Solution Mining Research Institute Fall 2022 Technical Conference
Chester, United Kingdom 25-28 September 2022

JOINT CONTRIBUTION OF PASSIVE SEISMIC MONITORING AND BLOCKFALL SYSTEM FOR DETECTION AND ANALYSIS OF ROCKFALL IN SALT CAVERNS CASE STUDY ON GEOSEL-MANOSQUE SITE (FRANCE)

Eric Fortier[1], Vassily Zakharov[2], Arnaud Réveillère[3]

[1] Baker Hughes, Sainte Tulle, France
[2] Brouard Consulting, Paris, France
[3] Geostock, Rueil-Malmaison, France

Abstract

Rock falls are relatively frequent in salt caverns and may sometime damage inner strings. In liquid hydrocarbon storage caverns, a broken string can usually be detected if the break is located above the product-brine interface; in this case the brine string is rapidly filled with product, increasing the pressure on the brine string. However, in many cases, these block falls remain unobserved until they are revealed by a sonar survey or a gamma ray, performed several months or years after the incident, that detects a cavern-shape change or a rise of the cavern bottom.

This paper presents two complementary methods for the detection and analysis of rock falls. Both enable immediate detection of the rock fall. The first method is based on a passive seismic monitoring and the second uses a non-intrusive system called *Blockfall* which is set at the wellhead.

An in-situ test at Geosel underground storage (Southern Alps, France) is presented. Geosel operates 28 salt caverns with diameter of approximately 40 m (130 ft), height of about 300 m (984 ft). These caverns are located at a depth between 300 m and 500 m (984 to 1640 ft) in a saliferous diapiric structure, within an active seismo-tectonic context.

Plastic properties of salt involves that the seismicity origin is associated to stress readjustment applied at the interface with insoluble layers and/or pre-existing structures inside the insoluble layers. These small readjustments induce micro-seismic events.

Micro-seismic surveillance objectives are to provide a close monitoring of the integrity of the cavity, and of associated pillars between caverns. Seismic activity follows the shape of the cavity (sonars) underlying destabilized area, and indicates the zone of influence of the cavity. The micro-seismicity is mainly recorded during leaching phases, and gas/oil filling or extraction (pressure variation).

The existence of insoluble layers can induce rock falls in the cavity. Recorded rockfall signal is characteristic with low frequencies and resonant waves. The good coverage of the seismic network, implies precise location of the rock fall event, and good estimation of Richter Magnitude and an assessment of the structure size.

The *Blockfall* system is not intrusive and based on the measurement of wellhead-pressure dynamic variations. The system manifold includes two pressure sensors installed at the wellhead on tubing and dedicated to measure low and high frequency brine-pressure oscillations. Electronic acquisition assembly includes 3G/4G mobile network router, which allows to establish and to keep secured and encrypted channel with remote server in order to transfer the data acquired by the system. Event data is automatically transferred immediately after detection of the event and finishing data recording; static data is transferred on a regular basis (once per hour for instance). The *Blockfall* system can be considered as a connected object in the sense that it can be monitored remotely.

Key words: Rock fall, blockfall system, seismic monitoring system, caverns, underground storage