

Carriço Gas Storage Project Design Optimization during Drilling and Leaching in a Complicated Geological Environment

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Abstract

The Carriço Gas Storage Project is the first gas storage in a salt formation being developed in Portugal at the Atlantic coast. Due to intercalated insoluble layers with thicknesses of several meters the rock salt deposit faces a challenge for the planning and the construction of gas caverns.

Based on two selected caverns the paper describes the design optimization before and during drilling as well later during leaching. All actions were based on tight cooperation of geologists, rock mechanics, drilling engineers and leaching experts in close coordination with the client.

Preliminary geological investigations for cavern TGC-2 pointed to steeply dipping insoluble layers, even up to 40 m in the upper cavern area. The initial rock mechanical layout allowed circular cross-sections with a maximum diameter of 70 m. The revised concept allowed circular cavern cross-sections with maximum 90 m as well as cross sections of elliptical shape with a ratio of minimum to maximum diameter of 70 m to 110 m. Based on this revised more flexible rock mechanical concept the leaching plan was modified. Additionally, the cavern was developed in close cooperation of leaching engineer and rock mechanical expert, which worked perfectly during the entire project.

Based on an optimum purpose designed leaching concept and a thoroughly monitored and controlled leaching process considering all available technical information and with a high effort of measurements the thick insoluble layer could finally be destroyed. At the end a cavern was created with a final volume of approx. 750,000 m³, which significantly exceeds the expectations from the original leaching concept.

RENC-6: Based on existing experience, an analysis of the spatial distribution of all field caverns and a minor well deviation of 30 m the maximum cavern diameter could be enlarged from 70 to 90 m. Shortly before start of drilling the well design had been modified to allow the relevant deviation.

When detecting a dolomite layer of up to 60 m thickness in the planned lower cavern area, the initial leaching concept had to be revised completely. Supported by rock mechanical experts the cavern was now relocated to an area above the layer on short notice. By locating the cavern in a greater distance to the dolomite layer, the initial restriction on the later minimum and maximum gas pressures could be avoided.

The subsequent leaching phase lasted for less than three years. The final net cavern volume exceeded the initially planned 500,000 m³ by now 580,000 m³. The challenges of the initial leaching phase could be overcome only by the interdisciplinary and efficient overall planning of the project including the support of various experts all on short notice.