Leakage detection in an industrial water pipe network using induced polarization imaging

Katona, Timea (TU Wien, Research Group Geophysics, Wien, AUT);
Gallistl, Jakob (TU Wien, Research Group Geophysics, Wien, AUT);
Schlögel, Ingrid (Zentralanstalt für Meteorologie und Geodynamik, Wien, AUT);
Flores-Orozco, Adrian (TU Wien, Research Group Geophysics, Wien, AUT)

The integrity of water pipe networks in large industrial sites is critical to sustain an efficient mode of operation. Common approaches used to detect leakage are based on direct analysis, which are commonly time consuming and may require excavations, i.e. are largely invasive. In this context, non-invasive geophysical methods appear as suitable and cost-effective tools to evaluate the integrity of water pipes and detect leakages. In particular, here we propose the application of the time-domain induced polarization (TDIP) imaging method, a technique highly sensitive to the presence of metallic materials, as well as to changes in the subsurface water content. To evaluate the applicability of the method, we present here imaging results for data collected along thirteen transects collected within an industrial site in Austria, targeting at the detection of possible leakages in a water pipe network. Such pipe is coated by a plastic-based insulator to prevent corrosion of the metal. Hence, the failure of the insulator leads to corrosion and damage to the pipe and the leakage. Moreover, the lack of an insulator coating the pipe causes an increase in the IP effect due to the contact of the metal and soil. Measurements were performed using 1 m electrode spacing and a dipole-dipole electrode configuration to image the near subsurface with high resolution. The measurement conditions were particularly challenging as, considering the industrial context, most investigated areas were covered by a concrete overlay. Hence, installation of the electrodes was done within holes drilled into the concrete to properly put in contact the electrodes with soil materials, and to ensure acceptable contact resistances, as required to deliver high current injections and enhance the signal-to-noise ratio. Nevertheless, data quality was affected by major differences in the contact resistances and thus, the currents injected, as well as by the presence of anthropogenic structures associated to cultural noise. Therefore, we performed an extensive analysis of the data prior to inversion, aiming at obtaining imaging results not affected by systematic errors. Imaging results presented here indicate a close correlation of the electrical properties with the location of confirmed leakages and the Ground Penetrating Radar measurements, thus demonstrating the potential of the method.