Sandia National Laboratories

Environmental Program

In Situ Reactive Barrier Systems

Technology Need

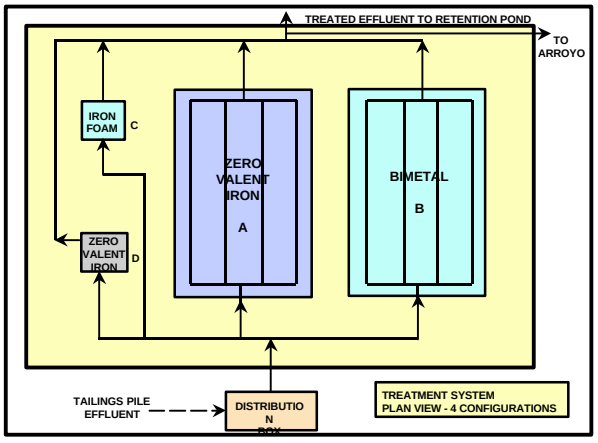
Until recently, remediation of contaminated groundwater utilized pump and treat or a related variation. Experience gained in this area has shown that pump and treat schemes are not cost effective in treating the majority of groundwater contamination problems. As an alternative to active pump and treat remediation systems efforts are being made to devise passive in situ treatment techniques.

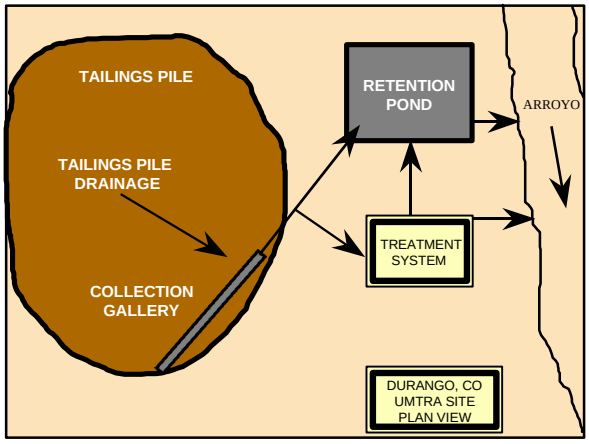
Objective

The primary aspects of a subsurface reactive barrier system are: (1) engineering / design, (2) system modeling, (3) installation methods, and (4) treatment materials. The engineering / design and installation techniques are adaptations of conventional civil engineering applications. The system modeling is simply modeling for a different reason, and the treatment materials have evolved from water treatment principles. The primary objective of this research project is integration of these four individually mature technologies to demonstrate an in situ passive technique for remediation of contaminated groundwater. Engineering design and constructability have proven to be the critical issues. Experimental results are providing the information necessary to determine adequacy of this technology at other sites with groundwater contamination problems.

Project Description

In an effort to devise a cost efficient technology for remediation of uranium-contaminated groundwater, the Department of Energy's Uranium Mill Tailings Remedial Action (DOE-UMTRA) Program through Sandia National Laboratories (SNL) fabricated a field-scale research project utilizing reactive subsurface barriers at an UMTRA site in Durango, Colorado. A reactive subsurface barrier is produced by emplacing a reactant material (metallic iron was used in this experiment) in the flow path of the contaminated groundwater. The reactive media then removes and / or transforms the contaminant(s) to regulatory acceptable levels. Uranium is the primary contaminant of interest in this technology deployment.





Many of the Department of Energy's waste streams are more complex than the Durango Project. Oftentimes mixed waste streams can contain mixtures of metals, radionuclides, and organic contaminants which cannot be fully treated by simplistic chemical approaches. Treatment of complex waste streams by reactive barrier technologies requires: (1) development of robust chemical treatment zones that can passively treat a wide range of contaminants within as small a treatment zone volume as possible; (2) meeting long-term performance criteria in a cost-effective manner; and (3) economical constructability. In response to the need for reactive systems that will target multiple contaminants, a reactive barrier demonstration is planned for a complex ground-water contaminant problem at DOE's Rocky Flats Environmental Technology Site (RFETS).

Site Layout.

Advantages

(1) In situ treatment keeps contaminants away from the surface, minimizing potential worker and public exposure to toxic contaminants; (2) passive design requires minimal operation and maintenance; (3) waste constituents are concentrated into a relatively small volume treatment zone enhancing waste management of the contaminated site.

Costs

The costs for this technology can range by an order of magnitude primarily as a function of the geologic and hydrologic site conditions, i.e., costs are very site specific. It is more appropriate to compare cost savings of a reactive barrier installation vs. the baseline cleanup technology. The reward from reactive barriers is the payback over time due to the passive nature of the technology. The expected payback on the Durango, CO UMTRA project is three to four years.

Placement of Iron Foam Plug Flow Reactor.

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