TECHNIQUE FOR ESTABLISHING SINGLE CAVERNS OF UNDERGROUND DISSOLUTION IN RECIRCULATING MODE

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1. CONCISE GEOLOGICAL BACKGROUND OF THE SITE AND THE WELL DESIGN

The productive (payable) bed of rock salt occurs at a depth range of 872.0 - 909.8 m. The lower member (899.5 - 909.8 m) consists of an interbedding of salt and dolomite. The payable bed has two ´regular dolomite beds of 0.4 m in thickness (876.7 - 877.1 m) and 0.3 m (903.5 - 903.8 m). The rock salt bed is underlain by dolomites occurring at a depth range of 909.8 - 918.8 m and by clays (918.8 - 932.8 m). Lower, down to the face, the section presents sandstones.

The weighted mean of the rock salt bulk weight is 2.08 g/cm^3 .

The orientation of the payable bed is close to horizontal, the rock salt is actually monomineral and consists of halite (93-98%).

The position of operating pipe strings at the start of preparatory wash-out is as follows:

- water supplying, diam.= 108 mm - 905.8 m;
- brine pumping-out, diam.= 73 mm - 908.0 m.

2. WASH-OUT (DISSOLVING) OF PREPARATORY WORKING

The absence of the possibility to utilize weak brines during dissolution of a preparatory working makes it necessary to obtain production brines in a recirculation mode. In such a system an accumulating tank (1) (fig.1) of 200 m^3 capacity is used. Water being supplied through the control-and-distributing point from the tank (9), goes to the well (3), is partially saturated by NaCl in the cavern, returns on the surface and goes to the accumulating tank (1) until its complete filling. With water supply capacity equal to 16 m^3/h such filling occurs within 12 hours. Afterwards the water supply into the well is stopped and the solvent is pumped to the well from the accumulator (1). Thus, a closed loop is formed: accumulating tank (1), injection pump (2), water supplying pipes, water supplying column (4), cavern (6), brine outpumping column (5), accumulating tank (1) where solvent circulates until the concentration of brine (same as solvent) in the tank reaches 260 g/l. After that the injection pump (2) is stopped, and brine from the accumulator (1) is pumped into two reservoirs (7, 8) - each of them 100 m^3 - for subsequent marketing to users. Further cavern dissolution in the recirculation mode then continued by the renewal of water supply into the well (3) from the reservoir (9) and discharge of brine into the accumulator (1) till its filling up; after that renewed recirculation in the closed loop (accumulator (1), injection pump (2), underground cavern (6), accumulator (1) where the brine is saturated up to 260 g/l and is discharged into tanks (7, 8) of 100 m^3 each for marketing).

3. OPERATIONAL (STOPING) DISSOLUTION THROUGH THE WELL

After establishing a development opening of the proposed (intended) volume which is sufficient for resaturating the brine - under the designed capacity - the overlying payable series is mined in 5 m steps. The mining of each step is carried out in two stages. At the first stage the rock salt is stepwise dissolved, i.e. the shoe of the water supplying column is set at the roof of the step being mined, and brine is taken in in the lower part of the cavern. Cavern dissolution is carried out for 60 days in this mode until radius at the roof reaches 10 m, and after that further dissolution of the step must be made by convective mixing through lowering the water supplying column to a needed (corresponding) depth and continuing to dissolve during a time interval - until the corresponding radius is reached (fig2).

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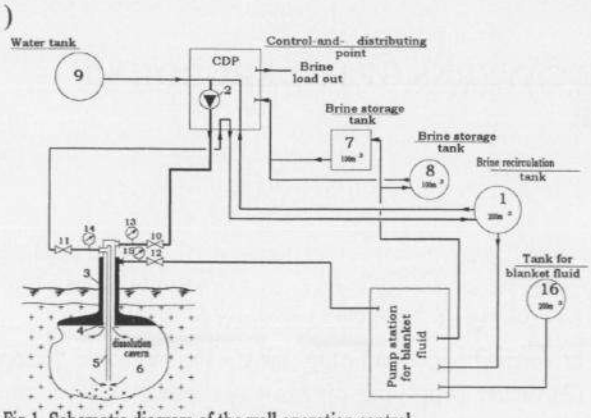

Fig.1. Schematic diagram of the well operation control during preparatory cavern dissolving.

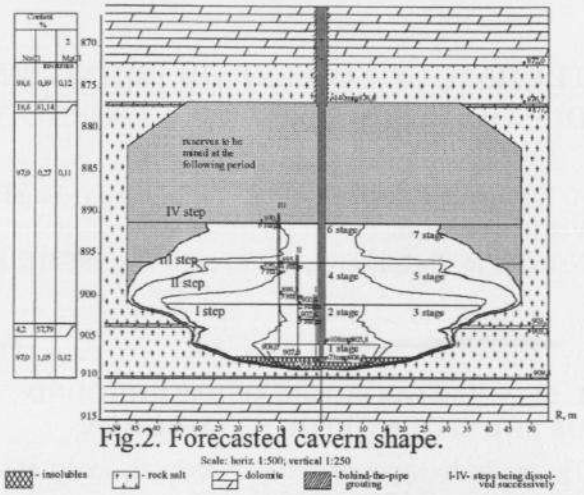

Fig.2. Forecasted cavern shape.

During the well operational mode exploitation the following flows scheme applies: water from tank (9) by pumps (2), located in the building of control-and-distributing point, is pumped into the well (3) via water supplying column (4). Commercial brine produced in the cavern (6) is sent into brine accumulating tanks (1, 7, 8) through the brine outpumping column (5) and via pumping control-and-distributing point (CDP); from these tanks the brine, when necessary, may be sent - via pumping CDP - for loadout to customers (fig.1).

The cavern will be completely mined-out for 13.9 years (4170 days) and will reach a volume of 158.5 thousand .m^3; for that it will be necessary to use 522 m^3 of blanket fluid, and 961.3,000 m^3 of brine and 288.8,000 t NaCl will be produced, which corresponds to 84.3% as the recovery ratio of valuable mineral from the designed cavern contour (delineation).

4. CONCLUSION

The technique developed for establishing single caverns had been experimentally tested at three commercial wells and revealed good convergence with forecasted calculations. This is visibly illustrated at the demonstration facility.