Solution Mining Research Institute Spring 2021 Virtual Technical Conference

19-22 APRIL 2021

Tightness of salt caverns used for hydrogen storage

Pierre Bérest[1], Benoît Brouard[2], Grégoire Hévin[3], Arnaud Réveillère[4]

[1]LMS, Ecole Polytechnique, IEP, Palaiseau, France

[2]Brouard Consulting, Paris, France

[3]Storengy, Bois-Colombes, France

[4]Geostock SAS, Rueil Malmaison, France

Abstract

Tightness is a fundamental requisite of any storage cavern. Tightness results from (Bérest and Brouard, 2003): properties of the rock mass, nature of the stored products, quality of the cementing job, pressure and pressure changes of the stored fluids, and well architecture (i.e., the *completion*, or the number and the lengths of the cemented casings).

Much information and experience are available from the 2000+ salt caverns used worldwide for hydrocarbon storage. Generally speaking, salt permeability is exceedingly small. Several incidents proved that breaches or conduits can be created between a cavern and a neighboring cavern, or between a cavern and the boundaries of the salt formation. The origin of most of these incidents is the presence of Anomalous Zones in the salt formation. *In-situ* tests proved that the overall cavern permeability experiences a significant increase when fluid pressure at cavern depth is larger than 80-85% of the geostatic pressure.

However, as in most pressure vessels, it is the “piping” (the access well) that most often is the weakest point. Several incidents are described in this paper. The origin of most of these incidents is the presence of a single casing between the stored product and the rock formation.

In this context, tightness tests are mandatory. It is suggested to test the wellbore after drilling and to test the cavern before commissioning. The Nitrogen Leak Test, a high-resolution measurement technique, has become a standard. It consists of filling the annular space with pressurized nitrogen, setting the gas-brine interface below the last casing shoe, and tracking this interface with a logging tool. The mass of gas is very small when compared to brine mass, and accurate measurement of gas-mass changes during the test is possible. It is suggested to test the well with nitrogen and hydrogen, successively, and to set the gas-brine interface at various depths to track the leaks originating from different parts of the well. A cost-effective method, based on the observation of wellhead pressures, is proposed.

Key words: Hydrogen Storage in Salt Caverns, Tightness tests in salt caverns, Tightness of underground storages