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THEORETICAL AND EXPERIMENTAL BASICS FOR A NEW TIGHTNESS TEST METHOD TO ENABLE TESTING OF GAS STORAGE CAVERNS DURING GAS STORAGE OPERATION

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1 Abstract

The main aim of this numerical and experimental investigation was to clarify the mixing behavior of two gases under defined thermodynamical and geometrical conditions to prove the practical feasibility of a tightness test during gas storage operation. At first, numerical simulation of defined thermodynamical and geometrical properties for a real gas cavern has been conducted.

The experimental investigation has been conducted to prove and, if necessary, to correct the obtained numerical results by means of real-time measurements under almost real technical and thermodynamical conditions. For this, an experimental facility $(1\,m^3)$ was developed and constructed, which mainly correspond to a geometrical shape of a gas storage cavern (at least in the relevant zones). The experimental facility enables an accurate measurement of the distribution of mass concentration under specified conditions as a function of time and position. Based on the obtained results of the numerical investigation with reference to the high influence of the convection on the intermixture a mechanical element (convection barricade) has been developed. The convection barricade leads to time-conditioned inhibition and prevention of the intermixture, which is caused by convection.

The results of the numerical and experimental investigations confirmed that the technical development of a new tightness test method for proving the technical gas tightness (MIT) of gas caverns during gas storage operation is possible by using of a convection barricade. A gaseous storage medium can be layered with a lighter test gas over a sufficient time interval without to create a significant mixing zone caused by diffusion and convection effects. For this purpose the application of the test method must be adapted to the technical and economical circumstances in the practice.

Key words: New tightness test method, Cavern testing, Diffusion, Diffusion coefficient, Convection, Convection barricade, Gas layering, Conventional test MIT, *He*-Test, Gas intermixture, Computational fluid dynamic.