

## Railroad Ballast Spill Cleanups with HC-2000 Minimizes Track Down Time



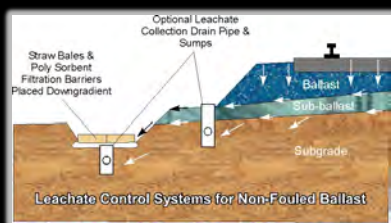
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## Remtech's HC-2000 Multi-Media Applications

- Cleans, desorbs, reduces odors & degrades fuels, oils, lubricants, and solvents in ballast, soil, and water.
- Minimizes or eliminates track interruption time. Application with or without high-rail equipment.
- Approved for environmentally sensitive areas.
- Also used in difficult access and unstable sites.

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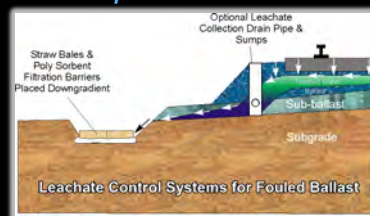
## Fate of Spills in Non-Fouled Ballast



- Well maintained mainline track and sidings with good water drainage.
- Spills migrate through ballast and into sub-grade towards drainage ditches.
- Vertical migration limited by trapped water and soil permeability.
- Horizontal migration limited by drainage culverts and track bank slopes.

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## Fate of Spills in Fouled Ballast



- Located in fuel terminals & switching yards and track sidings.
- Ballast voids filled with fines (ballast breakdown), oil and grease traps water decreasing drainage. In advanced track fouling, bed flooding occurs.
- Vertical migration limited by trapped water and decreased permeability.
- Horizontal migration limited by drainage culverts and slopes away from tracks
- Requires loosening and/or ballast removal around ties.

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## Ballast - A Trickling Filter?

- Heterotrophic bacteria in ballast & soil – maximum concentration in fines. Moisture retained by fines creating an ideal degradation environment.
- Ross McKinney in his book *Microbiology for Sanitary Engineers* states “.... the best source of micro-organisms is soil. . . soil can furnish all the microorganisms ever needed in waste disposal. . . all sanitary bacteriologists who seek a special culture should look under their feet; the supply is inexhaustible”.
- Heterotrophic concentrations are 10 times greater in ballast than soil (10's of millions of Colony Forming Units/gm). Fuel, lubricants, and greases released from locomotives, tank, and hopper cars provide food (substrate) that acclimate native bacteria to petroleum hydrocarbons.

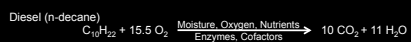


## How Does HC-2000 Work?

- HC-2000 stimulates native heterotrophs that control bioremediation. Bio-augmentation (addition of supplementary microbes) is ineffective as native heterotrophs prevail over foreign microbes. Native microbes allow co-metabolic (complete) breakdown of contaminants.
- HC-2000 supplies limiting organic nutrients, enzymes, co-factors, electron donors, and bio-surfactants to reduce degradation times.
- HC-2000 is applied as liquid with bio-surfactants to increase contact with contamination and enhance microbial cell wall transfer.
- HC-2000 is a food quality organic product readily assimilated by microbes (no 2 to 3 month acclimation delays before it begins to work as with inorganic nutrients).
- HC-2000 can be applied under aerobic, facultative, and anaerobic conditions.



## SIMPLIFIED MICROBIAL AEROBIC WEATHERING/MINERALIZATION OF PETROLEUM HYDROCARBONS



## HC-2000 Treatment Steps

- Contain/Remove Mobile Phase Free Product – Install temporary containment barriers – sorbent/straw filtration dams and recover free product.
- Test Pit to locate fuel pathways, leachate collection, and removal and treat in place areas.
- Install Leachate Control Systems – Intercept fuel with collection trenches, pits, drainage tiles & sumps, or temporary detention pools. Remove hot spots, if necessary.
- Desorb bound contaminants. Apply HC-2000 followed by water flush and repeat until free product recovery volumes diminish to manageable limits.
- Bound contaminants account for over 60% of contamination. Fuels may become mobile as they are desorbed and broken down into shorter hydrocarbon chains.



### HC-2000 Treatment Steps, cont.

6. HC-2000 degrades mobile and bound phase hydrocarbons in aerobic and anaerobic environments.
7. Protect Structural Integrity of Track System - Do not disturb ballast below ties or within a 45% slope of ties.
8. Apply HC-2000 followed by oxygen saturated water to increase penetration, moisture, and oxygen. Install leachate control near the toe of ballast and/or in drainage swales
9. **Ballast Treatment** – Apply HC-2000 topically followed by a water chase or through injection probes. Fouled ballast - mixing or agitation enhances HC2 delivery and treatment. Pressurized water (3,000 to 5,000 psi) or a cribbing bucket loosens ballast next to ties.
10. **Monitor Degradation** – visual observation of stormwater runoff (no sheens); sampling of ballast fines and downgradient soil and leachate for total petroleum hydrocarbons. Supplemental water may be required to maintain moisture levels at 70% of field holding capacity.



Is fuel leaving track right of way? Is release localized or spread over large area?  
How much fuel released?

If fuel is leaving track right of way – determine pathways by test pitting, checking drainage ditches, swales, and streams.

Construct leachate collection/containment systems to recover bulk free product

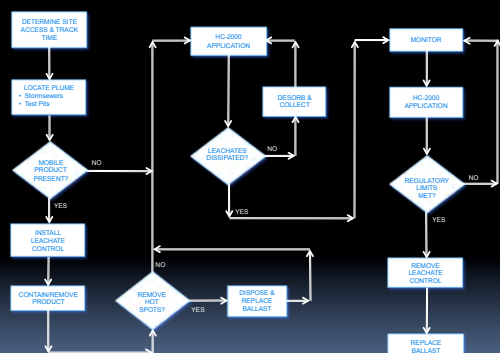
Apply HC-2000 followed by water chase to flush out residual fuel. Collect in sumps, filtration dams, or sorbent.

Apply HC-2000 to degrade mobile and bound phases of hydrocarbons.

Continue treatment until no sheens are observed in stormwater leaving ROW or until soil regulatory limits are met.



### HC-2000 Treatment Steps



### HC-2000 Regulatory Approvals

- Georgia & Florida - treatment of groundwater on a case-by-case basis.
- Most States approve within several hours.
- Pre-Approved for soil/ballast applications in Georgia.
- EPA On-Scene Coordinators & National Park Service officials approve on a case-by-case basis



## Case Histories



### Locomotive Fire on Mainline Track

A locomotive caught fire on a super elevated mainline track in Northwestern Georgia. An estimated 100-gallons of diesel fuel were released along a 100-foot section of track.



A solar powered HC-2000 and water application system achieved a 90% TPH reduction over a 118-day period with no fuel saturated ballast removal.

#### Cost/Benefit Analysis

Project costs - \$41,000 and no track time lost  
Removal & Replacement - >\$500,000's including track service interruptions.



### Locomotive Fire on Mainline Track Dallas, Georgia

A Locomotive caught fire on a super elevated mainline track in Northwestern Georgia. An estimated 100-gallons of diesel fuel were released along a 100-foot section of track.



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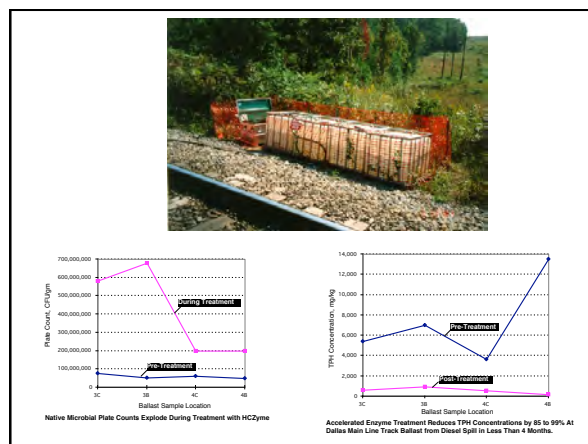
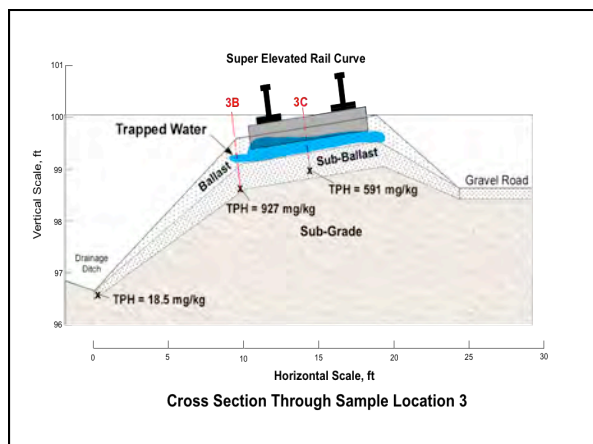


#### Cost/Benefit Analysis

Project costs - Active remediation cost \$41,000 with no track down time

Removal & Replacement - >\$500,000 including track service interruptions.





### Passenger Train/Vehicle Collision at Grade Crossing

A passenger train struck a vehicle at a road crossing in Northwestern Georgia. 750-gallons of diesel fuel were released over 0.35 miles of track. HC-2000 was applied with a high-rail truck. Five applications of HC-2000 were applied over a 42-day period with TPH reductions averaging 68% with no saturated ballast removal. Fuel concentrations were reduced to levels for natural attenuation to complete the degradation process.



#### Cost-Benefit Analysis

Project Costs - \$17,000  
Removal & Replacement costs - \$150,000 plus track service interruption costs.



### Lube Oil Rail Siding Treatment

HC-2000 was used to degrade Over 30-years of motor oil deposits on a lubricant facility rail siding. During a four (4) month treatment period, total petroleum hydrocarbons were reduced by over 60%.



#### Cost-Benefit Analysis

Project Costs - \$26,000 and no track time lost.  
Removal & Replacement – \$250,000 plus business interruption costs.



### Lube Oil Release at Industrial Rail Siding

HC-2000 was used to treat 350-gallons of lube oil released from a locomotive over 1,745 linear feet of track. An interceptor trench was installed along the final 85 feet of track. 150-gallons of Lube oil was desorbed with HC-2000 from the trackbed ballast and pumped to an on site oil/water separator. Residual Petroleum hydrocarbons were degraded With HC-2000.



#### Cost-Benefit Analysis

Project Costs - \$18,000 and no track time lost.  
Removal and replacement costs plus  
business interruption costs >\$100,000

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### Train/Vehicle Collision at Grade Crossing

1,500-gallons of diesel fuel were released over 1,790 ft of mainline track from an at grade collision of a train with a tractor trailer in Warner Robins, Georgia.



Seven (7) HC-2000 applications were made to reduce TPH below Georgia DNR cleanup requirements. TPH concentrations (30,000 mg/kg+) were reduced by an average of 98% (<600 mg/kg) over 20-months with no saturated ballast removal.

#### Cost-Benefit Analysis

Project Costs - \$30,000  
Removal & Replacement - \$175,000 plus  
\$10,000/hr in lost track revenues

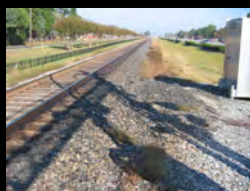
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### At-Grade Collision Warner Robins, Georgia

At grade collision with low boy ruptured lead locomotive fuel tank on mainline track. Traveled 1,787 ft prior to stopping releasing an estimated 1,000 gallons of fuel.

Five HC-2000 applications made during 1<sup>st</sup> three months. Two additional applications made six month later followed by 6 month treatment period.

97% TPH reduction at Impact Point 1 &  
99% reduction at Rest Point 2.

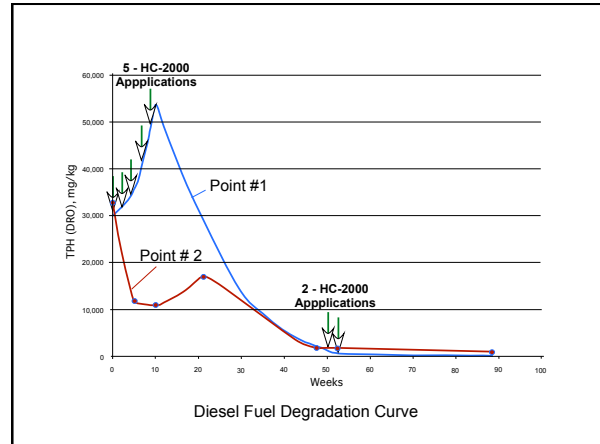


Cost Benefit Analysis  
Excavation/ track replacement & Business  
Interruptions - Potentially \$Millions

Passive Insitu Treatment - \$36,500







Waste Oil Spill  
Between Two Mainline Tracks

A waste oil tanker spill (est. 600 gallon) migrated through a storm drain to two main line tracks covering 140 ft of drainage ditch and 60 ft of ballast.

Six cubic yards of oil saturated gravel/soil were excavated from the storm sewer outfall and ditch. A poly sorbent/straw filtration system was installed in the drainage ditch.

A 70 ft x 6" HPDE drain pipe terminating in a 20-gallon sump was installed between the tracks and a second system was installed in the ditch.

6 HC-2000 applications were made during the initial 4 month period. Leachate collection and filtration system maintenance & monitoring continued for an additional 8 months until sheens dissipated.

Cost/Benefit Analysis

Limited Excavation & HC-2000 Treatment – \$40,000. Ballast removal/replacement - \$100,000 plus lost track revenues @ 25 to 75 trains/day

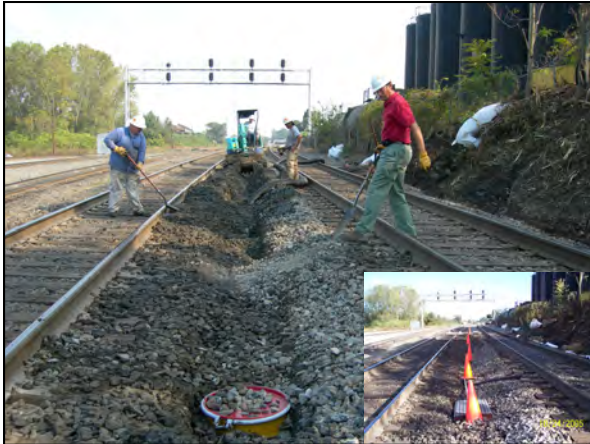
Waste Oil Release Between Mainline Tracks

600-gallons of waste oil were released from a tanker over-fill. Oil flowed between two mainline tracks. 5-cubic yards of oil saturated ballast were excavated and placed in supersacks. Two leachate collection systems were constructed (one between the tracks and one on the track shoulder). 167-gals. of oil were desorbed and recovered using HC-2000 during first 4 days. Seven HC-2000 applications were made during a 60-day period. The site was monitored for 9 months until no sheens were observed in stormwater runoff.

Cost-Benefit Analysis

Project Costs - \$40,000  
Removal & Replacement - \$50,000 plus track interruption costs of \$250,000/day

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### *Mobile Fueling Release at Railyard*

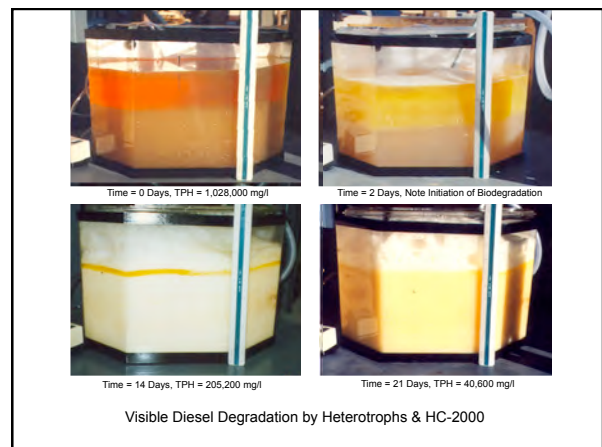
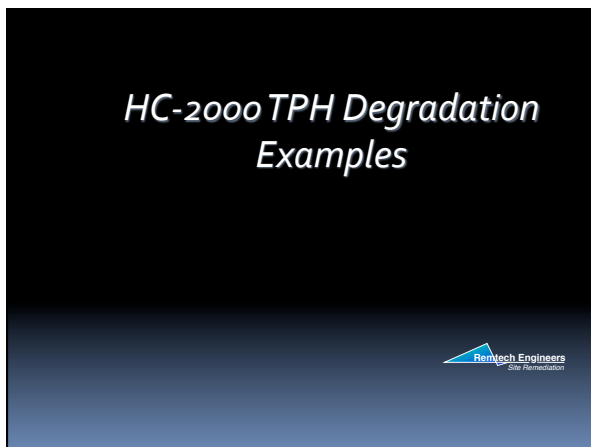
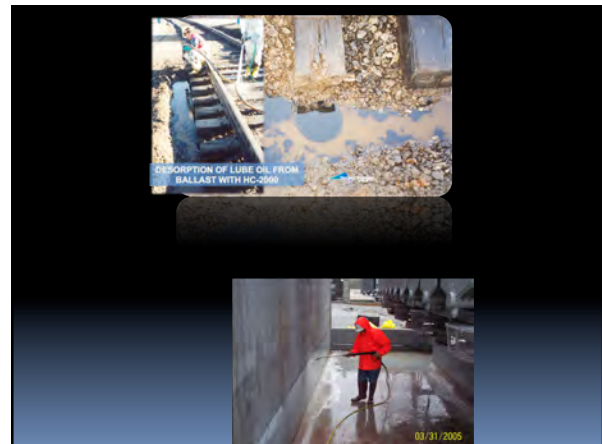
- 600 gallons of diesel fuel released from locomotive mobile fueling at rail yard.
- 126 tons fuel saturated ballast excavated.
- Leachate collection system installed adjacent to tracks with 150 gal of fuel collected during first week.
- 3,370 sf of rail siding and runoff area treated with HC-2000.
- Site monitored until no sheens observed in stormwater runoff.

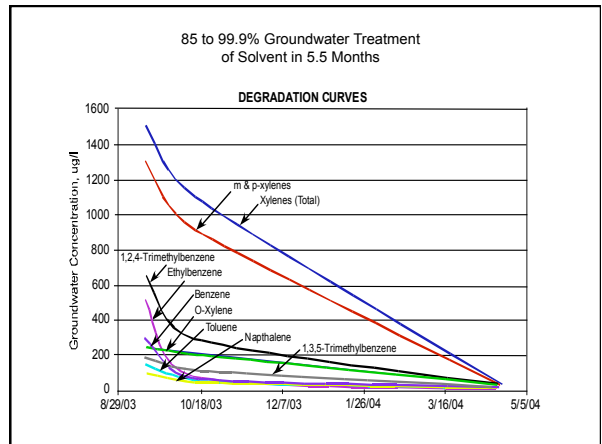
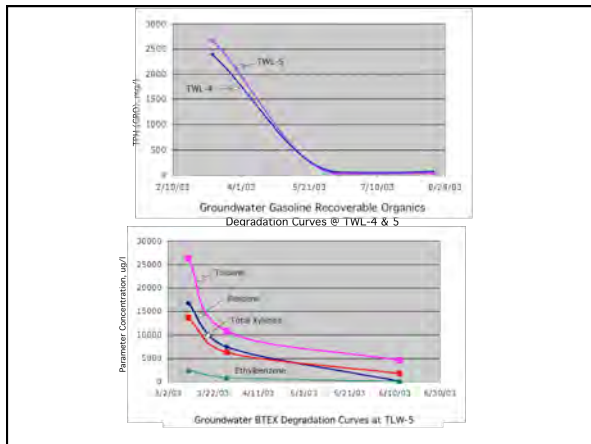
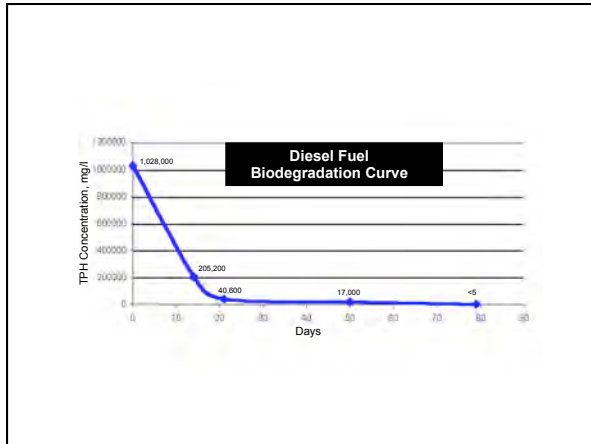
Cost-Benefit Analysis

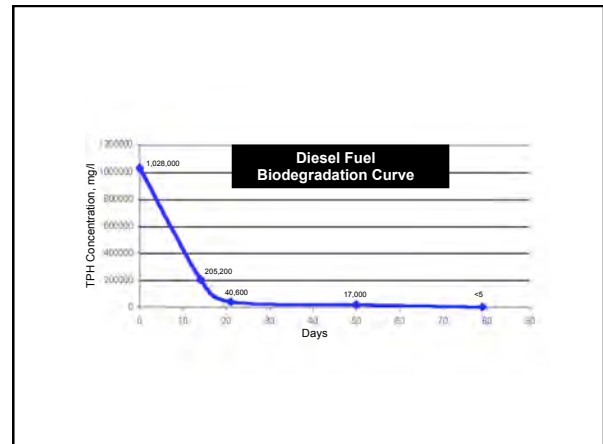
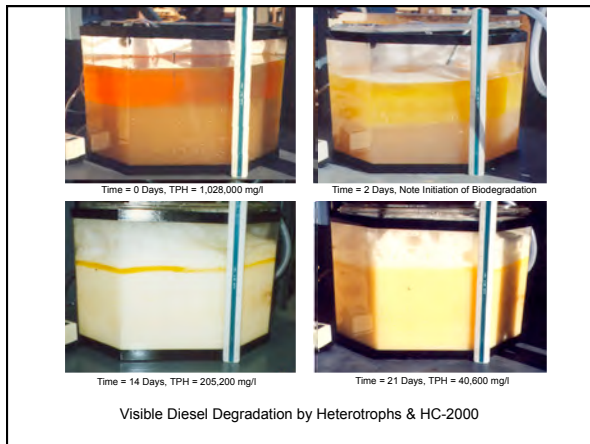
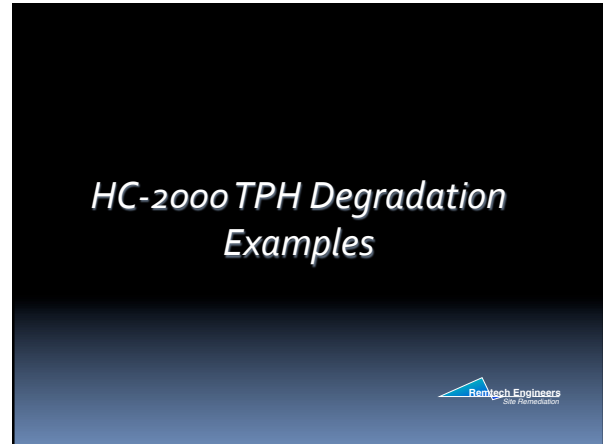
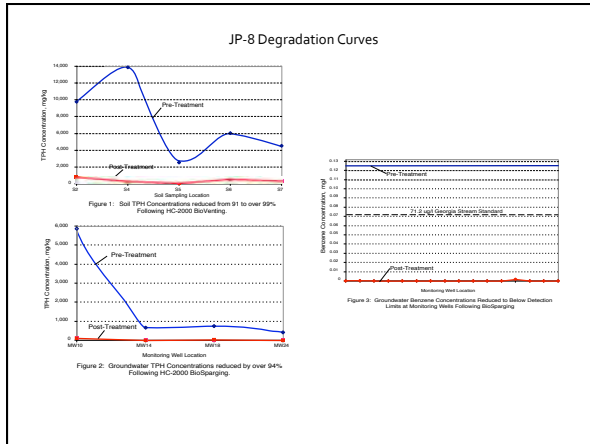
Project cost - \$37,000  
 Removal & Replacement - \$50,000 plus track interruption costs of \$100,000/day

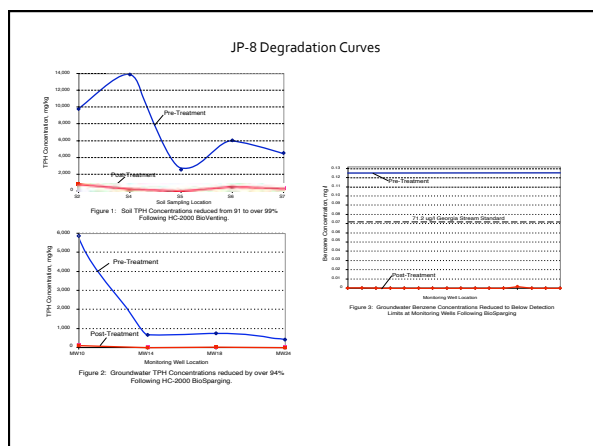
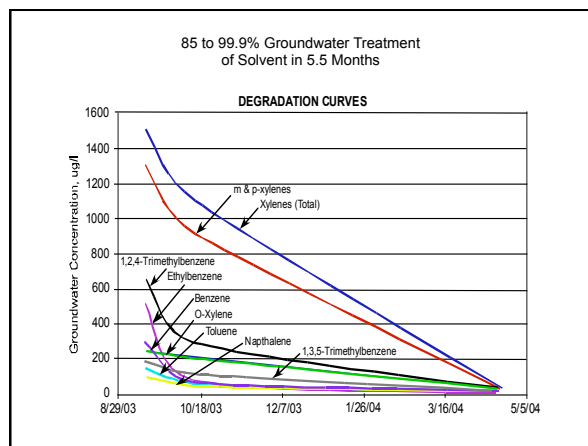
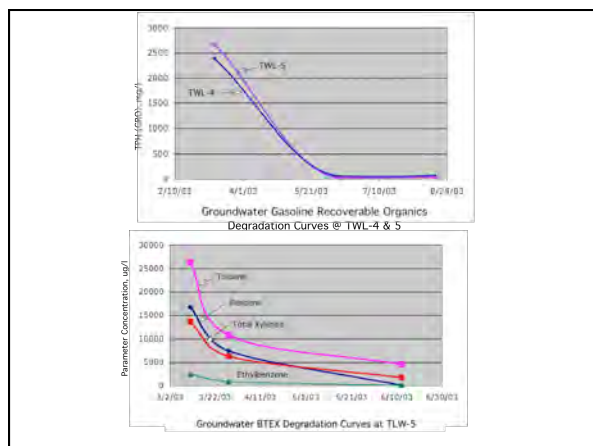













## HC-2000 Application Systems

**Access Vehicles:**  
High-Rail Trucks, All-Surface Vehicles, Pickup Trucks

**Spray Equipment:**  
Pumps - diaphragm, roller, or centrifugal  
Water Trucks

**Nozzle Selection:**  
Trace quantities of pulp may clog finer nozzles and piston pumps (especially pressure washers)  
• HC-2000 may be injected past pressure washer pumps with chemical nozzles

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