

KARA TRUTNOV SITE: SUCCESSFUL REDUCTION OF MIXED CONTAMINATION OF CHROMIUM AND CHLORINATED ORGANICS

Remediation company EKORA in collaboration with company NANO IRON, producer of zero-valent iron nanoparticles (nZVI), conducted pilot injection of surface stabilized nanoparticles of elemental iron (NANOFER 25S) and their subsequent full-scale application to eliminate groundwater contamination of chlorinated hydrocarbons (CHCs) and hexavalent chromium (Cr^{6+}) at KARA Trutnov site in Czech Republic.

SITE CHARACTERISTICS

General

Name:	KARA Trutnov
Location:	Trutnov, Czech Republic
Industry:	processing of fur
Contaminants:	mixed contamination of Cr^{6+} and CHCs

Hydrogeology

Treatment Area:	60 000 m ²
Groundwater Table:	3-3.5 m bgl
Groundwater Velocity:	~9 m/day
Geological Profile:	quaternary fluvial gravel, basal part is formed by Permian sandstone

Common remediation methods including pump and treat, venting, and permanganate ISCO has been previously used at the site. The main contamination plume was eliminated but as a result, Cr^{6+} was mobilized from the bedrock. Therefore, nZVI was chosen for the subsequent laboratory tests and proved to be most suitable for the further treatment of this contaminated site.

REMEDIATION APPROACH

Remediation Objectives

Verification of laboratory test results,
Determination of effective application ratio and NANOFER 25S migration ability,
Establishment of the most suitable application method,
Testing of application equipment,
Impact of remediation on hydro(geo)logical characteristics and groundwater itself

Application Strategy

Application Type:	gravity feed through permanent wells
Product:	NANOFER 25S suspension prepared directly on site
Total Quantity Applied:	20 470 kg / 45,000 lb in 10 application rounds

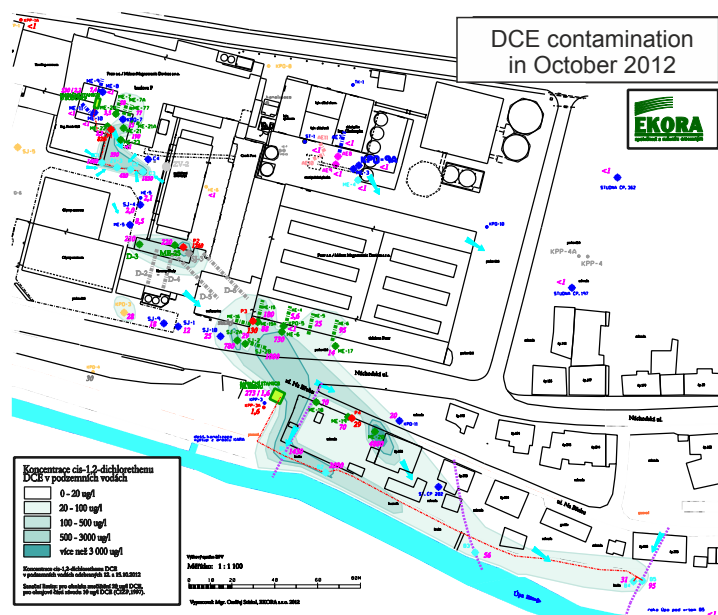
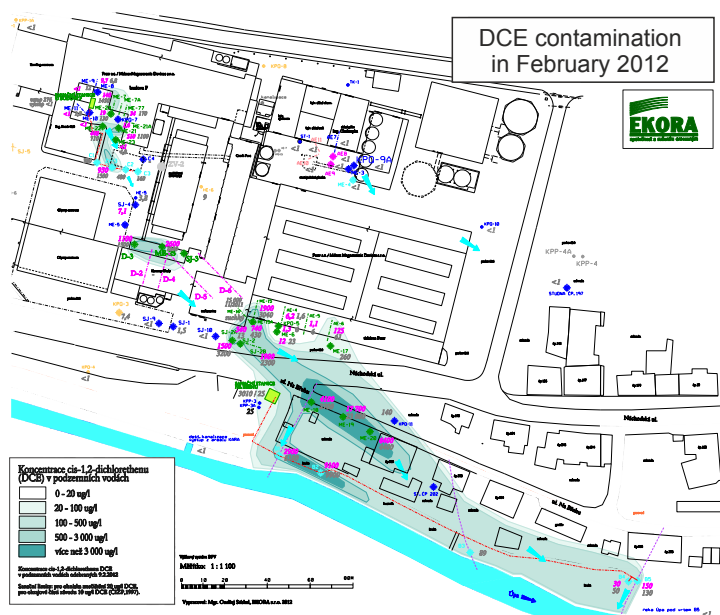


RESULTS OF A PILOT TEST

Change in chemical composition of groundwater sampled from well ME-24 caused by nZVI application

Parameter	Unit	September 2011 (before application)	September 2011 (after application)	October 2011 (after application)	October 2011 (after application)	Removal efficiency [%]
pH	-	6.94	8.58	7.98	7.87	
Total chromium (Cr tot.)	mg/l	42.5	<0.001	0.874	<0.001	100
Hexavalent chromium (Cr ⁶⁺)	mg/l	42.2	<0.005	0.873	<0.005	100
Vinylchloride (VC)	ug/l	278	70.4	<4	<4	100
trans-1,2-dichlorethene (t-DCE)	ug/l	14.1	1.9	<1	<1	100
1,1-dichlorethene (DCE)	ug/l	4.4	<1	<1	<1	100
cis-1,2-dichlorethene (c-DCE)	ug/l	2340	1060	3.1	18.9	99.2
Trichlorethene (TCE)	ug/l	642	92.4	1.64	<0.50	100
Tetrachlorethene (PCE)	ug/l	903	62.6	3.77	<0.50	100
Sum of CHCs including VC	ug/l	4182	1287	8.5	18.9	99.5

RESULTS OF A FULL-SCALE REMEDIATION



CONCLUSION

Pilot application of zero-valent iron nanoparticles (NANOFER 25S) for remediation of groundwater contaminated by mix of hexavalent chromium and chlorinated hydrocarbons confirmed the results of laboratory experiments and the high efficiency and safety of this method.

The subsequent full-scale remediation of the site resulted in total removal of Cr⁶⁺ and CHCs from the quarternary aquifer, in which decrease of CHCs level deep below the contamination limits has been observed. A significant drop in CHCs concentration also in the Permian profile was recorded. Nevertheless, a new source of contamination was discovered during site remediation and therefore, a project covering further treatment of KARA Trutnov site was recently proposed.

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