nZVI Direct-Push Application as an In Situ Treatment of CHC: Results of Long-Term Monitoring Using Advanced Technology for Zonal Groundwater Sampling

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The main objective of this study is a verification of migration characteristics and remedial efficiency of the new type of zerovalent iron nanoparticles (nZVI) using an advanced procedure for monitoring of vertical stratification of contamination prior and after injection. The Spolchemie site was chosen to test nZVI for in situ remediation of chlorinated hydrocarbons. Spolchemie is one of the leading synthetic resin manufacturers in Europe, located at Usti nad Labem (Czech Republic) in the heart of Europe. The production, treatment, storage and distribution of various raw materials and products has led to extensive contamination by chlorinated ethenes and methanes, which in many cases have dispersed widely from the original source areas. The test site is contaminated only by chlorinated hydrocarbons; the remediation concept of the site is using an existing permeable reactive barrier, but recent contamination was caused by overflow of this wall and is solved by nZVI application.

This new contamination is the subject of present field test using NANOFER STAR particles – 1500 kg of 20% suspension. The nZVI has been supplied by NANO IRON, s.r.o., Czech Republic. A number of groundwater monitoring campaigns have been undertaken followed by a preliminary site investigation. Based on this work a conceptual site model (CSM) has been developed detailing the subsurface conditions followed by a preliminary risk analysis. This initial CSM has been refined by further targeted investigation and subsequent updating of the risk analysis. With further funding being secured, the CSM was expanded following delineation of the contamination, geological and hydrogeological surveys, well logging, development of a hydrogeological model of the site and a remediation feasibility study. At Spolchemie, injection equipment, particle suspension preparation and procedures have been set up; nZVI has been injected by the direct-push technique after detail monitoring using newly developed micropumps (PHOTON WATER TECHNOLOGY) installed into 5 depth horizons. The Micropump system is a newly developed advanced technology for zonal groundwater sampling to obtain the vertical distribution of contamination in the groundwater. nZVI nanoparticles are characterized with regard to their physical and chemical properties, their mobility and migration potential in the subsurface.

The presented poster will summarize the positive results of NANOFER STAR application - e.g. 330 days lasting contaminant reduction in different depth horizons, good distribution of the nZVI particles in the subsurface (migration up to 3 meters laterally from the injection points), significant increase of non-toxic degradation products (ethene concentrations 7 times higher than before the injection). Two important lessons have been learned from this pilot; the first is the importance of continuous monitoring of vertical distribution of the contamination and the second is the use of a tracer test to distinguish the dillution and reduction effect of nZVI injection.