



Measurement of magnetic susceptibility for quality control of geothermal drilling backfills

Developed and tested in collaboration with Bohrlochmessung Storkow GmbH 



As a result of using shallow and deep geothermal probes for the production of heat and energy in the German private, commercial and public sector over the last few decades, a large number of drillings and geothermal installations were established.

These drillings might penetrate an aquifer as well as various layers of earth, which can have serious consequences: groundwater contamination, extensive lifting and lowering – a phenomenon which has caused ground elevations of up to 45 cm in Böblingen, Germany.

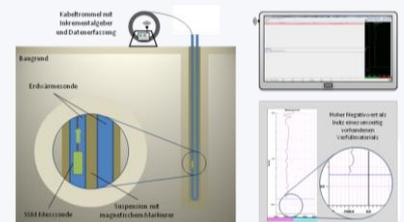
Quality control during or after the backfilling process of boreholes is facing the following problems:

1. There is no proof of the existence or non-existence of the backfill material in the annulus.
2. Measurement of the volume of the backfill material and of the flow rate is insufficient.
3. Due to its small diameter (26 mm), geothermal probes only allow to insert extremely small sensor systems.

A first step to approach these problems was taken by the company SCHWENK Zement KG, who invented a backfilling material which magnetically differs from its environment. The second step was the development of a sensor probe which reliably detects the existence of this special backfilling material without being disturbed by anomalies in its immediate

surroundings. The maximum diameter of this sensor should not exceed 22 mm in order to fit into the geothermal probe. This approach allows to protect the sensor and to operate it in a controlled manner.

As a response to these requirements, the companies Bohrlochmessung Storkow GmbH and SENSYS Sensorik & Systemtechnologie GmbH developed the sensor system MagSoil®.



See next page for measurement principle

The MagSoil® system consists of a sensor which measures the magnetizability and the conductivity of materials. Having a diameter of 16 mm or 22 mm, the sensor is designed to fit into narrow pipes. It can be used for measurements that are carried out in the immediate vicinity of a geothermal probe. Thus environmental noise or anomalies in the further surrounding do not disturb the measurement.

The MagSoil® is a portable system to be used on building sites. All system components (sensor, length counter, cable up to 1,000m, data acquisition and power supply) are fixed to a standard cable reel. Bluetooth is used for data transmission to Windows® devices.

The sensor is conducted inside of the geothermal probe and can be used to monitor the backfilling process or for follow-up inspections, making sure the backfilling material was homogeneously distributed. The SSM probe is lowered to the very end of the geothermal



Sensor, length counter, data acquisition and power supply on cable reel

probe for data logging.

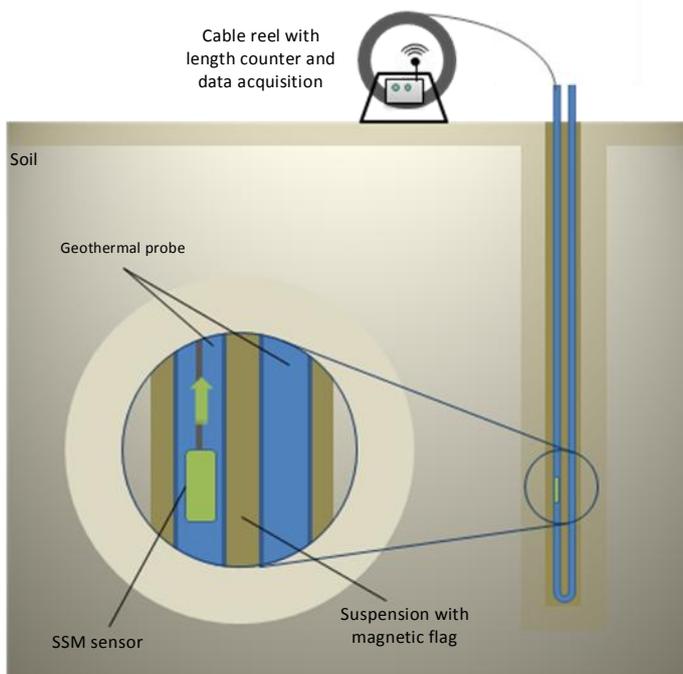
Data logging is started when pulling the sensor back up. The integrated length counter supplies information about the length. As a result, the data display is based on the measured depth.

Negative measurement values indicate the magnetizability of a material. Positive values on the other hand indicate the conductivity of a material.

Preliminary measurements carried out in latest geothermal

installations in Baden-Württemberg revealed detailed information about the quality of individual backfilling procedures.

The SENSYS measurement system MagSoil® clearly indicated local cloggings and voidages, where backfilling material was missing. As a result, the drilling contractor was able to take the necessary steps to improve the situation while carrying out the backfilling.



Measurement principle and display of data

