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Engineered Retardation Factor Manipulation Using PlumeStop® Liquid Activated Carbon™ for Passive Management of Plume Dynamics

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Background/Objectives. Monitored natural attenuation (MNA) represents a valuable tool in the remediation toolkit. The approach combines pragmatism with science and a detailed understanding of natural processes to provide a methodology capable of cost-effectively achieving site goals. However, natural attenuation takes time. This can make MNA impractical. Even when ownership is long term, advection distances may be too short or groundwater flow too fast to achieve compliance within the required boundaries.

In cases where MNA is thus precluded, active remediation is required instead. This may be through increasing the biological attenuation rate through the use of reagents (Enhanced Natural Attenuation [ENA]), reducing the source and/or plume concentrations using physical treatment or in situ chemical oxidation (ISCO), or actively managing advection through groundwater pumping (hydraulic containment/pump & treat). Each approach, whether used alone or in combination, will typically present increased costs and/or disturbance over MNA.

Approach/Activities. An emerging alternative to active intervention is to effectively 'splice in' additional remediation time into shorter distances. This can be achieved by engineering the retardation factor in the subsurface. By definition, this slows the contaminant advection relative to the groundwater velocity. The residence time of the contaminant for (principally biological) attenuation is therefore increased within a given compartment, allowing natural attenuation to proceed to target over a far shorter distance.

The use of PlumeStop® Liquid Activated Carbon™ represents a new means of securing this end. The technology provides a flow-emplaceable means of coating the subsurface flux channels with micron-scale activated carbon. 'Dialing-in' the required retardation factor may consequently be achieved through a one-time, injectable intervention – essentially engineering the 'effective foc' of targeted flow-channels. Principles of use, together with corroborating placement and performance validation methodologies, are presented in this talk.

Results/Lessons Learned. Retardation factor increases ranging from several hundred percent to multiple orders of magnitude may be readily secured using the approach. The extent of this increase is determined by the interplay of contaminant concentration relative to carbon emplacement, the nature of the contaminants themselves, and the specific/dynamic mix of contaminants and/or competing sorbate species as degradation proceeds. The predictive integration of the approach into a wide range of contaminant fate and transport models to aid in concept evaluation, performance-prediction and engineering design is discussed.

It is anticipated that this talk will be of interest to environmental engineers, fate and transport modelers/risk assessors, regulators and site environmental managers alike.