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Water Supply Requirements for Solution Mining; an Important Challenge for the Iranian Underground Natural Gas Storage in Salt Dome

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Abstract

Due to the importance of sustainable supply of energy carriers, especially at peak hours, construction of underground caverns for storing hydrocarbon materials in salt domes using the solution mining technology is among the priorities of the current projects in Iran for storing natural gas under the ground. Considering the key role of easy and cheap access to the water resources required for the salt dissolution process, the solution mining technique has not been welcomed warmly in the arid and hot areas of the world. Evidently, transfer of water to these areas is associated with several problems considering the distance and transmission costs. Moreover, supply of water through aquifers is not a suitable solution for supplying the water required by the solution process due to the high depth and limited volume of the aquifers in the region. However, considering the national major requirements the natural gas storage project was designed in central region of Iran. Because of the arid and hot climate of the region, supply of water required for the solution process was one of the most important challenges in this project. In order to resolve this challenge various solutions were studied. Establishment of a desalination plant for treating the brine resulted from the solution mining process can be considered one of the effective ways returning water to the reuse cycle. Since detailed subsurface exploratory studies of the aforementioned salt dome are being conducted, no precise information on the physical, chemical and mechanical properties of the salt mass in the area is available. Therefore, at this stage it has been assumed that each salt cavern has a volume of 500,000 m^3 and also the required water for each cubic meter of salt was assumed to be 9 m^3. In this paper, besides pointing out the necessity of underground storage of natural gas in Iran, a brief introduction to the project for the storage of natural gas in the salt dome is presented. The predictions for supplying the water required for the construction of a cavern with a capacity of 500,000 m^3 using the solution mining technique were also made based on different solution speeds. Accordingly, different scenarios were considered based on the amount of water available for the solution mining process. All of the scenarios indicated that in order to construct the aforementioned cavern, the water shortage problem is a major challenge to which solutions shall be prepared before executing the project. Moreover, in this research, different desalination methods available for maximum recovery of the resulting brine (including different thermal, membrane, Nano-based, and hybrid methods) were introduced briefly and the prioritization of the best brine recycling methods was examined based on technical, operational, economic and environmental considerations. Considering the above parameters as well as investment costs, climatic conditions, project lifetime, nativity and ease of access to technologies the reverse osmosis method was the best brine recycling method and other alternatives took the lower stands in accordance with their priority.

Key words: Solution Mining, Underground Storage of Natural Gas, Hot and Arid Climate, Water Supply, Brine Treatment