

A Pilot-Scale Unit Coupling Recirculation Well and Advanced Oxidation Technologies for the Remediation of Contaminated Aquifers

Bassam Tawabini, Mohammad Makkawi

KFUPM

Abstract

The proximity of shallow groundwater systems to different sources of contamination makes them vulnerable to serious both environmental threats and human health risks. Hazardous pollutants that leak from underground storage tanks, landfills, and other industrial activities may eventually reach the underneath shallow groundwater aquifers and trigger different physical, chemical and biological contaminations. Developing a low cost and efficient technologies to remediate the groundwater has always been the goal of many research studies worldwide. This study aims to demonstrate the efficiency of a combined recirculation well-advanced oxidation (RW/AO) approach in remediating a contaminated-brackish shallow aquifer. Detailed geophysical, geological, hydrogeological and chemical investigations were conducted to delineate aquifer's characteristics. Identifying aquifer's type, groundwater depth, hydraulic heads distribution, aquifer parameters, flow direction, aquifer materials and groundwater quality is an essential step towards designing an efficient remediation system. Hydraulic and chemical tests were also carried out to understand aquifer's physical and chemical properties like hydraulic conductivity, groundwater velocity, turbidity, salinity, and chemical components. In the second phase of the study, a pilot-scale remediation unit was designed and fabricated using local resources. The pilot system has two integrated components: groundwater recirculation mechanism and decontamination photoreactor. For optimum recirculation, the pumping rate was set between 2.5 and 8.0 gpm. Moreover, the 8 UV-lamps oxidizing photoreactor was utilized to remove pollutants from the water. Results showed that the remediation system has an excellent capacity to remove the target contaminant (MTBE) in the field. The concentration of MTBE was reduced from 1400 $\mu\text{g/L}$ to as low as 34 $\mu\text{g/L}$ within 30 minutes with treatment efficiency of about 98%. It can be concluded that the (RW/AO) technology has proved, under the study conditions, its efficiency in removing MTBE from contaminated shallow aquifer in a short period of time.