Water in Gas Storage Caverns – Problems and Solutions

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1 Abstract

A residual quantity of brine from the solution mining process always remains in gas storage caverns. In most cases, due to the morphology of the solid substance surface in the cavern sump, the brine removal string cannot reach the deepest point of the brine-filled cavern. Even if the brine is extracted as far as the gas lock in the brine removal string, brine remains underneath the tubing shoe and in the pore space of the sump sediment. In the best cases this consists of less than 1,000 m^3 of free brine, in extreme cases it amounts to more than 10,000 m^3. It is not possible to extract these quantities of water by means of gas turnover.

At the brine-gas interface, water evaporates into the dry stored natural gas. Depending on the pressure and temperature conditions, brine surface and passage of time, the water vapour content in the gas can rise to its maximum value. This is approx. 75 % of the saturation concentration from pure water.

Due to the water present, gas hydrates can be formed. These can cause damage to installations and completely block pipelines. To prevent hydrate formation in the pipeline network, the gas

must be dried after withdrawal from the cavern. The drying devices require investment and operating costs and often determine the limits of the production rate.

There are two basic options for solving this problem – removal of the residual brine from the cavern and prevention of water evaporation into the gas. Attempts have been made to achieve the latter using so-called sump covering media. However, for various reasons they have proved unsuitable. Removing of the residual brine is the better option.

Various cavern operators have tried to minimise the quantity of residual brine by extending the brine removal string or by using coiled tubing. However, success has been the exception here.

EWE holds a patent for sump draining by replacing the brine with an organic liquid that mixes with brine. The principle behind this method is that this liquid is pumped into the sump through the brine removal string, then the resulting mixture is removed by injection of gas, processed above ground and the processed liquid pumped in again. This cycle is repeated until the brine has been almost completely replaced by the organic liquid. Currently studies are still under way to clear up remaining questions, and when they are completed an in-situ trial is planned in a cavern of the Nüttermoor storage area. A report on the results will be presented at a later date.