The Pros and Cons of Using 100-mesh Sand in the Eagle Ford

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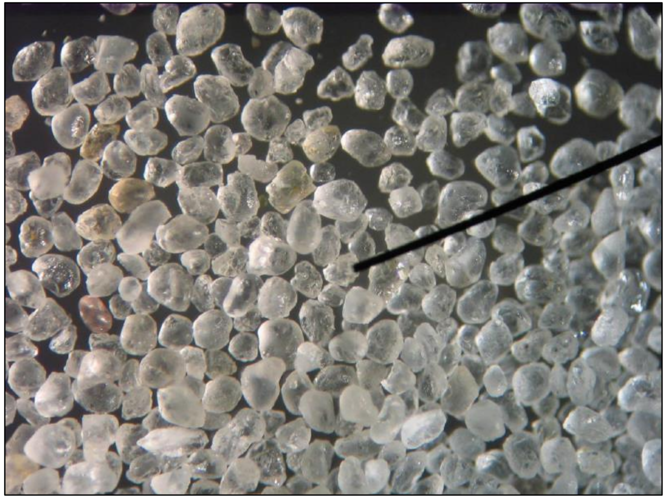
Physical Properties of 100-mesh Sand

- Crystalline silica (quartz) sand
  - ~2.65 specific gravity
  - Preferably mono-crystalline ("Northern white", Ottawa, etc.)
- 70/140 API mesh range
  - ~0.19 mm median particle diameter

Examples of API-recognized proppant sieve sizes	
6/12	20/40
8/16	30/50
12/18	40/70
16/20	70/140

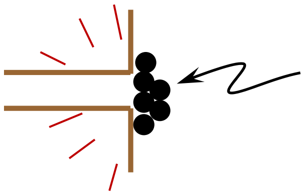


Source: PropTester, Inc. report of Mississippi 100-mesh test

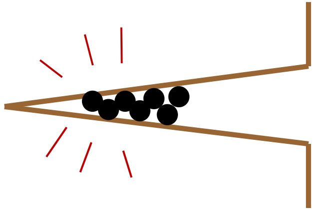
Traditional Uses of 100-mesh Sand in Hydraulic Fracturing

- Fluid loss control (fissures)
  - To improve fluid efficiency, for fracture geometry development
- Plug off excess multiple competing fractures
  - Particularly in near-wellbore region
- Diversion
  - For main fracture propagation in an isotropic or highly naturally-fractured environment
- Scouring and erosion
  - Open tight restrictions in near-wellbore region

Bridging, Plugging, and Diversion



Bridging at restriction entrance



Bridging within fracture (near-field)

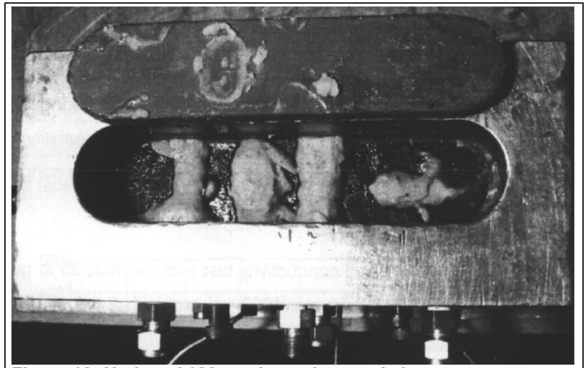
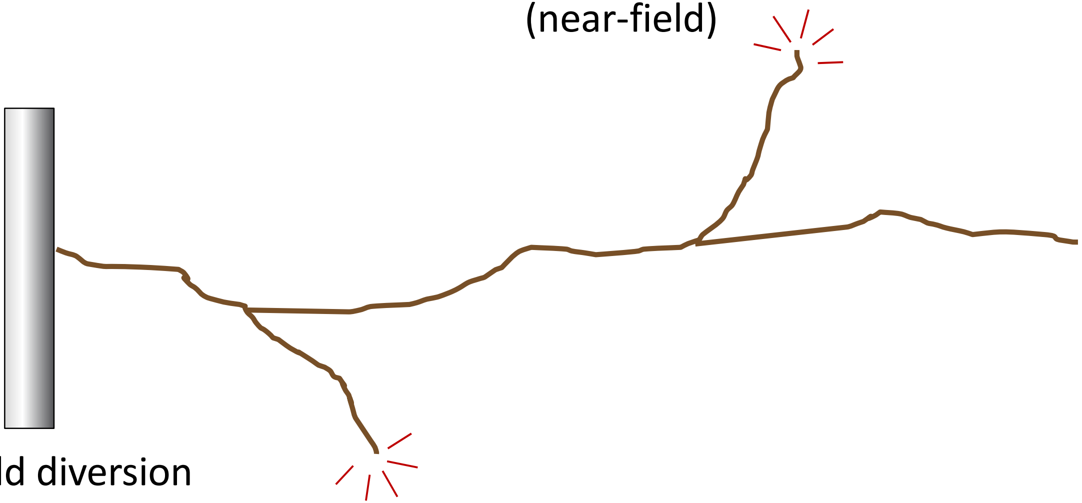


Figure 10: Nodes of 100 mesh sand on coal cleats

SPE 67298



Far-field diversion

Proppant	Median Diameter (mm)	Bridging Width (in)
100-mesh	0.19	0.022
40/70-mesh	0.28	0.033
30/50-mesh	0.45	0.053
20/40-mesh	0.55	0.065

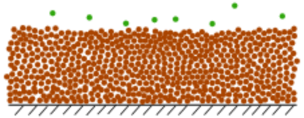
When Can 100-mesh Sand be Considered a Proppant?

$$F_{CD} = \frac{k_f\, w}{k\, x_f}$$

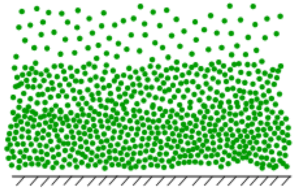
- If conductivity is sufficient based on reservoir permeability
  - Assume k_f w = 10 md-ft, x_f = 300 ft.
  - If F_{CD} ~ 10 desired, then k must be = 0.003 md or less
- If the 100-mesh, as delivered, is within specs to qualify as a proppant
  - Sieve distribution, roundness and sphericity, turbidity, acid solubility, crush, etc.
- When 100-mesh has better transport characteristics than larger proppant
  - Biggest difference in thin fluids (e.g., slickwater)
- When 100-mesh can be placed in fractures that larger proppants cannot enter

Proppant Transport in Thin Frac Fluids (in slickwater)

Proppant	Median Diameter (mm)	Narrowest Fracture (in)	Settling Velocity (ft/s)
100-mesh	0.19	0.022	0.05
40/70-mesh	0.28	0.033	0.12
30/50-mesh	0.45	0.053	0.30
20/40-mesh	0.55	0.065	0.44



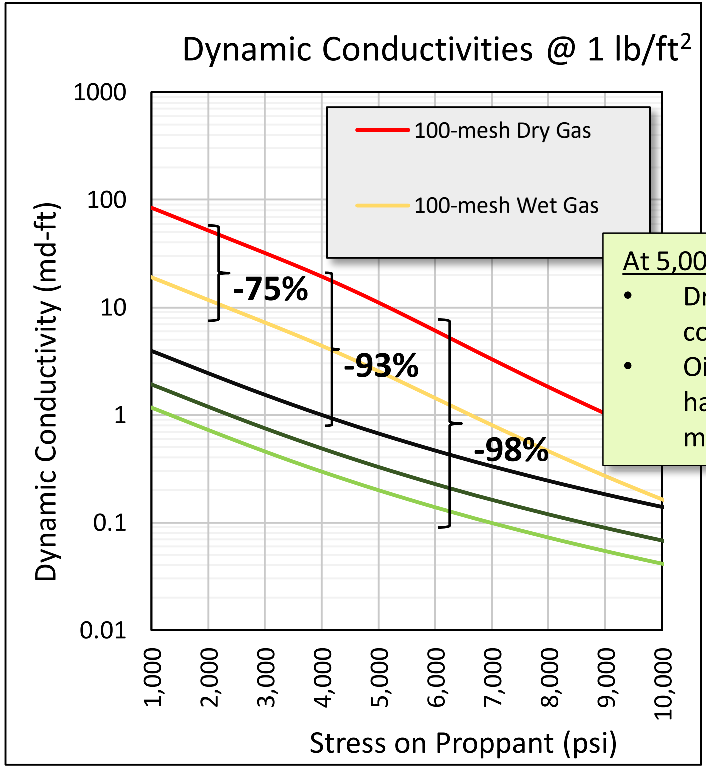
Grain-Pickup Velocity (ft/s)	Minimum Flowrate per Cluster (bpm)
0.16	2
0.35	5
0.89	13
1.33	20

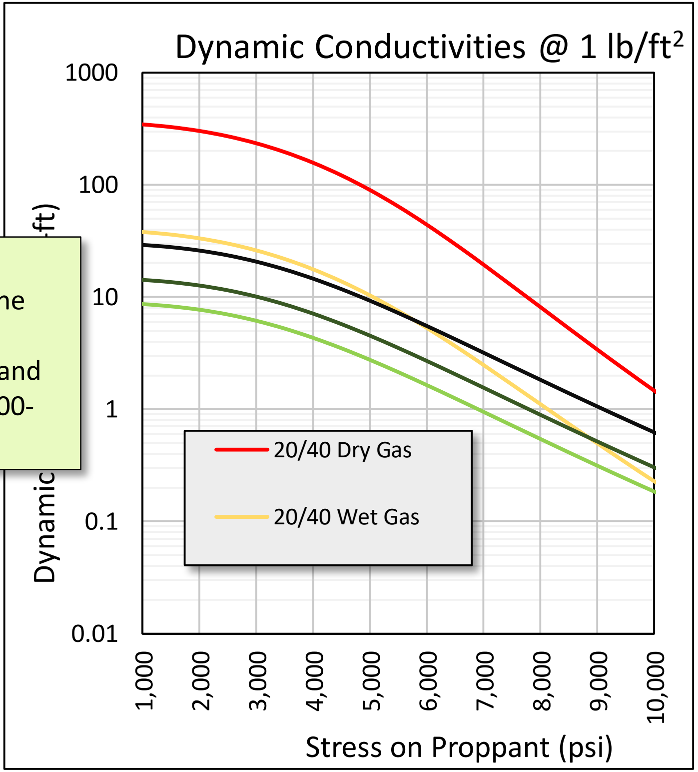


Suspension Velocity (ft/s)	Suspension Flowrate per Cluster (bpm)
0.53	7
1.15	15
2.98	40
4.45	60

- **Narrowest Fracture Width:** 3 grain diameters (bridging).
- **Settling Velocity –** Stokes' Law
- **Grain-Pickup Velocity:** Minimum horizontal flow velocity for grains to be picked up from a proppant bed, around 3 times settling velocity (Biot & Medlin, SPE 14468).
- **Minimum Flowrates**: Assumes frac width = 0.25 in, frac height = 100 ft
- **Suspension Velocity:** Minimum velocity for proppant to be completely entrained in carrier fluid, around 10 times settling velocity (SPE 14468).

What is the Conductivity of 100-mesh?





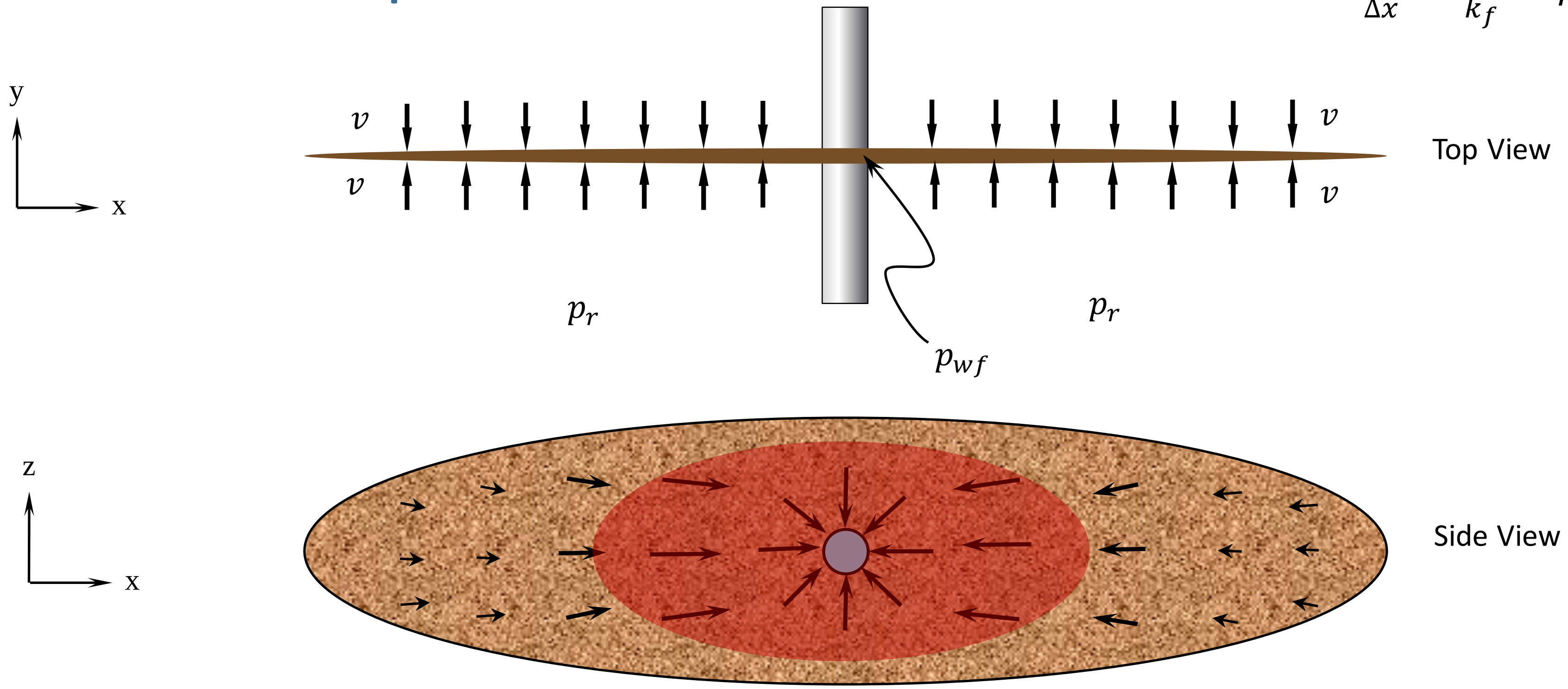
At 5,000 psi:

- Dry gas: 20/40 sand has 7x the conductivity of 100-mesh
- Oil & 60% water cut: 20/40 sand has 12x the conductivity of 100-mesh

PredictK calculations

Pressure Drop in a Fracture

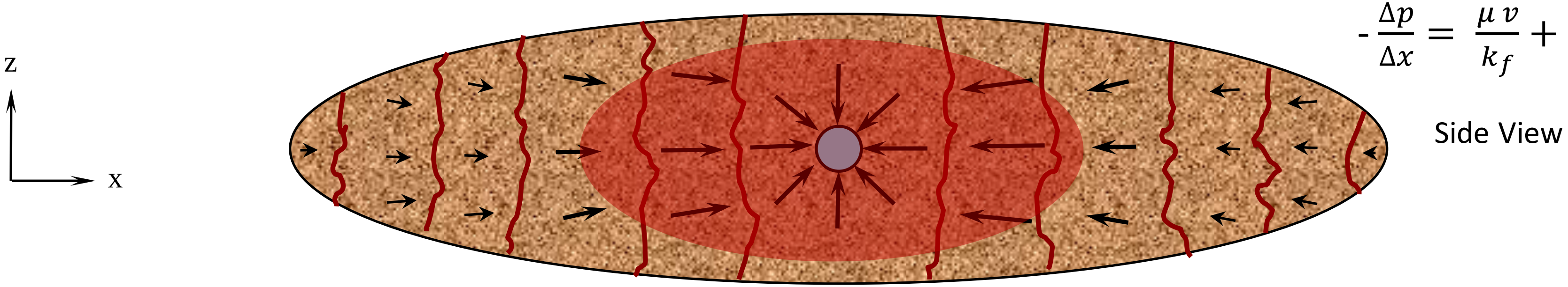
$$-\frac{\Delta p}{\Delta x} = \frac{\mu\, v}{k_f} + \beta \rho v^2$$



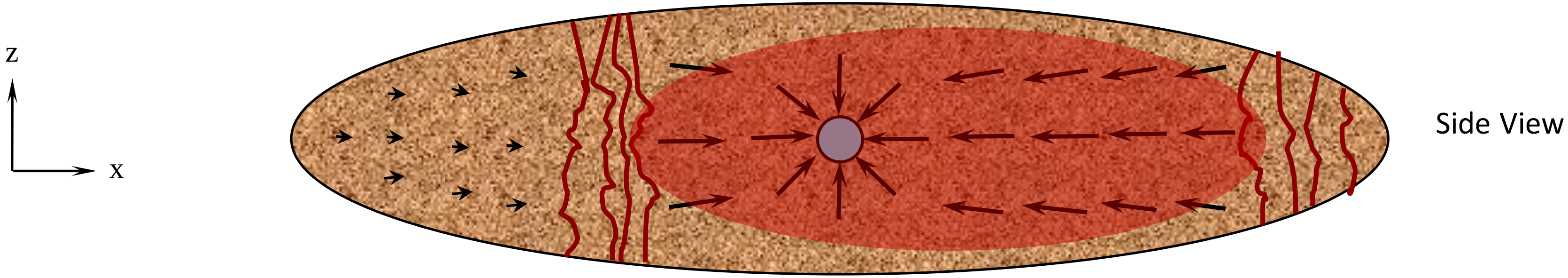
Matrix-dominated production

Pressure Drop in a Fracture (w/ Natural Fractures)

$$-\frac{\Delta p}{\Delta x} = \frac{\mu\, v}{k_f} + \beta \rho v^2$$

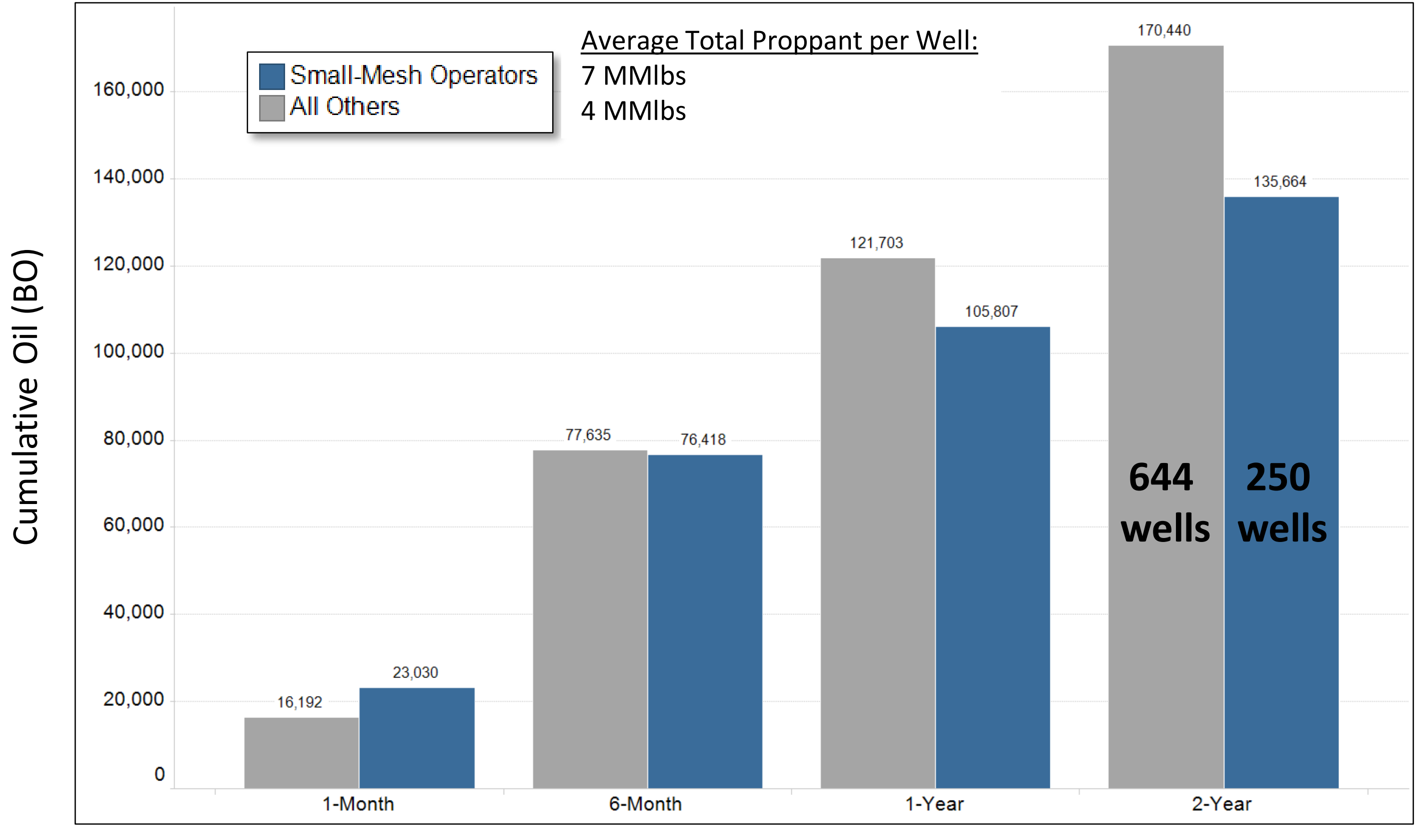


Equally-distributed natural fractures



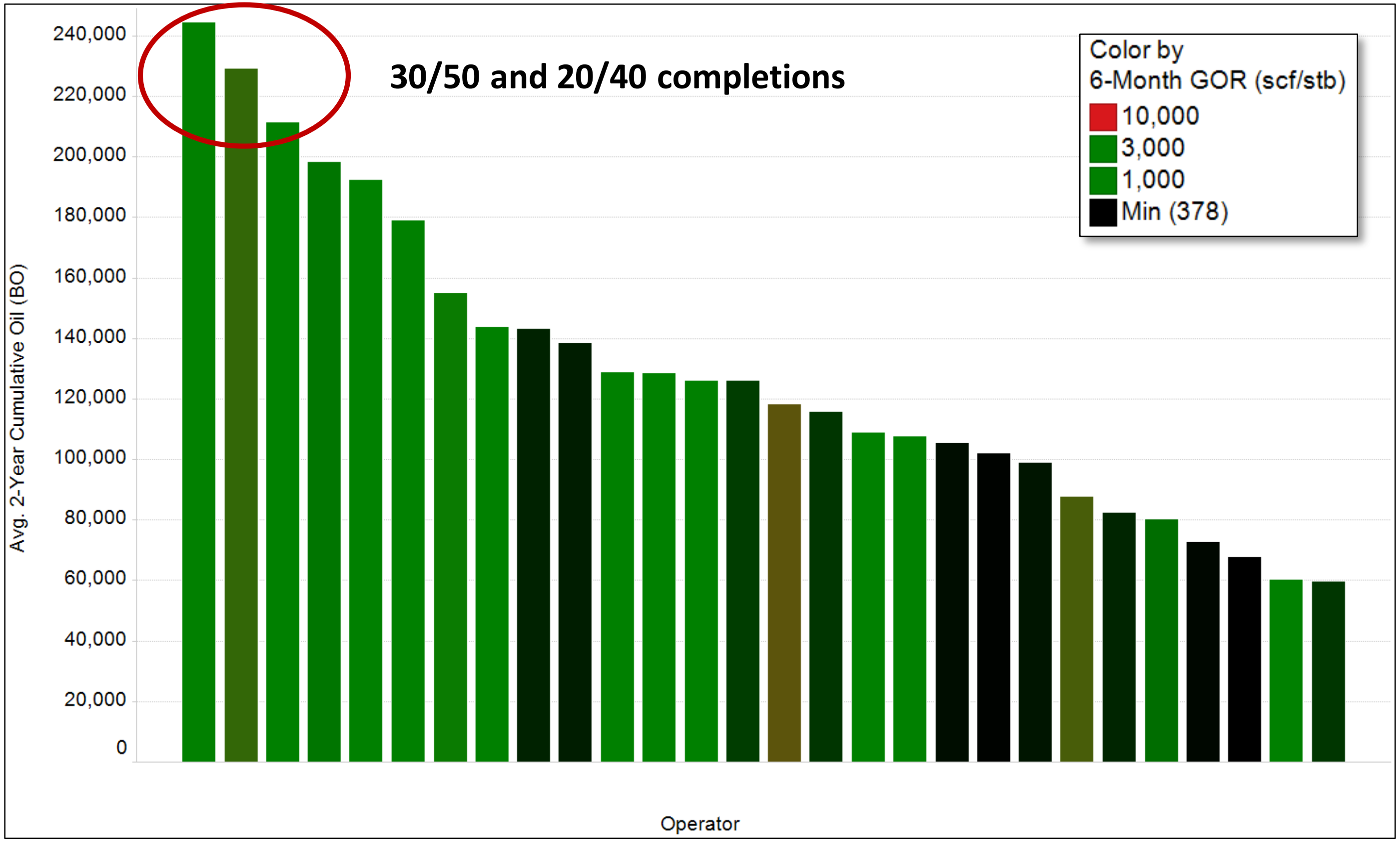
Unequally-distributed natural fractures

Eagle Ford Public Production Data Evaluation



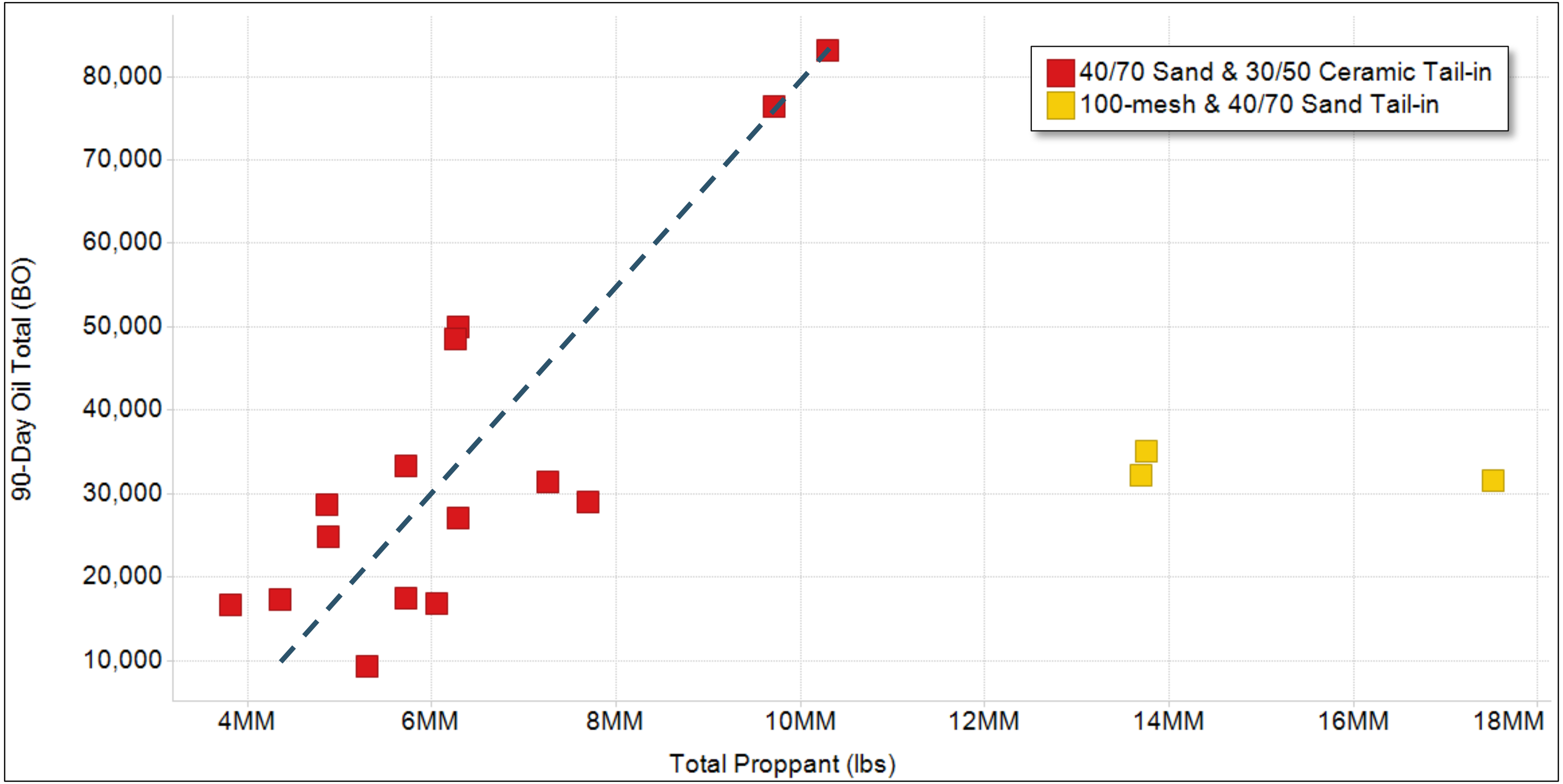
Source: Public data; Karnes, De Witt, and Gonzales Counties
Completions 2012 and newer, with at least 2 years of production

Completion Practices – Operator Comparison



Source: Public data; Karnes, De Witt, and Gonzales Counties
2,216 wells

McMullen County Eagle Ford 100-mesh Study



SPE 173336

Shallow Eagle Ford Proppant Mesh Case Study

20/40-mesh Treatment Design

This well produced ~80,000 BO in first 6 months.

Nearest offset wells using primarily 100-mesh produced an average of 13,000 BO in 6-months (4 wells).

Best 100-mesh well produced 23,000 BO in 6-months, 1.5 miles away.

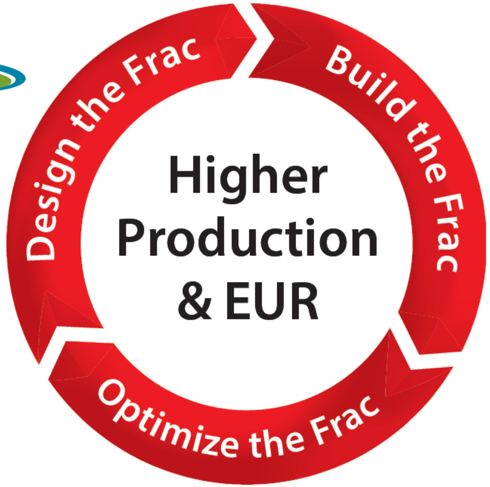
Conclusions

- 100-mesh can be applied as a fracture placement aid
- 100-mesh might be considered a “proppant,” if formation permeability is truly as low as core data suggests
- Studies in a liquids-rich basin do not support use of 100-mesh as a primary “proppant” in hydraulic fractures
- Higher-conductivity proppant is better in higher flow portions of fractures

Thank you!

FRACPRO

CARBO CERAMICS & TECHNOLOGIES



StrataGen

Questions?