Solution Mining Research Institute Fall 2022 Conference

Chester, United Kingdom, 26-27 September 2022

Determination of the Volume of Gas Storage Caverns with the Use of Thermodynamics

Dirk Zapf[1], Christian Sonnenschein[2], Thomas Beutel[2], Olaf Kruck[3]

[1]Leibniz University, IGtH-IUB, Hannover, Germany
[2]EWE GASSPEICHER GmbH, Oldenburg, Germany
[3]SOCON Sonar Control Kavernenvermessung GmbH, Giesen, Germany

Abstract

The volume of a gas storage cavern has a great importance for the operation. Depending on the depth of the cavern, it determines the amount of stored gas. From rock mechanical point of view, the volume is also an important parameter for the dimensioning of operating parameters, such as maximum and minimum internal cavern pressure and the operating rates.
For example, a different volume at the same flow rate leads to significantly different results for the temperature development in a gas storage cavern. This in turn substantially influences the stress state surrounding the cavern.
In addition to the volume, the ratio of the volume to the thermally effective surface of the cavern wall (V/S) also plays a major role in the temperature development in the gas.
Socon has been the world's leading company for measuring the cavern shape with ultrasonic for several years. With this method, the volume can be determined very accurately. All caverns have irregularities derived mostly due to leaching and geological influences. However, some parts of these irregular shapes (hidden leached pockets) cannot be detected by the ultrasonic survey, which in turn leads to an uncertainty in the determination of the total cavity volume.
In this paper, a method for estimating the cavern volume that cannot be measured directly is presented, which is based on the assessment of a gas withdrawal phase over a defined period of time. The measured wellhead pressure curve is then calculated with thermodynamic simulation programs, considering the withdrawal rates. One of the main variables influencing the calculation results is the assumed geometrical volume.
This method for estimating the volume is presented on the basis of two real existing gas cavern projects.

Keywords: *rock mechanics, thermodynamics, gas operation, cavern volume, sonic survey*