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A New Cost Effective Well Testing Methodology for Tight Gas Reservoirs

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SUMMARY

Objective

Obtaining formation characteristics (kh or permeability x thickness per layer) in a tight gas environment is highly challenging: formation tester tools (WFT) run during open hole logs are often unsuccessful, conventional well tests are not appropriate as no gas flow is usually observed after perforations. Testing after hydraulic fracturing is prohibitive as it would require a very long shut in order to reach radial flow.

A new well testing methodology has been developed and has been applied on a few field cases; it aims at providing a dynamic kh profile along the openhole and does not require running downhole tools or pressure gauges in the well.

Principle of the test

The test is conducted at well TD, once open hole logs have been run. The test typically consists, after having run a tubing string, in displacing continuously the annulus mud to a fluid having a different specific gravity and viscosity, such as a brine.

During the test, the brine/mud interface is moving upward the borehole while brine is pumped down the tubing at a constant pressure. At the same time mud is circulated out from the annulus. As viscosities and densities of both fluids are contrasted, brine and mud permeation rates in a given layer will differ. The difference between the flow rate of the brine injected down the tubing and the flowrate of the mud coming out from the annulus allows deriving a kh indicator along the wellbore.

Stationary measurements may also be recorded at various depths which are defined according to open hole logs in order to optimize the completion strategy: the objective of these measurements being to assess the flow potential of various layers in order to select the zones to be stimulated through hydraulic fracturing. During these stationary measurements, the entire wellbore is pressurized without exceeding frac pressure. The various fall-offs resulting from fluid leak off across the open hole are successively analyzed to back-calculate a kh index by layer.

A deconvolution of the time-dependent and interface depth-dependent permeation flows is necessary. An inversion process which accounts for the injection history of the various layers has been developed, it allows deriving kh and skin values for each layer. The new process has been already tested on three different field cases that will be presented in the paper.