REMEDIATION OF THE SITE CONTAMINATED BY MORE THAN 1,000 TONS OF DICHLOROETHANE

Robert Raschman[1], Jan Němeček[2]

[1,2] DEKONTA, a.s., Volutova 2523, 158 00 Prague, Czech Republic, info@dekonta.cz

Abstract

During the 1999 conflict in Yugoslavia, HIP PetroHemija - a large chemical factory located in Pancevo - was bombed. The storage tanks containing DCE (1,2-Dichloroethane) were hit and 2,100 tons of DCE were spilled of which about half infiltrated into the soil. It is assumed that the world worst chlorinated hydrocarbons contamination has occurred. Since 2001 the works on subsurface characterization, risk assessment and pilot tests (pump-and-treat and steam enhanced extraction) have been performed. The contours of the free-phase pool as well as the contours of dissolved-phase chlorinated hydrocarbon plume in the affected aquifer (formed in backfilled sand up to 5 m thick) were determined. Urgent remedial pump-and-treat system for extraction of DCE from saturated zone was installed on the site and it has been operated since last September. The urgent remedial system consists of 6 extraction wells located to the area of the highest thickness of the DCE free phase pool. The extracted mixture of DCE free phase and heavily contaminated groundwater is treated in a gravity separator subsequently water containing up to 7,500 mg/l DCE is treated in a steam stripper and finally discharged to the waste water treatment plant. More than 285 tons of DCE have been removed from saturated zone since the beginning of the urgent remedial pumping.

Introduction

Installation of the urgent groundwater remedial system was financed by the Czech Ministry of Industry and Trade and operation of the system is financed by the United Nations Office for Project Services in Belgrade. DEKONTA performs urgent remedial pumping at the HIP PetroHemija site in Pancevo, during an interim period of time – before installation of a full scale remedial system under UNEP. Urgent remedial pumping started in January 20, 2003.

Description of Remedial System

The remedial scheme was developed on the basis of the results of the pilot tests performed and evaluated by DEKONTA in autumn 2002. The goal of the remedial scheme was to maximize the total EDC extraction rate for given total pumping rates (maximal capacity of the facility's steam stripper of 8 m^3/hour). Maximal allowed groundwater drawdown in remedial wells and pumping rates from individual wells were proposed in order to prevent adverse effects of the groundwater pumping on stability of subsurface and of on-site installations.

During the course of January and March 4 remedial wells were pumped. Due to very low natural recharge of aquifer pumping rate was significantly decreasing in the period January - April. Thus, another 2 remedial wells were added to the active remedial system in order to stop decrease of pumping rates and to keep high EDC extraction rates.

Extracted groundwater was lead via three settling tanks to the steam stripper. Free phase separated in the settling tanks was periodically pumped to the collection tank. Water treated in the steam stripper was then discharged to the PetroHemija´s wastewater treatment plant. Treatment facilities are operated by HIP PetroHemija according to direct contract with UNOPS.

Project Objectives

During the remedial pumping, monitoring and operational measurements was performed with the aim to the following:

- monitor and optimise the remedial technology (technological aspects),
- monitor removal of DNAPL (Dense Nonaqueous Phase Liquids) from the shallow aquifer (ecological aspect),
- detect potential adverse effects of groundwater pumping (geomechanical aspect).

The basic parameter monitored during the remedial pumping was the total yield of EDC by the remedial technology. The total yield of EDC was calculated as a sum of the amount of DNAPL accumulated in technological tanks and of EDC amount dissolved in water entering the steam stripper unit.

Further important parameter of the remedial system was the efficiency of the steam stripper. The efficiency was monitored comparing EDC concentrations in water samples of inlet and outlet of the steam stripper.

Decrease of the DNAPL amount in the shallow aquifer is assessed by measuring the DNAPL layer thickness in remedial and monitoring wells.

Improper operation of the remedial system can cause unacceptable adverse effects. Pumping of large amounts of solid particles or/and excessive drawdown of groundwater table can cause surface subsidence or even damage of aboveground or underground structures. In order to prevent these potential adverse effects measurements of groundwater table in remedial and monitoring wells and amount of soil particles in pumped groundwater is being performed.

Project Results

The project results can be summarized as follows:

- In the whole period of pumping (20.1. – 31.8.2003) about 32 450 m^3 of contaminated groundwater were pumped and treated.
- In the whole period of pumping 283.9 t of EDC (DNAPL: 64.6 t, and EDC dissolved: 219.3 t) were extracted. Another 2 t (DNAPL: 1.5 and EDC dissolved: 0.5 t) were extracted during pumping tests of selected newly installed remedial wells. It is assumed, that reduction of DNAPL pool thickness in aquifer by 0.1 m in average has been achieved by remedial pumping in the area of about 2 700 m^2.
- Daily EDC amounts extracted gradually decreased from more than 2 000 kg / day in January to about 600 kg in the mid of August. These changes reflex significant decrease of daily amounts of pumped DNAPL. Increase of daily EDC extraction rates can be easily achieved by including selected newly installed wells into the remedial scheme instead of those presently pumped wells (see recommendations).

- Amounts of solid particles pumped with GW did not detect any alarming values causing significant adverse effects of remedial pumping on stability of terrain or building structures.