# SURFACE TERRAIN FOR DISSOLUTION SALT EXPLOITATION MONITORING

**Arsene C.[1)], T. Oneţ[1)], M.V. Ortelecan[2)]**

[1]*Faculty of Constructions, Technical University Cluj-Napoca, 72 Observatorului Street, Cluj-Napoca, Romania; cornelarsen@yahoo.com;* [2]*Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Mănăştur Street, Cluj-Napoca, Romania*

**Abstract.** In addition to the solid-state exploitation method, another method used for salt deposits is through dissolution. Even though through this method, the voids of dissolution are located at depths higher than in the case of solid exploitation, in time, manifestations caused by a number of factors occur at the surface, that disrupt the process of extraction and controlled conduct. It is also necessary in this case to create a tracking station, its points allowing us to make observations through specific topographical methods, to determine the magnitude of these events.

**Keywords:** tracking, topographic methods, tracking stations, subsidence.

## INTRODUCTION

In our country, although there are many salt massifs, besides those exploited in the solid state, few are extracted through the dissolution method, given the geological, mining and qualitative conditions that must be met in order for the exploitation to be profitable and to be realized under safety conditions (Hirian and Georgescu, 2009).

Essentially, the method consists in drilling wells, from the surface or underground, through which pressurized water is introduced to dissolve the salt massif and extract the resulting solution (brine).

The salt dissolution process is conducted using an insulating fluid and is influenced by (Atudorei et al., 1971):

- the salt concentration of the dissolution fluid (water) - the dissolution rate is counter proportional to the salt concentration;
- the temperature at which the dissolution process takes place - the dissolution rate is directly proportional to the temperature (at 80-90 ° C, the dissolution rate is almost four times higher than the one recorded at temperatures of 16-20 ° C;
- the circulation rate of the dissolution fluid in relation to the salt massif;
- the tectonics of the salt massif;
- the intrusion of other salts and / or impurities into the salt deposit.

The well-drilling exploitation method - the large-scale version, appeared in the U.S.A. after which it was taken over by other countries. In this alternative, the horizontal dissolution rate appears, from the axis of the well to the periphery, the void resulted has the form of a cone trunk with the large base upwards, and at the end, a cone trunk assembly.

Here, in the first stage, the small stepped (small-scale) version (in Ocna Mureş) was applied - a procedure approved by the engineer V. Dima. Unlike the large-scale version, where the lifting of the exploitation columns takes places about 1-2 times a year, the small-scale version involves daily lifting of the exploitation columns. Within this process the predominant rate is the vertical dissolution one. The resulting dissolution void has the shape of a cylinder with the top part severed or sharpened.

For the moment, in our country we apply the big room procedure.

The exploitation method is shown in Fig. 1 schematically.

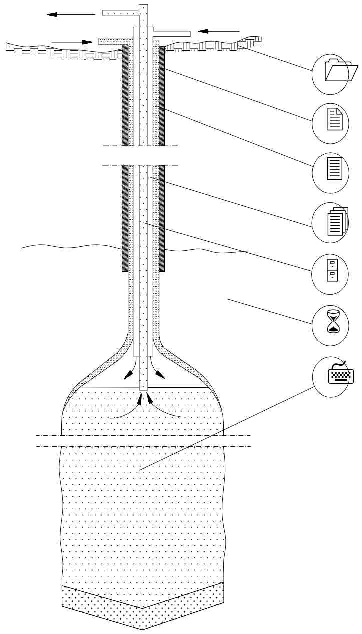

Fig. 1 Well salt exploitation method

Fig. 1 shows:

1. terrestrial surface;
2. anchorage column;
3. insulating fluid;
4. water insertion column;
5. brine extraction column;
6. salt deposit;
7. dissolution void.

## MATERIAL AND METHOD

Unlike the situation where the salt deposit is exploited in a solid state, in the case of the dissolution exploitation method the area of influence at the surface is higher, given the extension of the exploited area exploited through this method.

Even if the resulting dissolution voids have a diameter of up to 100m and are situated at high depths in relation to those resulting from the solid state exploitation, the manifestations occurring at their level (caused by factors such as tectonic, geomorphological, seismic or defective application of the exploitation procedures) are transmitted at the surface.

The tracking station in this case includes, in addition to the longitudinal and transverse alignments, the connecting marks (points in the area's support network, located in stable areas outside the zone of influence) and tracking marks set on the flange of the well, or, if the site is not accessible, at the base of the feet of the well.

At the ends of the alignments, outside the affected area, 3-4 support marks will be placed on each side, at distances of 40-50 m between them and arranged, in relation to the position of the exploited space, starting from where the value of the vertical displacement is null (Ortelecan et al., 1999). In this case alike, the distance between the work marks is determined by the depth of exploitation, the relief, the existence of some tectonic disturbances or disturbing factors, with values of 40-50m, correlated with the position of the marks placed on the flange of the wells, respectively those at the foundation of the feet of the wells.

Observations will be made using the same tools and the same work methodology in each cycle, and after processing, the position of the tracking station marks (including the ones mounted on the flange) and the connecting marks specific to the current cycle will be determined.

## RESULTS AND DISCUSSION

A first step in processing the observations of each measurement cycle is, as with all tracking networks, checking the stability of the points in the support network (micro network) used as connecting marks, treating the network as a free one (Ghiţău, 1983). After identifying stable points, the spatial positions of the marks in the current cycle are determined, and then used to determine the displacement vectors (Arsene and Ortelecan, 2013), towards the position occupied by each of the reference points in the previous cycle, respectively in the base cycle.

The alignment sheet will present the situation plan with the alignment marks and the position in relation to the other alignments and targets, data on the position of each reference point at the original measurement and the current cycle data.

As the area of influence in this exploitation method is high (due to the extended area on which the wells are located), but also because of the relief and the installations related to the wells, the distances between the marks are determined indirectly.

After calculating the specific parameters: $\Delta x_i$, $\Delta y_i$ – horizontal displacements, $\Delta d_{i,i+1}$ – the variation of the length of the interval, $\varepsilon_{i,i+1}$ – the longitudinal deformation, $S_i$ – subsidence, $\Delta S_{i,i+1}$ – the immersion difference, $S'_{i,i+1}$ – the interval inclination, $\Delta S'_{i,i+1}$ – the interval variation and the rate of immersion per period – $v_i$ , the diagrams are plotted: horizontal plan movement, subsidence diagram, longitudinal displacement diagram, longitudinal deformation diagram, the interval slope diagram, the inclination variation diagram, which identifies the track and direction of the movement of each mark from its position in the base cycle to the current observation cycle.

## CONCLUSIONS

In the case of the salt-dissolution exploitation method, even if the brine extraction voids are at great depths, the effects of the movements caused by these voids can in some cases seriously affect the surface (Photo. 1). The causes that lead to the occurrence of the displacements may be geomorphological, tectonic, seismic, incorrectly guided by the dissolution process, or by carrying out surface procedures that do not take into account the existence of the wells and, implicitly, the dissolution voids associated with them.

Another cause is the vertical deviation of the drilling direction, often encountered when the drilling depth is high. The deviation from vertical a drill causes the dissolution process not to occur symmetrically (Atudorei et al., 1971), leading, in time, to the partial or total dissolution of the pylons of the wells.

Given the fact that direct access to the dissolution voids is not possible, in order to accurately outline the displacement phenomenon, besides the topographical methods used for monitoring, cavernometric (for the resulting void), gravimetric, electrical measurements and, more recently, micro-seismic monitoring are used. All these methods, in conjunction, enable the gain of information that makes taking measures, to avoid or limit destructive effects, possible.

Photo. 1. The well field Ocna Mureş - 2011

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