Use of computer simulations for data interpretation and design of the FLUTe® Activated Carbon Technique (FACT) for monitoring groundwater contamination

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In investigation and monitoring of contaminated sites and delineation of contamination plumes and flow paths in groundwater aquifers, the ability to adequately determine the inherent hydrogeological heterogeneities (different geological settings and fractures) is essential prior to choosing and designed remedial actions. The FLUTe Activated Carbon Technique® (FACT®) is a new way to do multi-level sampling (measurements from different depths using the same borehole) which has shown to have great potential (Cherry, Parker & Keller, 2007). The method seems to be cost-effective, versatile, have low detection limits, and have other advantages over the currently preferred methods.

At this time, there is a lack of knowledge and approaches to interpret obtained data and this is an obstacle to the widespread adoption of the technology. Moreover, there is ample room for improvement and optimisation of the system design. In this project, the limitations and possibilities of data interpretation were evaluated using a simple 2D model in COMSOL Multiphysics®. Field monitoring data obtained at a field site in Denmark were interpreted using the model and used to benchmark the method.

The model revealed that there is a non-linear correlation between the contaminant concentration at the site and the sorbed mass on the FACT® strips, which leads to difficulties in the data interpretation (Beyer, 2012). The relationship between the aqueous and sorbed concentrations can be explained if the hydrogeological properties of the aquifer are taken into account. The sorbed mass depends not only on the aqueous concentration, but also on aquifer parameters such as the porosity and the hydraulic conductivity. This fact is relevant in particular when the technology is applied in fractured media since the hydraulic conductivity can change several orders of magnitude within a short distance (Shapiro, 2011).

Combining the knowledge of the hydrogeological properties and the sorbed mass on the activated carbon strips leads to an improved interpretation of the contaminant concentration and distribution with depth. Furthermore, this study showed that the technology could be used for detailed investigation of the hydrogeological features affecting the contaminant transport (e.g. fractures) when the concentration data is available. The model indicated that the currently preferred design and operational method could be optimised, which would result in a reduction of material consumption and time needed to obtain satisfactory results.

References

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