ELECTRICALLY SUPPORTED ADVANCED REMEDIATION TECHNIQUES

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Abstract
Treatment of old environmental burdens represents one of the main environmental protection priorities in the Czech Republic. Due to prevailing high numbers of contaminated sites and the rather slow pace of their remedy, it is necessary to develop new ways with greater efficiency in complex geological settings. Although the long-time supported approach utilizing low-efficiency methods (such as pump-and-treat) is nowadays being abandoned, the range of modern and effective techniques is still quite narrow. Especially in the conditions of low hydraulic conductivity, the usable technologies are rather scarce. Recently favored methods based on the iron nanoparticles application have only a limited efficiency and the particles themselves represent a great investment that strongly limits the commercial deployment of this technique in a greater scale. The patent protected technology, developed with the support of TACR, reduces the cost of iron nanoparticle deployment down to 50 % by the support of direct electric current (DC). However, according to the high treatment costs and limited budgets, this improvement could still be insufficient in the conditions of the Czech Republic. Therefore, it is necessary to focus electrochemically enhanced reduction and oxidation processes to the possible use of cheaper reagents providing comparable results upon electron donation. The objective of this research was to develop new procedures for environmental burden treatment based on the synergy of electric DC with reducing or oxidizing agents and – most importantly – with the biological component of the environment. Redox reactions are characterized by the electron exchange between the reactants and the reagents' depletion. The supply of electrons in the form of DC is significantly cheaper than in the form of redox chemical processes. Due to the effect of electro-migration, the electric field can further aid in keeping the reagents within the target zone. Investigation of these processes and their optimization for the specific aquifer conditions lead to substantial cost reduction and to better usability of these techniques for the budget limited remediation projects in the Czech Republic. In this paper, we present the experimental design of the soil–oxidant–DC–bacterial component system and describe the contaminant behavior in this system. It becomes evident that within the right settings the electric current is an appropriate tool to support redox as well as biological processes leading to the effective remedy of the human-impacted environment.

Key words:
In-situ remediation, advanced techniques, electric current, sodium persulfate, bioremediation