



PlumeStop® Technical Bulletin 2.2

Sorption of Contaminants from Solution – Column Study

Quick Reference:

- Retained sorptive capacity of PlumeStop
- Resistance of soil-adsorbed PlumeStop to wash-out
- Maintenance of contaminant capture at high flux

Background

PlumeStop® Liquid Activated Carbon™ is composed of very fine particles of activated carbon (1-2 μm) suspended in water through the use of unique organic polymer dispersion chemistry. Once in the subsurface, the material behaves as a colloidal biomatrix, sorbing to the aquifer matrix, rapidly removing contaminants from groundwater, and expediting permanent contaminant biodegradation.

Wide-Area Dispersive Distribution

Unlike any other sorbent technology, PlumeStop can be installed in the subsurface through dispersive flow from low-pressure injection (without fracturing the formation), providing a wide-area, thin-film coating of the aquifer matrix. It does not create preferential flow pathways, plug the formation, or compromise monitoring wells through extreme carbon loading, as is often the case with pressure-emplaced powdered activated carbon.

More information on low-pressure ease of distribution and dispersive emplacement of PlumeStop can be found in [PlumeStop Technical Bulletin 1.1: Distribution through a Permeable Medium](#).

Rapid Removal of Contaminants from Groundwater

PlumeStop rapidly sorbs organic contaminants from aqueous solution within the timescale of hours. Pollutants partition directly into the PlumeStop particles that are sorbed to the soil formation, thereby removing the pollutants from groundwater. Contaminant advection in the aqueous phase is therefore eliminated and partitioning into the vapor-phase is also reduced (Henry's Law). Results can be dramatic, with



groundwater cleanup objectives often met within days of PlumeStop application. The principles of contaminant sorption onto PlumeStop are described in Technical bulletin 2.1: Sorption of Contaminants from Solution. The sorptive capacity of PlumeStop within a permeable soil matrix and the resistance of the sorptive coating to wash-out are the subject of the present technical bulletin.

Acceleration of Contaminant Biodegradation

Once sorbed to the soil and with contaminants partitioned onto its surface, PlumeStop is colonized by contaminant-degrading bacteria. These bacteria may be naturally present or applied as an inoculum. The concentration of the contaminants and the degradative microflora on the PlumeStop surface reduces mass-transfer kinetic constraints and supports greater speed and efficiency of degradation compared to solution-phase bioremediation.

The net result is a substantial increase in the instantaneous rate and extent of contaminant destruction. Information on post-sorption biodegradation and rate acceleration by PlumeStop can be found in [PlumeStop Technical Bulletin 3.1 Post-Sorption Contaminant Biodegradation](#).

PlumeStop – Post-Placement Contaminant Sorption

Introduction

Securing an effective distribution of PlumeStop easily through a saturated soil system is clearly a core component of its function (see Technical Bulletins 1.1).

Other properties of equal importance are:

- The treatment to secure dispersion must not compromise sorption;
- The dispersed material must coat the formation and not wash out (contaminant mobility must be reduced, not enhanced)

These points are addressed in the present Technical Bulletin.

Test Description

The test to evaluate the sorptive capacity of PlumeStop compared two columns that were set up identically and packed with loamy coarse sand¹ (Figure 1). An equal flux of aqueous *o*-xylene solution (approximately 10,000 µg/L) was passed in parallel through each column, and the systems were run in this manner until the natural sorptive capacity of the soil equilibrated and the baseline conditions stabilized (approximately four weeks).

327 g of 0.2% PlumeStop colloidal suspension were then added to the head of the test column followed by continued elution with the *o*-xylene solution. For the control column, the *o*-xylene solution was eluted without interruption. *O*-xylene concentrations in the effluent of each column were recorded at intervals of 1 – 3 days through the duration of the six-week study.

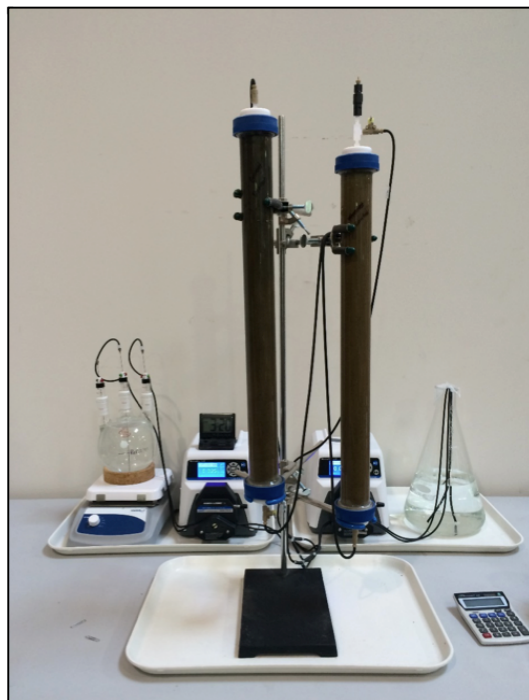


Figure 1. *O*-Xylene column study set-up

Test Results

The comparative *o*-xylene concentrations in the effluent of the column study treatment and control systems are presented graphically in Figure 2.

O-xylene concentrations in the effluent from the PlumeStop-treated column were reduced from a baseline of approximately 11,000 µg/L to below the quantitation limit of 1,000 µg/L within ten days of application, with the response delay corresponding closely with the time required to elute one pore volume of PlumeStop solution through the column. Concentrations in the treated system remained below quantitation limits through the course of the study (six weeks), over which time approximately fifteen pore volumes of ca. 10,000 µg/L *o*-xylene solution were fed through each system (equivalent hydraulic seepage of ca. 260 ft/year (80m/year)).

¹ (48% coarse grain; 31% med; 8% fine; 2% v. fine; 11% fines.)

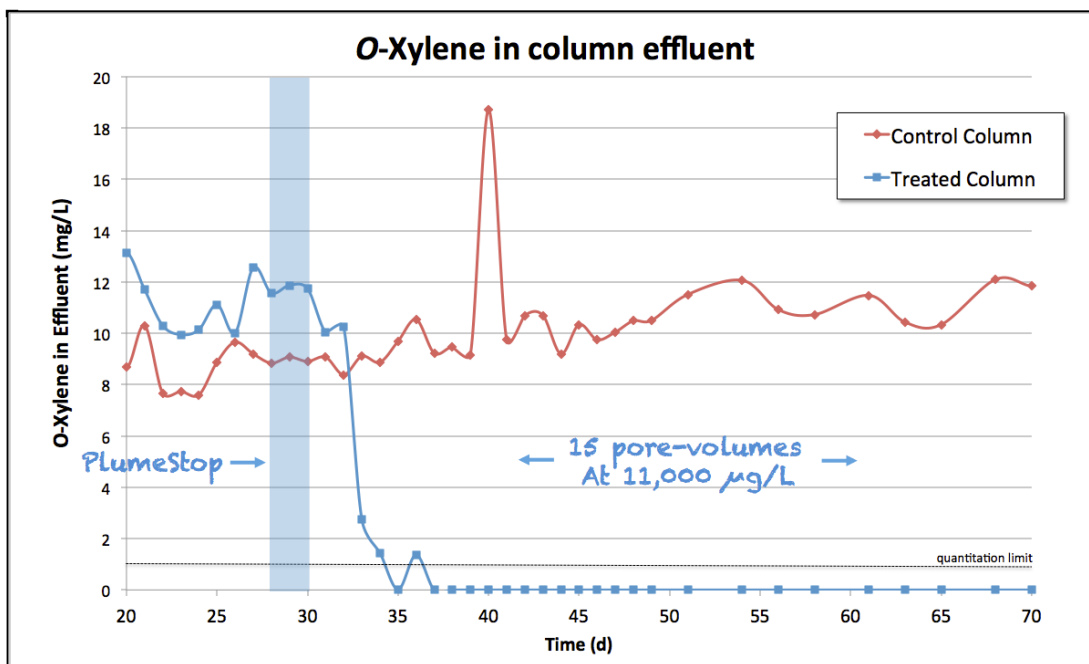


Figure 2. Comparative o-xylene concentrations in column effluent. The application of PlumeStop to the test column at 28-30 days is shown by the blue box.

Test Conclusions

The column study provides confirmation that the distribution treatment of PlumeStop does not inhibit contaminant sorption, even at high flux conditions – the PlumeStop in the test system was able to sorb 10,000 µg/L o-xylene for at least 15 pore volumes. The study additionally confirms that the PlumeStop was sufficiently retained within the soil formation to effect this result – the dispersive treatment neither inhibited sorption nor resulted in excessive mobility leading to wash-out. (See also Technical Bulletin 1.1.)

The retained sorptive capacity of dispersion-emplaced PlumeStop, its resistance to post-placement wash-out, and continued contaminant capture at high flux are therefore illustrated by the present study.

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