ASCE Manuals and Reports on Engineering Practice No. 100

Groundwater Contamination by Organic Pollutants

Analysis and Remediation

ASCE

AMERICAN SOCIETY OF CIVIL ENGINEERS

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Groundwater Contamination by Organic Pollutants

Analysis and Remediation

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Sponsored by
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Abstract: Groundwater contamination by organic pollutants has become an important topic since the early 1980s due to detection of large-scale contamination events. Since that time, substantial research efforts have been focused on developing new and innovative technologies and management approaches to clean up organic-contaminated sites. With the development of new and effective technologies, current research efforts are now more focused on risk assessment and management at contaminated sites, and remediation in complex geological environments. Although research, technology transfer, and public education have been active links of the overall effort, still there is limited technology transfer and understanding of common remediation technologies and corresponding analysis among practitioners and managers. The goal of this monograph is to provide some insight into the remediation technologies associated with the saturated subsurface and corresponding analysis. It is intended to improve the understanding of both existing practitioners and beginning engineers, geologists, water chemists, and biologists.

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FOREWORD

Groundwater contamination due to organic contaminants is a common occurrence in the United States and elsewhere. The detection of large-scale groundwater contamination in the United States in the early to mid-1970s brought about the implementation of two important federal acts: the Resources Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, or Superfund). With the initiation of these acts, research related to soil and groundwater remediation accelerated and opened the public debate on health hazards caused by contaminated drinking water. The detailed investigation of early contaminated groundwater sites revealed that hazardous organic contaminants ranging from gasoline to chlorinated solvents were responsible for these widespread environmental problems. It was also found that these contaminants entered the valuable drinking water aquifers due to leaks and spills of underground storage tanks and pipelines as well as unauthorized disposal of hazardous wastes.

When large-scale groundwater contamination was first detected, remediation technologies were almost nonexistent, except pump-and-treat technology. Therefore, great emphasis was placed by federal, state, and private agencies on developing innovative technologies to treat contaminated groundwater so that health risks would be minimized and drinking water sources preserved. However, early progress in remediation technologies was slow because of the lack of understanding of the physical, chemical, and biological processes that control the fate and transport of organic contaminants in the subsurface as well as the complexity of the chemicals themselves. The processes controlling the environmental fate of organic chemicals in the vadose zone are different from those in the saturated zone. Similarly, different organic chemicals—ranging from hydrocarbons to dense solvents—react differently to subsurface conditions. Even in the presence of these difficulties and other limitations, such as subsurface heterogeneity, researchers have developed many innovative technologies to remediate aquifers contaminated with hazardous waste.