PRACTICAL EXPERIENCE WITH THE GAS LIFT METHOD DURING THE GAS FIRST FILL IN THE ETZEL CAVERN FIELD AND FURTHER POSSIBLE APPLICATIONS

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1 Abstract

The development of the Etzel cavern field as a major gas storage facility in Europe by IVG Caverns GmbH involves, beside the construction of new caverns, the conversion of crude oil caverns to natural gas storage caverns. The planning and technical supervision of the Gas First Fill of the Caverns as part of the conversion project is managed by KBB Underground Technologies GmbH. The debrining and first fill operation is realized by IVG Betriebsführungsgesellschaft GmbH.

The relatively large heights of the former oil caverns meant that the brine-filled caverns could not be completely filled with natural gas in the conventional way i.e. injecting natural gas with maximum allowable pressures to displace the brine. This is because of the equalization of the maximum permissible gas injection pressure and the static brine pressure at a certain depth of the gas / brine interface. The maximum permissible gas pressure is primarily determined by the depth of the last cemented casing shoe and limits the gas pressure that can be safely used during brine displacement. The limit meant that the brine could not be removed from the lower part of the cavern using conventional means, which would have left valuable cavern volume unutilised.

The challenge of the complete displacement of brine in such caverns can be solved by using the gas lift method. This involves the injection of nitrogen into the brine stream. The nitrogen is injected via an injection string (CT) which runs down the brine displacement string in a predetermined depth. The addition of nitrogen reduces the specific gravity of the saturated brine, and therefore also lowers the gas injection pressure required to lift the brine to the surface. Using this method enables the complete first fill of the cavern to be carried out successfully.

The nitrogen gas lift method was used for the first time in saltcaverns towards the end of the gas first fill of caverns being converted in the Etzel cavern field. The successful implementation of the gas lift method meant that another approx. 1/3 of the total cavern volume on average could be emptied of brine and filled with gas. Five caverns have been completely filled so far, and another five will be completely filled in the near future.

The first part of the paper gives an insight into the practical experience in the Etzel cavern field with the gas lift method, and describes the main factors influencing the brine displacement rate and nitrogen consumption. This involved conducting practical and theoretical analysis to help determine aspects such as the optimal CT installation depth and the optimal nitrogen rate.

The second part of the paper shows the targeted design of taller caverns than usual which would also have to be filled using the gas lift method in the first fill phase. The potential gains in height, geometrical volume and working gas volume are sketched out and compared to the extra costs and the impact on profitability.

Key words: Cavern Design, Caverns for Gas Storage, Gas Storage, Rock Mechanics, Gas First Fill, Gas lift