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Lessons Learned from the Optimization of In Situ Bioremediation through Injection of Carbon Substrate

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Background/Objectives. As a result of historical fertilizer mixing operations in an unlined pond, groundwater became impacted by nitrates over an approximately 1 square mile area at this project site in New Mexico. Furthermore, because of expanded residential development and the heavy reliance on groundwater as a source of residential water supply, groundwater quality needs to be restored in the shallow aquifer (water table approximately 50 feet below grade). However, the nitrate impacted groundwater lies beneath a heavily developed commercial/industrial area making access and groundwater restoration problematic.

Approach/Activities. A unique remedial process that received a U.S. Patent (U.S. Patent No. 8-580-114) was developed to restore groundwater. The process involves the construction of a subsurface treatment zone by circulating carbon substrate (EOS® from EOS Remediation, LLC) through a predetermined interval in the shallow aquifer using a network of injection and extraction wells. The carbon substrate sorbs to the surfaces of the saturated soil matrix and establishes the treatment zone. Each individual injection well paired with four surrounding extraction wells, along with the injected carbon substrate constitutes a treatment cell. Treatment cells can be placed in small spaces and/or can be expanded (multiple cells) to accommodate greater treatment volumes. The location of the treatment cell is flexible and does not have to be in the primary area of the plume requiring treatment, but is typically located in an area with amenable lithology (e.g., silty sand).

Next pumping wells are installed within the plume or hot spots requiring treatment. These so-called “remote” pumping wells serve to deliver untreated water from the most impacted portions of the plume to the pre-constructed treatment cell(s). Untreated water delivered to a treatment cell is directed into the same injection wells for which carbon substrate was injected. The untreated water then passes through the treatment zone where carbon substrate was emplaced and where nitrates undergo denitrification. Treatment cells are designed to ensure adequate retention time as determined through a bench study. After passing through the treatment zone, water that has been denitrified is extracted through extraction wells and directed to treated water reinjection wells.

Successful construction and operation of these treatment cells is reliant upon emplacing sufficient EOS® in the subsurface to provide a long-term (on order of 3 years) source of carbon substrate for denitrification. The objective of construction of this full-scale in situ denitrification remediation system consisting of a network of treatment cells at two different locations was to optimize the distribution and emplacement of a maximum amount of EOS as practically feasible based on results from column and pilot testing and as verified through field testing during full-scale system construction.

Results/Lessons Learned. This paper will discuss the lessons learned in optimizing the injection, distribution and emplacement of EOS® in treatment cells constructed for this full-scale in situ denitrification system. A full-scale system has been constructed and is currently operational. Preliminary results will also be presented demonstrating successful in situ denitrification.