The Use of High-Resolution Tools for Preliminary Assessment of ROI of Injections of Remediation Products

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Background/Objectives. Many remediation techniques are based on injection processes. Thus, their level of success is directly related to the correct sizing of the injection pressures, as well as the correct distribution of the points where it shall take place. There are different types of test described in the specialized literature, and most of them are expensive, of complex performance and interpretation. The objective of this study was to demonstrate, in a practical way, how the use of high-resolution tools may offer a quick, low-cost, and simple alternative for preliminary assessment of the ROI (Radius of Influence) of injections. The target site is located at the State of Paraná/Brazil and was contaminated by halogenated solvents. The water level is about 5 m deep and the saturated zone is composed of a predominantly silty/clayey material. In the study area, the flow velocity of the groundwater is lower than 1 m/year, reflecting a combination of reduced permeability and low hydraulic gradient.

Approach/Activities. In office, based on hydrogeological information previously available, the following was estimated: the theoretical limit of the injection pressure to avoid the rupture of the formation at stake, as well as the hypothetical ROI of an injection of 110 L, in a window of 0.5 m thickness and mobile porosity of 5%. First, 2 HPT and EC drillings were carried out for previous establishment of the characteristics of the not affected zone intended for subsequent injection. After that, the injection was made via direct push of 110 L of doped water with lithium chloride (5% solution), between 8 and 8.5 m deep. In the second day in situ, 4 HPT and EC drillings were carried out around the direct push injection point (1.0 m distance).

Results/Lessons Learned. Preliminary calculations indicated an injection limit pressure of about 0.5 bars and an expected ROI of 1.2 meters, for the injection of 110 L of doped water with lithium chloride (5% solution), in a window with 0.5 m thickness. The injection via direct push confirmed such assumptions. Among the 4 HPT and EC drillings around the injection point (approximate 1-meter radius), only the drilling located at the S showed results that indicated the influence of the injection. At this point, the average EC results were about 15% greater than the average results of the other drillings, and the maximum EC surpassed by 12% the greatest peak measured among the other points. The correlation between EC and HPT results (adjusted pressure) has also shown to be clearly negative, different from the other drilled points. This suggests that in this drilling, the most significant EC amounts reflect the transportation of the lithium chloride solution in low-pressure zones and no variation of granulation in the subsurface. The greater variability of HPT data (coefficient of variation 76% higher than the basic condition) and minimum HPT value 62% lower than the minimum value of the other points sourced evidence that these low-pressure zones were artificially generated, i.e., in the S axis, there was rupture of the formation. Therefore, with a short-term test (2 days in situ), it was possible to conclude that the application of remediation techniques based on injection of remediation products is hardly feasible in the study area, as the distribution zone tends to be limited and heterogeneous.