CAVITA: A Multipurpose Numerical Code for Brine Production Planning and Cavern Design and Control

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INTRODUCTION

One of the most important factors for the management of the brinefields is the knowledge and the forecast of the dimensional development of the mined caverns, in order to optimise the operative conditions and to assure the safety of the mine.

It is well-known that solution mining involves injection of fresh water into salt rocks for production of brine. The dissolution of salt acts into the growing upwards cavern during the productive phase; the shape and the size of the cavern influence the process of dissolution itself and are controlled by specific technical operative parameters.

The knowledge and the control of these parameters are basic in order to achieve an optimal technical-economical exploitation of the available resources (minimum amount of water injected, maximum concentration and / or saturation of brine, maximum recovery of the resources) and to monitor the safety and environmental constraints (geomechanical stability of cavern, subsidence). This monitoring is very useful not only for production purposes, but even for storage (LPG, oil and its by-products, chemical plant dump, nuclear wastes.....).

On this subject, Mining Italiana developed the numerical code named CAVITA , improving the previous version. The code provides the forecast production of brine for each cavern, according to the geometrical and production planned parameters (flow rate, density, temperature, injection and withdrawal depths) and provides, furthermore, the final shape and size of the cavern after any chosen amount of time.

The code is a multipurpose tool in solution mining activities as it can be used either for the short or long term planning in a brinefield or for the simulation of the tightness tests. CAVITA is regularly used for several years during the exploitation in the Belvedere Spinello (Crotone, Italy) brinefield for short term planning and for monitoring the shape of the caverns. It is noteworthy the fact that the code is continuously tested and calibrated on the production data arising from the 20 caverns in the brinefield, which represent a valuable help for performing in situ tests whose results are used for upgrading, in real time, all the effective parameters controlling the simulation of the dissolution in the development of the caverns. For this purpose the comparison of the results of the sonar surveys that yearly record the

shape and the size of the caverns and the mass-balance control of the salt dissolved into the brine that daily is recorded and upgraded is used.

A further use of CAVITA, taking advantages of the availability of such a large number of caverns, like in Belvedere Spinello, whose presence allows to upgrade continuously the code, is the simulation of the tightness tests of the caverns that indirectly provide several results that can be used for monitoring the cavern from a geomechanical point of view, helping , for instance, the geomechanical modelling of the brinefield.

Another application of the code is the long term planning in new brinefields. For this purpose the code was used for the planning of the new opening brinefield in Torrente Cavone (Matera, Italy), providing very useful indications about the correct flow rate of injection to be used for a rational optimisation of the period of exploitation and about the planning of the starting new wells.

Moreover, the code is a powerful tool for planning cavern design for storage of LPG or hydrocarbons, where the time of fulfilment of a complete cavern has to be lesser than in the productive case and, consequently, the flow rate and pressure used have to be suitable for this purpose. In this case too, it was possible, with the simulation, to verify either the time spending in the development of the cavern following the project specifications or to optimise the flow rates of injection in order to rationalise the operative period, calibrating them according to the size of the pipeline and to the pressures.