ANALYSIS OF WATER LEVEL AND LAND SUBSIDENCE DATA FROM THOREZ OPEN-PIT MINE, HUNGARY

Professor Rozalia JAMBRIK DSc.
Director of the Institute for Environmental Management,
Head, Department for Hydrogeology and Engineering Geology,
University of Miskolc,
Hungary

SUMMARY

The most important occurrence of land subsidence in Hungary caused by underground water withdrawal can be found in the NE of Hungary, in an area of open-pit mining at the foot of the Matra mountains. This paper presents the monitoring system of the underground water withdrawal, the processing method of achieving the underground water depletion and of the land subsidence as its indirect effect, as well as conclusions which can be drawn from the analysis of the observed data. The back analysis is illustrated by examples.

INTRODUCTION

The most important occurrence of land subsidence in Hungary caused by underground water withdrawal can be found in the area of the brown-coal open-pit mines of Matraalja (see Figure 1).
The first exploratory wells were drilled in 1920 and by 1961, the total number of geological exploratory wells was 646. These were supplemented by exploration for production purposes, hydrogeological, engineering geological and soil mechanical exploration, geophysical measurements, the information from geological logs of local and regional water level observation wells, as well as the geological, hydrogeological and water quality data from the water-wells. The data made it possible to make a basic geometrical model, which was the basis of an integrated seepage-hydraulic-mechanical model used to describe the complex processes of water decrease and the resultant land subsidence. In the coal sequences 12 coal seams can be found, dipping at 2-3 degrees in S-SE direction. The dewatering affects 13 water bearing layers in the multi-layered aquifer system. The dewatering of the Upper-Pannonian brown-coal area of the open-pit mines at Thorez was begun in 1961 by using a dewatering gallery method. Since 1967, this method of dewatering was changed to the filter wells method used in the intermediate layers.

The opening of the first mining sector (East-I) began in 1964, its exploitation lasted from 1969 to 1984. The extension of that mining sector is planned in an area of about 5 km². The dewatering of the second mining sector (West) began in 1970, with actual production beginning in 1975. The dewatering of the third open-pit mine (East-II) began in 1980, and it has been mined since 1982. During the drainage of the Matraalja sector which has been progressing since 1961, about 460 million m³ of underground water has been pumped by the Matraalja Coal Company from an area of 900 km² from a maximum depth of 200 m.

**MONITORING SYSTEM OF THE MATRAALJA OPEN-PIT MINES**

The process of mine drainage meant a slow decrease in water level over several years in a given vertical cross-section at first and afterwards, maintenance of the water level was necessary for the purposes of the mining activity. The mine drainage was performed by using the method of intermediate layers and a system based on the transverse range of the wells. Because of this method and drainage system the process of the water management and recharging has to be taken into account in certain areas, the effect of the drainage on new mining areas is superimposed on the former water levels. Because of the complicated hydraulic connections of the multi-layered aquifer system, the direct and indirect effects including decrease of water level and land subsidence of the transverse drainage systems cannot be separated, the resultant is recorded by monitoring time-logs.

The regional water level was recorded every three months by using groups of observation wells of the Panpipe system, suitable for separate observation of each water-bearing layer. The drilling of observation wells was continuous and progressed as the cone of depression extended, so the time intervals between the observations are different. Because of the limited utilization possibilities of the depressed area the distance between the observation wells are also not uniform (see Figure 2). The local water level decrease and the efficiency of the drainage has been controlled by using a system of local observation wells located inside the mining zone and in its immediate surroundings.

Mining began after obtaining the planned degree of advanced drainage. A geodetic measuring system was used for the measurement of land subsidence caused by the drainage of aquifers. This geodetical net work has been continuously expanded, the measurement of its net-points was performed every six months. The surveying net work is correlated to lineal surface facilities such as roads and railways, and can be found at various distances from the observation wells. The distance between the surveying net work and the nearest observation well varies from some hundred to some thousands of metres. Levelling of some basic points was carried out in 1955. The basic surveying net work was laid between 1970 and 1973, 9-12 years after the