DFIT℠ Analysis Service

Diagnostic fracture injection test analysis for multiple lenticular zones helps optimize the fracture treatment for each of the viable zones.

Challenge: How to determine pore pressure and permeability – critical fracture design parameters – in a well containing 26 zones when pressure-buildup tests are impractical and wireline formation testers have proved ineffective?

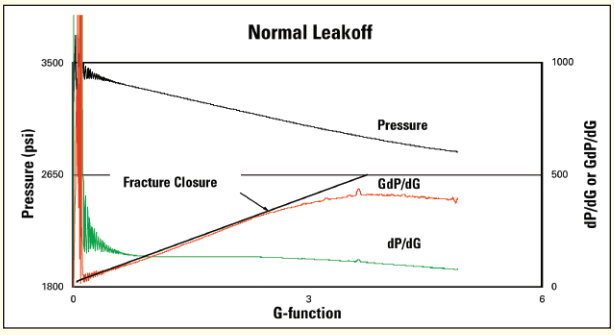
Often in tight-gas reservoirs (for example in the Piceance basin), the sands that show good crossovers in the logs are the ones that are very tight and have a very low permeability determined from a pressure transient analysis (PTA) test.

In addition, depleted sand zones can take too much of the treating fluid and jeopardize effective stimulation of remaining zones. And, pressure build-up tests on 4 to 40 lenticular zones can be very time consuming and costly.

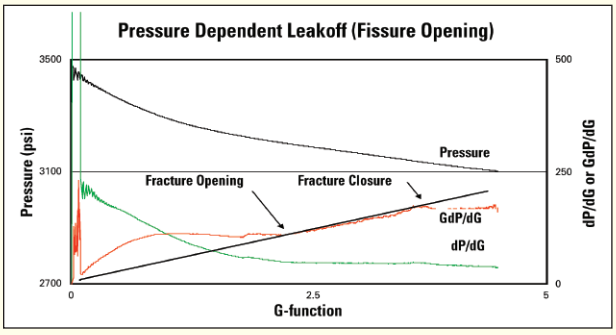
Solution: DFIT℠ diagnostic fracture injection test analysis service is the best and most economical alternative and provides these benefits:

- Determine pore pressure, leakoff and permeability to help optimize completions and make the go/no-go decision on each zone.
- Perforations can be distributed to treat all zones effectively using limited-entry fracturing.
- Pore-pressure and permeability can be determined from before-closure pressure- falloff data analysis.
- Reasonable estimates of well productivity are possible with multilayer reservoir simulation using the permeability and pore pressure estimates.
- After-closure pseudoradial flow analysis in coals results in a unique estimation of pore pressure and permeability.
- In some very low permeability coals it might be very difficult to stay below fracture pressure during below-fracture-pressure injection falloff tests. DFIT analysis does not impose such limitations.

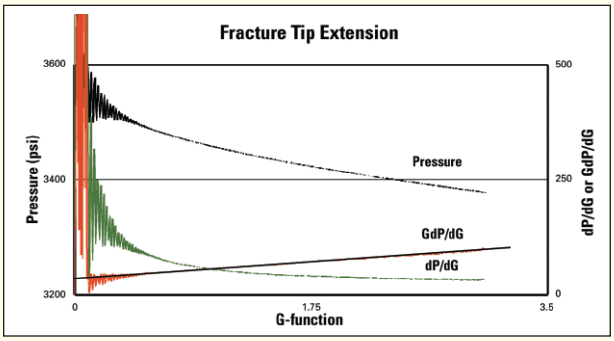
G-Function Derivative Analysis



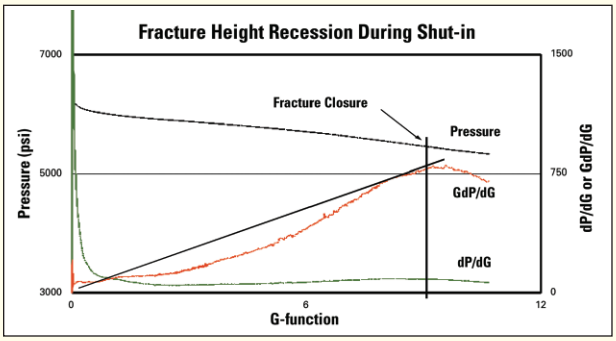
Normal leakoff – use normal design.



Pressure dependent leakoff – redesign to control leakoff.



Fracture tip extension – don't fracture this zone.



Fracture height recession – redesign to control height growth

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What is a diagnostic fracture injection test?

It is a small volume, low rate injection test followed by an extended shut-in period. This is essentially a pre-frac breakdown treatment but the pressure falloff data is recorded and analyzed. Since most low permeability sands require a breakdown treatment prior to the main fracturing treatment, a diagnostic fracture injection test adds very little cost to the completion and is an inexpensive method for estimating pore pressure and permeability. The pressure falloff data is then analyzed to gain information about several important parameters:

- Identify the different leakoff types: normal, pressure-dependent, fracture height recession and fracture tip extension.
- Identify closure stress and estimate pore pressure.
- Estimate permeability from the before-closure data using the modified Mayerhofer method.
- Determine pore pressure and permeability from the after-closure data using after-closure pseudolinear and pseudoradial flow analysis.

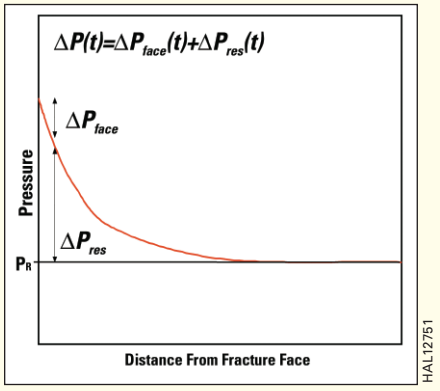
After-closure analysis can also be used to determine pore pressure and permeability but it requires an extended shut-in. In virtually all low permeability reservoirs too much time is needed to achieve pseudolinear or pseudoradial flow. This means that after-closure analysis may not be possible in low permeability tight rocks; however, in almost all coals because of the higher permeability (when compared to the tight sands) after-closure pseudolinear and pseudoradial flows are normally observed with an extended shut-in.

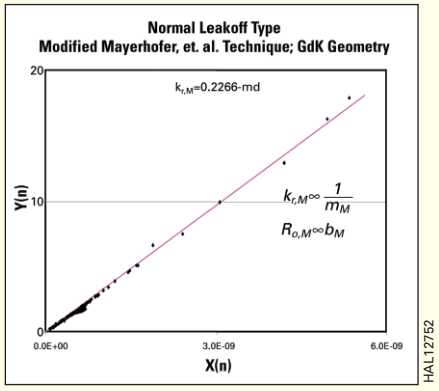
When and where is DFIT analysis service needed?

Producers often face significant challenges when completing massively stacked lenticular tight-gas sands. In the early part of field development, the pore pressure differences may be inconsequential to the completion and production of the well; however, as infill wells are drilled, individual sands might be pressure depleted and can jeopardize the stimulation of the remaining sands that are still at original pore pressure. Completing these lenticular sands effectively (where each sand requires some sort of stimulation to be productive) is critical to achieving an economic well.

In addition, most of the tight rocks in the Rockies do not close for several hours following a mini-frac. In such zones, the before-closure data can be analyzed making a DFIT the most economical way to determine the leakoff type, pore pressure and permeability. Sometimes this information can result in a decision not to a fracture a particular zone. The inherent savings of potentially hundreds of thousands of dollars can then be spent to stimulate productive payzones.

Before Closure Modified Mayerhofer Analysis





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