---|---|

| tensile strength | 500 | psi |
|---|---|---|

| if average density of overburden formation and target depth is known | | |
|---|---|---|
| overburden stress = | 11458.33333 | psi/ft |

| average density of the overburden formation | 165 | (lb/ft^3) |
|---|---|---|
| depth | 10000 | (ft) |

$$\sigma_h' = \frac{v}{1-v}\sigma_v' \qquad \sigma_v' = \sigma_v - \alpha P_p$$

$$\sigma_{h,min} = \sigma_h' + \alpha P_p \qquad \sigma_{h,max} = \alpha\sigma_{h,min} + \Delta\sigma_h$$

| effective vertical stress = | 8722.333333 | psi/ft |
|---|---|---|

| Poroelastic constant | 0.72 | |
|---|---|---|
| Pore pressure gradient | 0.38 | psi/ft |

| maximum horizontal stress | 6643.444444 | psi/ft |
|---|---|---|

| difference between max and min horizontal stress | 1000 | psi/ft |
|---|---|---|

$$P_{bd} = 3\sigma_{h,min} - \sigma_{h,max} + T_0 - P_p$$

| Breakdown pressure | 6986.9 | psi |
|---|---|---|

# ESTIMATING SURFACE TREATMENT PRESSURE AND HORSEPOWER REQUIRED

surface treatment pressure = (breakdown pressure + frictional pressure drop in wellbore - hydrostatic pressure)

| | | |
|---|---|---|
| formation breakdown pressure | 6986.88889 | psi |
| sp. gravity of fracturing fluid | 1 | - |
| formation depth | 10000 | ft |

| | | |
|---|---|---|
| pumping rate (q) | 20 | bbl/min |
| viscosity of fracturing fluid | 1 | cp |
| inner diameter (D) | 3 | in |

| | | |
|---|---|---|
| hydrostatic pressure = 0.052 x sp. gravity of fluid x H = | 4330 | psi |

frictional pressure drop = $\Delta_{Pf} = \frac{518\rho^{0.79}q^{1.79}\mu^{0.207}}{1000D^{4.79}}L$ 5724.830621 psi

| | | |
|---|---|---|
| Surface treatment pressure = | 8381.72 | psi |

Horsepower required = $HHP = \frac{qP_{st}}{40.8}$ 4108.69 hhp

| | | |
|---|---|---|
| Horsepower required = | 4108.686 | hhp |

# ESTIMATING IN-SITU/MAX. CLOSURE STRESS ON PROPPANT IN THE FRACTURE

| | | |
|---|---|---|
| minimum horizontal stress | 5643.44 | psi |
| reservoir/pore presssure | 3800 | psi |
| flowing bottom hole pressure | 2600 | psi |

Traditional method

$$\sigma_{Prop} = \sigma_{min} - p_{wf}$$

in-situ closure stress on proppant = 3043.44 psi

| Pwf | in-situ closure stress on proppant |
|---|---|
| 3800 | 1843.44 |
| 3400 | 2243.44 |
| 3000 | 2643.44 |
| 2600 | 3043.44 |
| 2200 | 3443.44 |
| 1800 | 3843.44 |
| 1400 | 4243.44 |
| 1000 | 4643.44 |
| 600 | 5043.44 |
| 200 | 5443.44 |
| 0 | 5643.44 |

New method

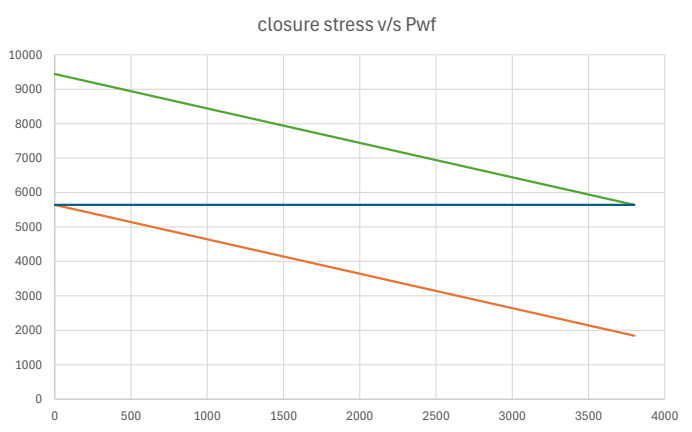
$$\sigma_{Prop} = \sigma_{min} + (p_r - p_{wf})$$

in-situ closure stress on proppant = 6843.44 psi

| Pwf | in-situ closure stress on proppant |
|---|---|
| 3800 | 5643.44 |
| 3400 | 6043.44 |
| 3000 | 6443.44 |
| 2600 | 6843.44 |
| 2200 | 7243.44 |
| 1800 | 7643.44 |
| 1400 | 8043.44 |
| 1000 | 8443.44 |
| 600 | 8843.44 |
| 200 | 9243.44 |
| 0 | 9443.44 |

| minimum closure stress on proppant |
|---|
| 5643.44 |
| 5643.44 |
| 5643.44 |
| 5643.44 |
| 5643.44 |
| 5643.44 |
| 5643.44 |
| 5643.44 |
| 5643.44 |
| 5643.44 |
| 5643.44 |

| Proppant | Conventional Sand | low density | Ceramic intermediate density | High density | Nut shells | Glass beads | Resin coated sand | Advanced ultra low weight | low weight |
|---|---|---|---|---|---|---|---|---|---|
| Specific | 2.50-2.65 | 1.75 | 2.7-3.3 | 3.4-3.75 | 1-1.35 | 2.65 | 2.55 | 1.25-1.75 | 1.60-2.10 |
| Bulk density | 1.49-1.55 | 1.65 | 1.84 | 191 | 0.85-1.04 | 1.55 | 1.65-1.75 | 0.86—1.15 | 0.95-1.30 |
| Closure pressure | 2500-6000 | 5000-8000 | 5000-10000 | >10000 | 2500-5000 | 3000-5000 | 6000-10000 | 5000-8000 | 7000-10000 |




For FBHP of 2600 the proppant which will be used must have the closure pressure range of minimum closure pressure (5643 psi) to maximum closure pressure at 2600 Pwf which is (6843 psi) .