Modelling Treatment of Chromium-Contaminated Groundwater With Zero-Valent Iron-Based Permeable Reactive Barriers

Hexavalent chromium (Cr(VI)) is a common groundwater contaminant, especially in industrial areas. Due to its characteristics of high toxicity and mobility, it is a great concern for human health and the environment. Cr(VI) can be reduced to the trivalent form (Cr(III)) which is less mobile and has a lower toxicity. Its reduction to Cr(III) can be achieved with a groundwater remediation method called Permeable Reactive Barriers (PRBs) which is a viable and cost-effective system. For two decades, PRBs containing zerovalent iron as a reactive material have been employed for in-situ remediation of groundwater. The design of PRB systems can be further developed with modeling tools. Based on the experimental results of Uyusur (2006), the present study is aimed to develop a mathematical model to understand the removal mechanisms of Cr(VI) using PRB systems and to investigate the effects of different operational conditions on its performance. In this regard, the change in reactivity of the iron surface due to mineral fouling will be integrated into the removal mechanism together with the proposed reaction network. The calibrated and verified model will also be used to run simulations for different geochemical conditions, flow rates, and loading rates, which will shed light to determine the optimum conditions for PRB type of removal systems.

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