

## What happened to Hengelo cavern 86?

Paul Oonk, Els Wijermars, Martijn ter Braack, Alex van El, Marinus den Hartogh  
Nobian Industrial Chemicals B.V., Boortorenweg 27, 7554 RS Hengelo, The Netherlands

### Abstract

As part of the Subsidence Management Policy, all not-inherently safe caverns in the Twenthe-Rijn Brinefield must be monitorable until they can be backfilled. In recent years, all but two closed-off caverns (60 and 86) were made accessible by either removing a plug from a well or by drilling a new well into the abandoned cavern. These two inaccessible caverns were located under a landfill with a fluid-tight protective floor, which prevented a relatively easy vertical well trajectory. After a successful drilling campaign and regaining access to cavern 60 according to plan, no cavern was found when drilling towards cavern 86.

At -306 m (-1004 ft) true vertical from ground level (GL), there were unexpected losses of drilling mud. This was 73 m (240 ft) above the expected cavern roof as last measured in 1979. After attempting to cure the losses, drilling recommenced with significant losses. Drilling continued into the last measured cavern bottom at -415 m (-1362 ft) GL. Throughout this section of the well trajectory five pockets (<1 m (3 ft) high) were encountered where there was no weight on the bit. This, in combination with higher-than-expected rates of penetration and deeper lying geological markers based on drilling-breaks, led us to conclude that this cavern had collapsed since abandonment in the early 1980s.

The main outstanding question was: can the process of layer-by-layer collapse of the cavern roof continue until the surface? In the worst-case scenario, this could potentially result in a sinkhole and/or the landfills fluid-tight protective floor to be torn apart and, thereby, risking polluting the surface environment. After careful examination of the final well trajectory and a geological assessment of the gamma-ray data, it was concluded that the migration ended well below -300 m (-984 ft) GL.

The lessons learned on cavern collapse will help Nobian reassess parameters used to evaluate if a cavern is inherently safe or not; the measured bulking factor was observed to be significantly higher than previously assumed, and the arching effect appears to constrain the potential cavern migration path. When the lessons are verified and incorporated it could result in several caverns currently classified as non-inherently safe to be reclassified.

**Key words:** Bedded Salt Deposits, Cavern Plugging and Abandonment, Rock Mechanics, Netherlands, Safety, Sinkholes, Subsidence