PetroFIX™
Remediation Fluid

Applying PetroFix To Prevent and Respond to Railroad Spills – Ballast Protection Experimental Results

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Issue

Freight and passenger trains may leak or drip oil *from* moving parts during normal operation. Along the world's railroads there are patches of oil where trains stop moving: at signals, stations and marshalling yards. Many trains run on diesel and spills can also occur at fuelling points.

It is impractical to investigate and risk-assess the potential impact of all the spill locations on a given rail network, due to both the high number of locations and their often relatively minor scale. Unfortunately, this means that spill locations often go untreated or large-scale and expensive ballast replacement is completed.

There is, however, interest in pragmatic, preventative or rapidly applied solutions that can contain or reduce the spread and impact of the spills. REGENESIS has evaluated the use of a technology (PetroFix) that can be used quickly and effectively – without prior recourse to site investigation, etc., to mitigate against the effect of small-scale spills.

What is PetroFix?

PetroFix is a highly concentrated water-based suspension consisting of micron-scale activated carbon and biostimulating electron acceptors designed to capture and remediate petroleum hydrocarbons. The product as a liquid suspension and eliminates any concern about carbon dust and is safe, fast, and easy to apply. The material is applied as a diluted liquid which makes surface distribution easy by simple pouring or spraying using a variety of spray pumps and nozzles. The small size of the PetroFix carbon both allows it to easily penetrate and coat the surface of ballast and underlying soils while also providing significantly more available carbon surface area than other forms of carbon to capture spilled hydrocarbons.

A oil spill impacting a railroad ballast.
PetroFix can be used quickly and effectively to mitigate against the effect of small-scale spills such as these.

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Proposed remedy

Spill response – PetroFix is injected into the subsurface in and around a spill, coating the subsurface in activated carbon, creating a filter that will reduce the scale of the impact and kick-start natural attenuation.

Preventative application – PetroFix is spray-applied to the ballast at existing stopping points, marshalling yards and filling points. This pre-coats the ballast with activated carbon, creating a adsorptive filter at the locations where oil loss is most likely to occur. When drips and small spills occur, residual contaminant is bound up and the environmental risk is reduced. PetroFix is black which helps obscure hydrocarbons that have spilled onto the material.

Application would comprise:

1. Applying PetroFix onto the ballast using a portable pump and tank to percolate a robust dose into the subsurface ballast to coat it with activated carbon;

2. Followed by spraying PetroFix using a directional/shaped lance tip to create a neat finish and get into less-accessible locations around sleepers, under the track etc.

Experiment

To demonstrate the efficacy of PetroFix as a topically-applied sorbent of diesel range organics (DRO) in a railroad ballast-type setting, a laboratory column study was performed. Two identical columns (60 cm x 4.8 cm) were constructed using well-defined sands and loams to emulate a surficial railroad ballast atop soil. The column components from bottom to top included 1) a lower main body of 75:25 fine sand:sandy loam; 2) a layer of 50:50 fine sand:sandy loam to mimic the top organic-rich layer of soil below the ballast; and, 3) a layer of fine and course sand at the very top representing the ballast of the railroad.

The treated column was dosed with 29.4g of a 50% PetroFix solution applied to the top of the column, representative of a recommended field dose. Both columns were gravity flushed top-down with tap water for 24 hours, mimicking rainfall, to infiltrate the PetroFix into the soil column before the contaminant was applied. The columns are shown in Figure 1, with the PetroFix treatment being visibly apparent to have infiltrated over half of the column and no PetroFix eluted from the bottom of the column.

The columns were fed tap water under gravity flow from top to bottom to emulate a natural flux of water through the top few layers of soil and on-going 'spills' of neat diesel slugs were added at regular intervals to each column. The water level was kept below the top layer of sand and gravel to ensure all diesel reached at least the top layer of soil.

Throughout the experiment, all the effluent was collected from both columns and sent at regular intervals for DRO analysis at a certified laboratory.

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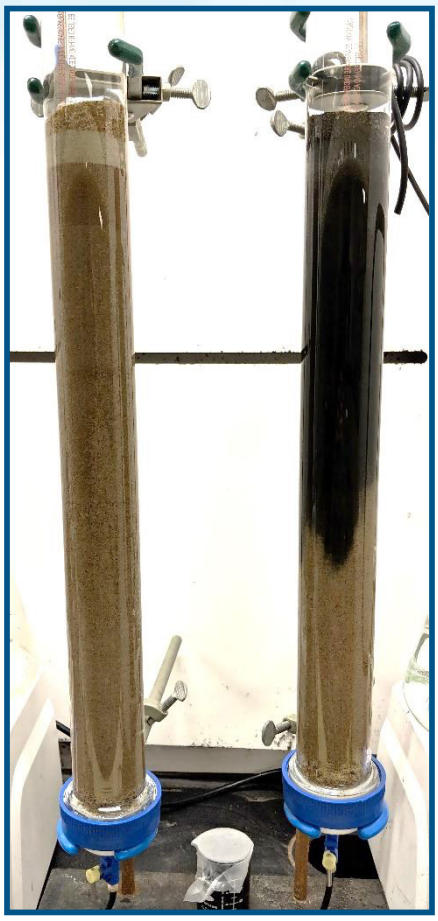

FIGURE 1

The control and PetroFix-treated columns used in the study to demonstrate the ability of PetroFix to capture small diesel spills.

Results

In total, 14 slugs of diesel were added to each column at an average mass of 0.18 g/slug for a total mass of 2.6 g diesel added to each column. Once applied to the column, the diesel quickly migrated through the control column and eluted within the first pore volume. The DRO continued to elute from the control for the duration of the experiment at concentrations ranging between 200 µg/L and 900 µg/L. In contrast, the PetroFix-treated column had no detectable (< 50 µg/L) levels of DRO eluting from the column for 15 pore volumes. The concentrations of DRO measured in the effluent of each column are depicted graphically in Figure 2.

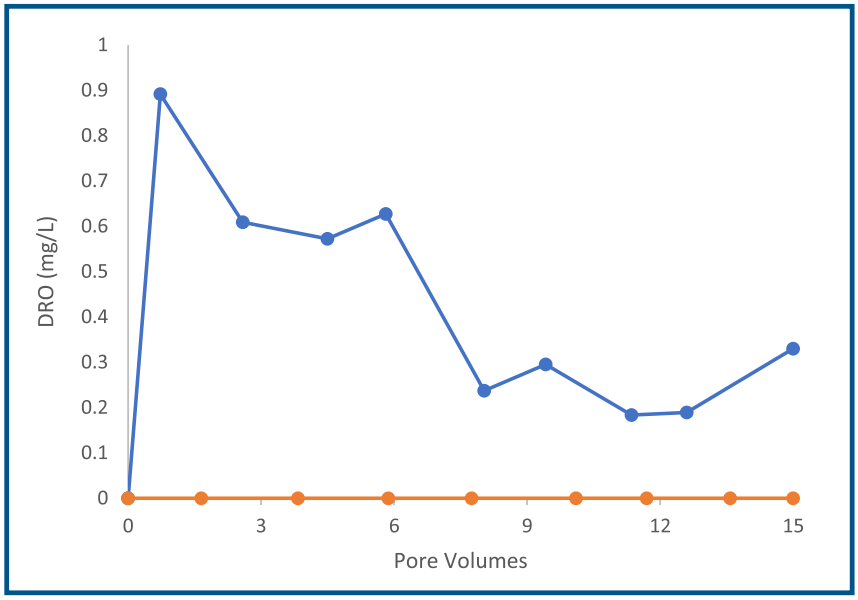

FIGURE 2

DRO concentrations measured in the effluent of the control (blue) and PetroFix-treated (orange) columns. Zero-value data points represent non-detect measurements (reporting limit = 50 µg/L).

Conclusions

This study demonstrated the ability of PetroFix to prevent the migration of DRO spills when topically-applied in a railroad ballast-type setting. These data indicate that PetroFix can decrease the environmental risk associated with contaminant migration into an aquifer that is possible with these surface spills and leaks. PetroFix can be used in both a preventative manner, as was conducted in this study, as well as for spill-response to isolate the contaminants within a small area.

PetroFix is optimized for all petroleum-based contaminants and similar results to the present study are also expected for gasoline and fuel oil (longer chain) organics. While not demonstrated within the scope of this experiment, PetroFix will stimulate the biodegradation of the target contaminants, regenerating adsorption sites and thereby prolonging the efficacy of the treatment.

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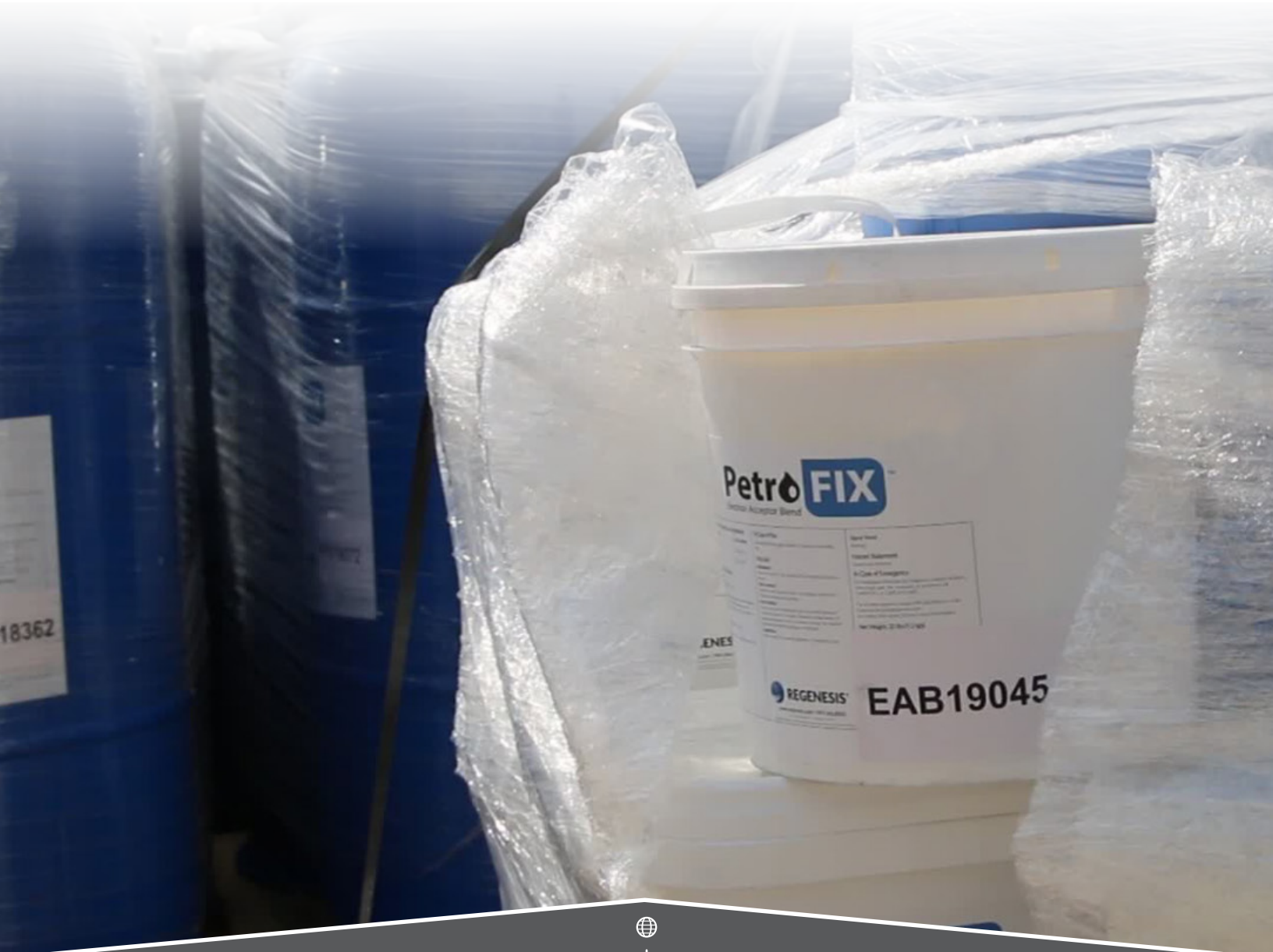

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