

## Remote monitoring of hydro-drillings

Open cast coal mines are typically places where measuring groundwater levels is a very important activity. This is not only to ensure the safety and operation of the mining operation itself, but also to minimize interference with the life of adjacent communities, transport infrastructure, surrounding nature and the landscape. Level measurements are usually taken several times a year at several dozen monitoring boreholes, most of which are located along the edge of the extraction area. The measured data are compiled in a technical report, based on which any technical measures are taken. This can often lead to a time lag of 2-3 years between changes in the subsurface and the implementation of measures. This causes risks of delay and can lead to subsequent costly measures.

### What monitoring looked like in the past

In both mining areas, operated by **Severočeské doly a.s.**, it was until recently necessary to measure the levels at most locations purely manually using a level indicator.



Figure 2 Steel container above the borehole

Only at a few locations (boreholes) was the level measured automatically and recorded in the local memory. However, the measurements required frequent servicing with battery changes and on-site data retrieval. A large steel protective container had to be placed above the borehole to house the measuring station and the battery. The construction of the container and the acquisition of the control panel was a costly affair, with a medium-sized discharged battery having to be replaced with a charged one approximately every 2-4 months. While some of the measuring panels had a GSM communicator, this did not have a signal available at most sites and so data was only retrieved on site by connecting a laptop.



Figure 1 Manual level measurement

### What are the significant changes in monitoring brought by the new solution

The situation began to change in 2018, when a one-year pilot of two types of developed devices, SENSECOM-GL1 and SENSECOM-HP1, adapted for low-energy operation using the then newly built SIGFOX nationwide IoT network, was completed.

The SENSECOM-GL1 enabled the wireless transmission of data from the metering control panel and thus ensured the continuous acquisition of data from at least those sites where metering control panels were already in operation.



Figure 4 Level measurement with VW probe and data sending with SENSECOM-HP1

However, it was the SENSECOM-HP1 device that brought a major breakthrough, solving several things at once.

This equipment can work directly with vibrating wire type transducers (probes), replacing the need for a measuring station at least where a single probe is used in the well. The device has minimal power consumption requirements. A

single small battery the C size is sufficient to measure and transmit data for several years. Minimizing the size of the whole device allows it to be placed directly in the well head, on top of which a cap antenna is also installed. This eliminates the need to build a costly house around the borehole and invest in a measuring station. Maintenance has also been simplified. The device is able to run 30 times longer, i.e. more than 5 years, without changing the battery. Metering results are sent twice a day via a full IoT network, making data available online, seconds after the measurement, rather than at quarterly or annual intervals with on-site readings as before.



Figure 3 Meter panel with connection to SENSECOM-GL1 IoT communicator

Shortly thereafter, the development of the multi-channel version of SENSECOM-HPC was completed, which fully replaced the operationally and capital-intensive measuring station for up to 5 connected probes simultaneously in one borehole (measurement of pore pressures in different rock layers). This equipment could also be placed directly in the well head. In the following 2 years, 100 wells in each extraction area were gradually equipped with single-channel or multi-channel devices.

## Data availability

Severočeské doly a.s. has developed its own information system that processes and plots incoming data into geological layers. Measurement results are also readily available in the equipment manufacturer's SENSEPARAM.COM portal solution, where examples of actual equipment in operation (anonymised) can also be seen.



Figure 5 SENSECOM-HPC for measuring from up to 5 VW probes and sending data via IoT network

Communication	Net	Name 1	Name 2	ID	Active	Date	MIS	VW1[us]	N1	VW2[us]	N2	VW3[us]	N3	VW4[us]	N4	VW5[us]	N5	TT[°C]	RH[%]
OK	SF	Demo	Demo	00207034	OK	20.12.2022 13:22:56	0	347.17	0	343.57	0	329.13	0	337.69	0	334.25	1	-0.5	74.5

Export CSV Alarm log

In SENSEPARAM.COM, calibration tables or parameters of polynomial equations of individual probes can be entered for more accurate results or to work with target parameters (e.g., water level in m above sea level). Measured or calibration-calculated quantities are shown in graphs, tables of historical values, etc.

Alarm notification messages can be set up for conditions when critical values are exceeded, sent as SMS or to an email address. Data in raw or processed form can be sent online to the customer's database for further processing, archiving, etc. using a callback.

## Application of solutions in other sectors - e.g. bridges, buildings, dams

The same SENSECOM-HP series devices are also used outside the field of hydrogeology, e.g. for diagnostics in the construction industry for precise measurements of expansion joints and cracks in structures, forces or tilts, in short, wherever vibrating wire transducers (so-called VW probes) are used for long-term static diagnostics.



Figure 6 Crack measurement in construction with 3 probes

## Benefit of the solution to customers



Figure 7 Monitoring of groundwater levels (and rock pore pressures) at one of the Severočeské doly a.s. sites.

Thanks to the SENSECOM-HP equipment, the hydrogeology team of Severočeské doly a.s. obtains daily readings of the level or pore pressure of separated rock layers from more than 200 boreholes in the area of the Libouš and Bílina brown coal quarries, with minimal operating costs and accuracy that allows, for example, to detect the effects of tidal forces on rocks.

There is no longer a need to use analytical reports from more than a year-old data. Important actions in the field are carried out much more quickly and in a cheaper way.

Without these low-cost, almost maintenance-free SENSECOM devices, online groundwater monitoring would not be possible to such an extent. This solution is equally applicable in other geotechnical and civil engineering sectors where sensors using the Vibrating Wire Gauges principle are used for diagnostics. The SENSECOM-HP series works with sensors of this type from several manufacturers such as Geokon, SISGEO, Gloetzel, RST Instruments, Geosense, DGSI, RocTest, BEWIS SENSING, etc.

The SENSECOM solution represents significantly lower investment and operating costs, easy installation, and almost maintenance-free long-term operation for many years. It sends measured data online, typically at twice daily intervals.