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➤ 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

1. Background

PlumeStop® Liquid Activated Carbon™ is composed of very fine particles of activated carbon (1-2 µm) suspended in water due to a unique blend of organic polymer dispersants. Once in the subsurface, the material behaves

as a colloidal biomatrix, sorbing to the aquifer matrix, rapidly removing contaminants from groundwater, and achieving permanent contaminant removal.

2. 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 due to extreme carbon

loading, as is often the case with pressure-emplaced powdered activated carbon.

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

3. Rapid Removal of Contaminants from Groundwater

PlumeStop sorbs organic contaminants from aqueous solution rapidly--within hours of application. 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 present technical bulletin focuses on the sorptive capacity of PlumeStop within a permeable soil matrix as well as its resistance to wash-out once emplaced.

4. PlumeStop – Post-Placement Contaminant Sorption

Introduction

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

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).

327g 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.

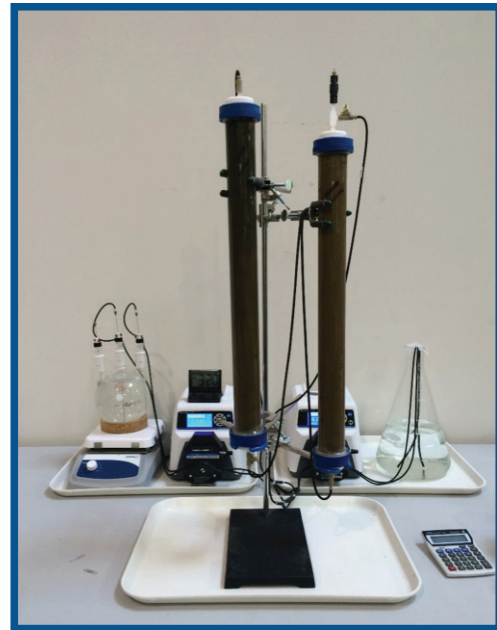


FIGURE 1 O-Xylene column study set-up

Test Results

The comparative O-Xylene concentrations in the effluent of the treatment and control systems are presented graphically in Figure 2.

In the PlumeStop-treated column, the o-xylene concentration in the effluent was 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 flow one pore volume 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 10,000 µg/L O-Xylene solution were fed through each system (equivalent hydraulic seepage of 260 ft/year (80m/year)).

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

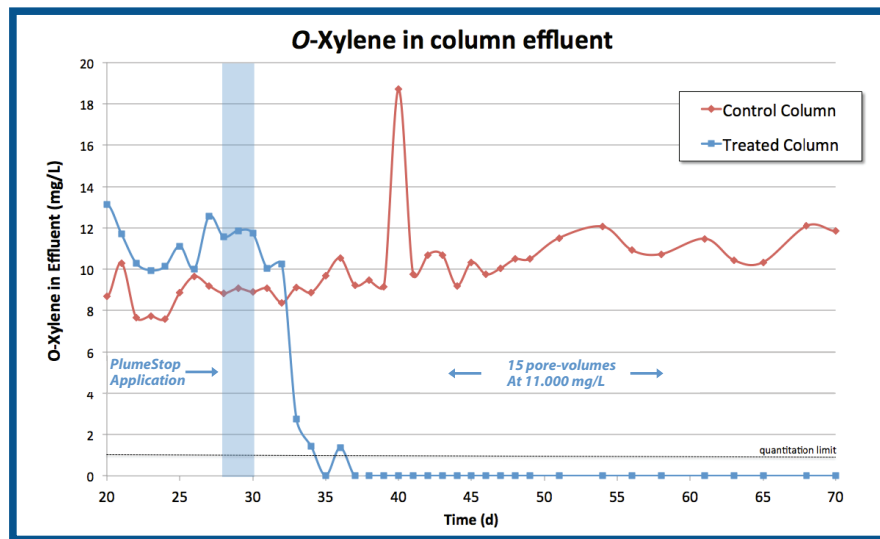


FIGURE 2

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 confirmed by the present study.



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