Solution Mining Research Institute; Fall 2006 Technical Meeting
Rapid City, South Dakota, USA, October 1-4, 2006

FEASIBILITY STUDY FOR THE STORAGE OF COLD COMPRESSED NATURAL GAS (CCNG) IN UNDERGROUND SOLUTION-MINED BEDDED SALT CAVERNS

W. Allen Marr, P.E.,PhD.
Geocomp Corporation, Boxborough, Massachusetts, USA

Abstract

This paper summarizes results of a feasibility study for the storage of cold compressed natural gas in underground, solution-mined, bedded salt caverns. The patent-pending, cold compressed gas storage concept involves storing cold gas in an existing salt cavern under pressure and removing the gas during peak demand times. More gas can be stored in a fixed volume by lowering the gas temperature than by increasing its pressure. This produces an economic advantage.

The performance of solution-mined caverns is governed by the geomechanics of the rock. To safely store gas, the rock must have low permeability and be free of ruptures and fractures that extend for large distances. The cavern must remain stable to avoid loss of storage volume and prevent any collapse that threatens the integrity of the riser pipe system.

Performance of a cavern depends on the physical and mechanical properties of the surrounding rock. This work included series of laboratory tests on core samples of dolomite and saltstone from a site in New York to measure the effect of low temperatures on their properties. The test results conclusively show that chilling the rock to temperatures as low as -150º F does not degrade the mechanical and physical properties of the saltstone and dolomite.

Advanced thermo-geomechanical analyses were performed to determine if a salt cavern can remain stable under the combined effects of cold temperature and high pressure. The analyses show that thermal compression of the rock may produce cracks along vertical planes that radiate outward from the cavern walls for distances of 200 to 300 ft. However, the cavern walls remain stable and gas tight. The analyses also show that the most critical time for cavern stability is during initial cooling when the tensile stresses are the greatest. Faster cooling appears to cause more cracking. Despite this cracking, the cavern remains stable because the rock remains uncracked in the vertical and radial direction away from the chamber and vertical stresses within the cracked zone are safely transferred to rock outside the tensile zone.