IPT Integrated Petroleum Technologies

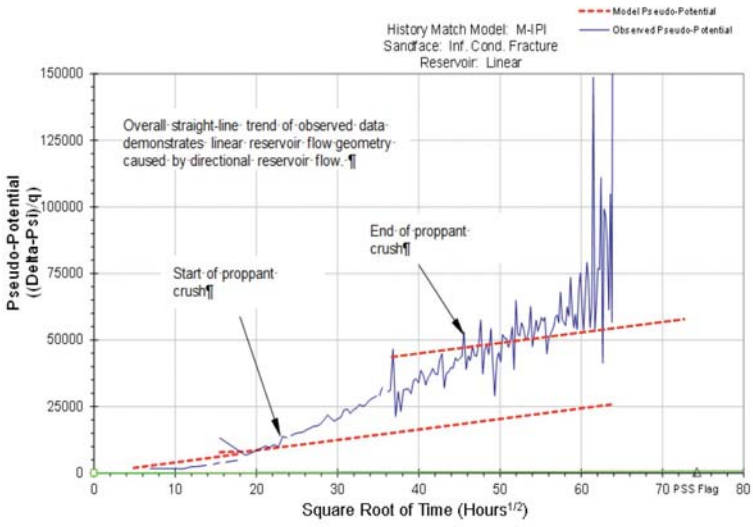
When Does Proppant Crush Occur?

Proppant crush occurs when the level of net stress exerted on the proppant exceeds the actual crush resistance of the material.

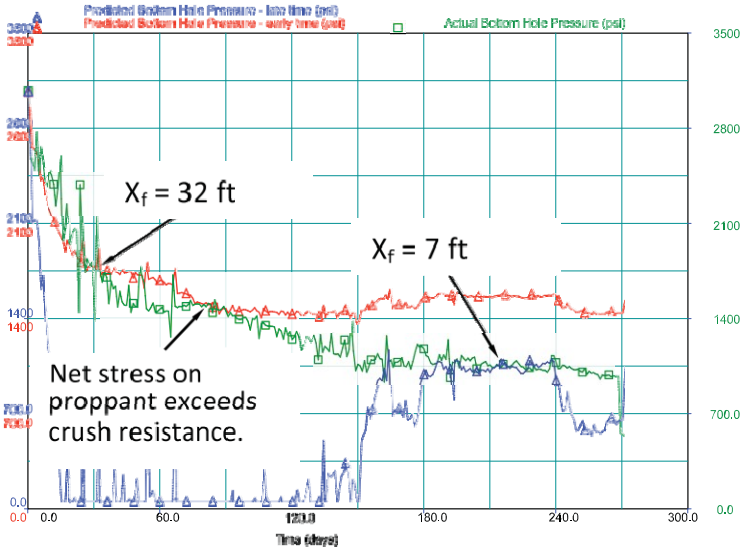
$$\text{Net Stress (psi)} = P_{closure}\ \text{(psi)} + P_{net}\ \text{(psi)} - P_{flowing}\ \text{(psi)}$$

How is crush identified?

Proppant crush is identified by a loss of productivity on the diagnostic plots. On a square root of time plot it is identified by a loss of productivity followed by a reestablished productivity trend with the same slope. In a finite difference simulator, it is identified by a loss of effective fracture half-length.



Normalized inverse productivity – square-root-of-time plot



Finite difference pressure history match

Why is this important?

Loss of effective fracture half-length as a result of proppant crush can result in a significant loss in EUR. In many cases the additional cost associated with higher strength proppant is more than offset by the potential loss of reserves associated with loss of fracture half-length.

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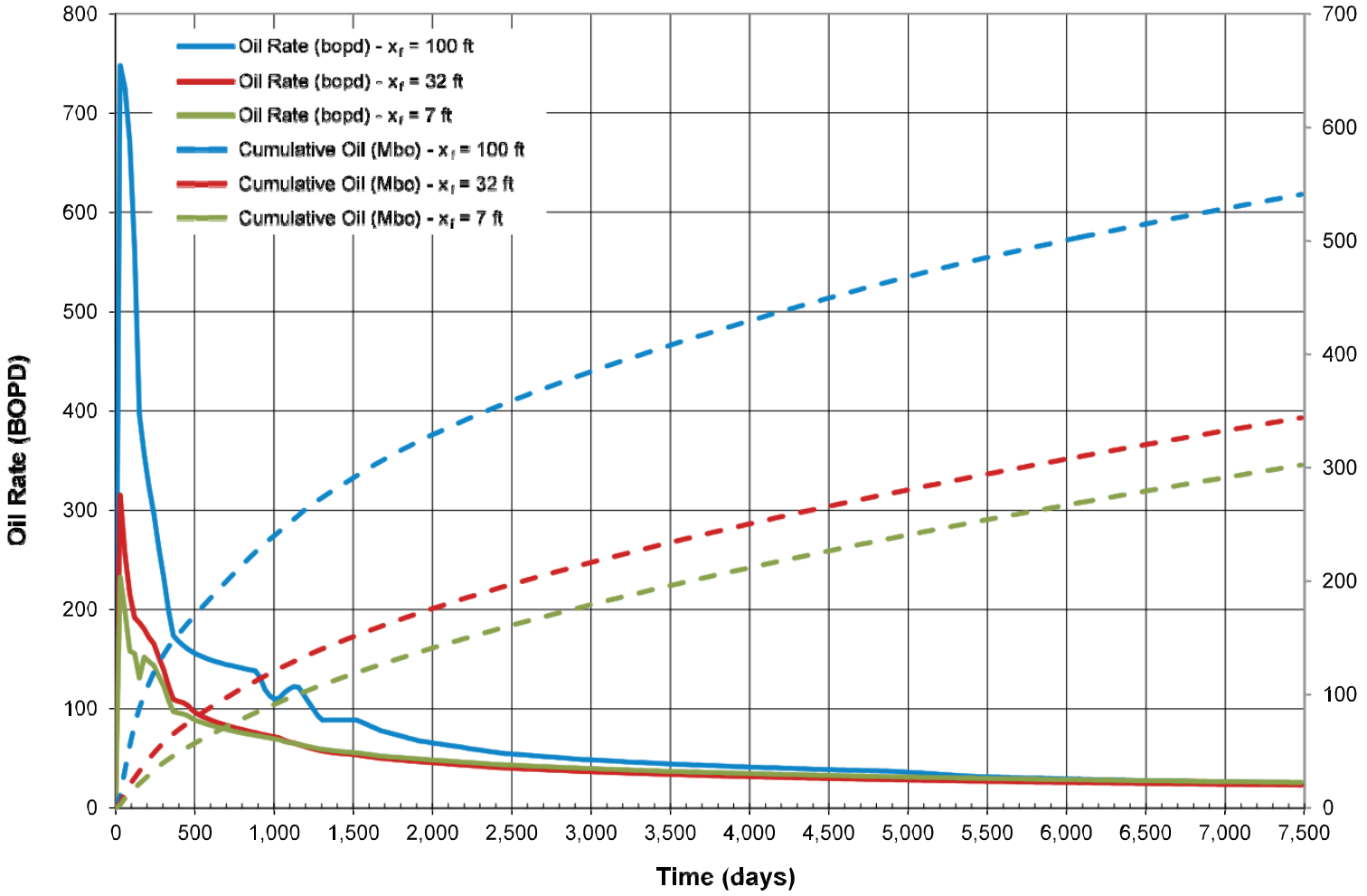
Performance comparison for various fracture half-lengths



Below shows the impact of using the same completion approach, but with proppant appropriate for conditions. Yes, the proppant costs more, but it yields more production which means more revenue!

Predicted cumulative hydrocarbons with x_f = 32 ft: 344 Mbbls, 2,203 MMscf
Predicted cumulative hydrocarbons with x_f = 7 ft: 302 Mbbls, 1,975 MMscf
Difference: 42 Mbbls, 228 MMscf

Unit Price: 60 $/bbl 2.75 $/Mscf

Revenue Diff: $1,947,000
Cost of RC Sand: $988,428

Potential Increased Revenue of $958,572