

Very low permeability measurements on small samples and drill cuttings



Below the nanoDarcy

Interpretation of a gas pressure drawdown

The samples are put under pressure in a small chamber. The pressure is quickly decreased by opening a valve in a second chamber.

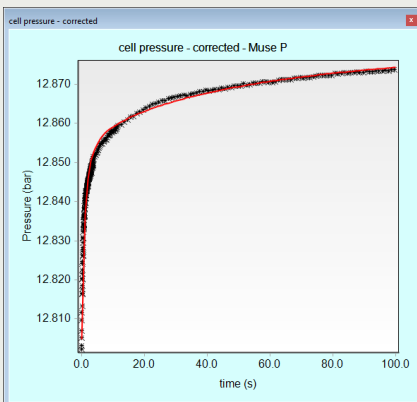
Permeability is derived from the interpretation of the transient pressure (SCA2010).

Improvements of the GRI-method

A benchmark on several commercial measurements using the standard Gas Research Institute method has shown several problems (paper SCA 2019).

A collaboration between TOTAL and CYDAREX has improved the method and the equipment (SCA 2021):

- Sample initially under pressure allowing a small variation of pressure inside the sample for a better determination of Klinkenberg correction.
- Filling of the empty space with a fine powder to reduce thermal effects linked to the decrease of pressure.
- Filling of the drawdown vessel for better temperature regulation.



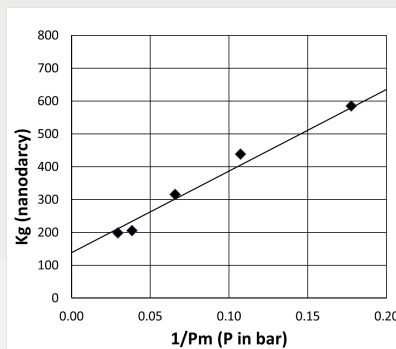
Experiments (black) and interpretation (red) on a shale using the double permeability model. Porosity is 14%, the low permeability is 1.8 nD and the high permeability 82 nD.

Specifications

- Mass of samples between 2 and 5 grams, single sample or granular.
- Cuttings or crushed samples with 1 mm minimum size.
- Pressure up to 40 bar.
- Permeability on crushed samples below the nanoDarcy, and up to 500 nanoDarcy.
- Numerical interpretation with single or double permeability models,
- Automatic history matching using the software CYDAR.
- Fast and easy measurement.

References

- SCA2010-32: Permeability measurement on small rock samples, Lenormand, Bauguet, and Ringot.
- SCA2019-016, Low permeability measurement on crushed rock: insights, Profice and Lenormand.
- SCA2021: to be published.



Example of a Klinkenberg plot on a crushed shale sample