Solution Mining Research Institute Fall 2012 Technical Conference

Bremen, Germany, 1-2 October 2012

Modern In situ and Laboratory Measurements of Permeability and Porosity to Prove Tightness of Underground Storage of Hydrogen, Natural Gas and CO_2

Mohammed Amro, Frieder Häfner and Carsten Freese

Institute of Drilling Engineering and Fluid Mining of Technical University Bergakademie Freiberg, Freiberg, Germany

Abstract

The underground storage of hydrogen, natural gas and CO_2 in porous reservoirs and salt caverns requires the proof of gas tightness of caprocks and saltrocks, respectively. The identification of the sensitivity threshold value for the permeability is however the main problem encountered while evaluating gas tightness. Laboratory and in situ measurements have to be able to verify permeability in a range of 10^{-21} to 10^{-22} m^2 (10^{-6}-10^{-7}mD), to ensure long-term tightness.

The method of the unsteady state measurement will be developed for laboratory conditions as well as for in situ conditions based on multi-chambers system.

The interpretation of data using this method allows the determining permeability, effective porosity and Klinkenberg effect by means of just a single measurement. The evaluation of the measured data is carried out numerically via the inverse solution of the differential flow equations.

The method of unsteady state measurement was firstly applied at the Institute in the beginning of 90 s. Recently, the method has been extended to consider the Klinkenberg gas slippage effect without additional measurements, and the involvement of measured pressure values in additional observation wells in the inverse solution. In addition, new software (***Perm1D, Perm3D***) for evaluating the measurement has been developed. To illustrate the implementation of the method, data from laboratory as well as *in situ* experiments in salt caverns taken from R&D studies will be presented and analyzed.

Key words: Caverns for Gas Storage, Cavern Testing, Leak, Computer Software, Instrumentation and Monitoring