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Novel Approach to Conducting a Mechanical Integrity Test with Optical Fiber

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Abstract

Accurate assessments of cavern integrity are necessary to ensure the fluids contained within a cavern do not contaminate the external environment. The basic results from a mechanical integrity test (MIT) are that of leak rate from a cavern and the associated precision or accuracy. The industry standard for evaluating cavern integrity is the nitrogen-brine interface MIT [1]. However, many variants to this approach are routinely implemented, which commonly use different test fluids and approaches for calculating leak rate.

Typical MITs are based on data acquired at two points in time, and the leak rate is determined from the change of test-fluid volume. Recent advances in sensing technology allow for acquisition of distributed down-hole temperature using optical fiber. The use of optical fiber allows for acquisition of down-hole temperature, from surface to total depth, almost instantly and at high sample rates (e.g., 10 full temperature logs per hour). The implementation of optical fiber during an MIT allows for stochastic techniques to determine the leak rate and the associated accuracy.

This paper discusses a novel approach for determining the leak rate and associated accuracy during an MIT of a solution-mined cavern. The large amount of acquired data allows for the leak rate and associated accuracy to be determined using stochastic methods, and a theory for this approach is provided. Optical fiber has been used in numerous MITs, and a case study from an optical-fiber MIT on a gas-storage cavern located in Louisiana, USA, is presented.

Key Words: Mechanical Integrity Test (MIT), Optical Fiber, Gas Storage