Solution Mining Research Institute, Fall 2005 Technical Meeting
Nancy, France, October 02 – 05

A new Model to Predict Subsidence above Brine Fields

Ralf Eickemeier

Federal Institute for Geosciences and Natural Resources (BGR)
Section B2.6 (Numerical modeling)
P.O. Box 510153, 30631 Hannover, Germany

1. Abstract

Solution mining for salt production as well as storage of natural gases or liquids in (salt) caverns causes subsidence at the overburden. Often the question arises, how the future subsidence will develop with time. The answer to this question can be important for the planning of new residential or industrial areas, for water drainage at the overburden surface and last but not least for the compliance with subsidence limits stipulated by the licensing authority. This work can be done by means of 2D- or 3D-FE analyses for simple cavern field configurations. In the case of complex cavern field configurations FE analyses can only be performed with time-consuming 3D-modeling. In some cases the FE analysis will even not be possible. Therefore in the past a lot of work had been done to predict the subsidence above cavern fields and solution mined caverns in another way, e. g. SMRI's software SALT_SUBSID, the Schober & Sroka model and the Fokker model. The model used for SALT_SUBSID is based on the work of T. Maruyama about "Statistical Elastic Dislocation in an Infinite and Semi-Infinite Medium". The Schober & Sroka approach is based on the model of the rock mass as a stochastic medium. The approach of Fokker is another approach related to the Schober & Sroka approach but more flexible for characterizing the shape of the subsidence trough. The new Eickemeier model combines the advantages of the Schober & Sroka model and the Fokker model. Additionally, the creep properties of the rock salt were included into the Eickemeier model so that detailed information about cavern convergence rates is not required.

Subsidence measurements are needed to determine the model parameters (effective creep parameters of the rock salt and shape parameters of the subsidence trough). The model parameters are calculated by means of least square analyses of the calculated and measured data at selected points.

The new BGR proprietary software ProSub includes also the SALT_SUBSID model as well as the Schober & Sroka model which represents a special case of the new Eickemeier model. For illustration first successful applications to the subsidence prognoses for the Winschoten / Heiligerlee and the Zuidwending brine fields are shown.