Spill Cleanup Of Fuel Contaminated Soils After Roadway Accidents Using In Situ Bioremediation

Chapter 5

SPILL CLEANUP OF FUEL CONTAMINATED SOILS AFTER ROADWAY ACCIDENTS USING IN SITU BIOREMEDIATION

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ABSTRACT

Release of fuel oils during transportation or during roadside accidents is very common. According to the figures available, number of incidents involving hazmat accidents has increased from 7,297 in 1990 to 14,443 in 1999. In most cases the standard cleanup protocol is followed but in some cases it is not possible to follow the protocol because of the accident locations. It is particularly difficult to excavate surface soil where utility lines are very near to the surface and services of utility agencies are not immediately available. In such situations, it is considered safe to use effective bioremediation solution for on-site cleanup. In these situations, AgroRemed has been employed with successful results. Two case studies are presented in this paper. One case demonstrates revitalization of roadside vegetation through bioremediation after a spill of motor oil and another case describes application of AgroRemed to sites affected by diesel spill with underlying utility cables. The TPH of the soil after bioremediation was reduced by more than 95% from 65,000 ppm in the first case, while in the second case the TPH was found to be below the detectable values from the initial value of 47,000 ppm. VaporRemed was employed for fumes originating from the spilled site and where the spill had affected the fertility of soil, AgroRemed was used. Both these products are available in a ready to use liquid form and are known to effectively bioremediate the contaminated soils and fumes in a very short period of time. The advantage of these products is that they de-toxify the contaminated soils and facilitate growth of vegetation.

The Virginia Department of Transportation was actively involved in the cleanup operations, and although the Virginia DEQ was not directly involved, the department reviewed the data to confirm that the values of TPH were below the accepted levels.

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1. INTRODUCTION

1.1 Fuel Oil Spills in first 3 months of 2007

An oil delivery truck overturned on the morning of Jan. 16, 2007 at the intersection of Old Pawling and Nanny Hill roads in New York State. It spilled 4,200 gallons of heating oil onto the road and surrounding properties, including a regulated wetland and a stream that flows into the Ten Mile River. Another spill occurred thirty days later on February 15, 2007 in Massachusetts releasing 2000 gallons of home heating oil coincidentally near Ten Mile River. Road accidents involving fuel oil spills are common and both the state environment agencies and cleanup contractors are busy most of the year attending to these spills. Route 117 in Warwick, MA was closed after truck carrying heating oil flipped over morning of 20th March, 2007 and leaked the fuel into the road.

Spills on roadways due to transportation accidents are not uncommon resulting into release of fuels on the road and embankment and destroying the vegetation in the impacted zone. The first task of the cleanup crew is to remove the free product from the impacted surface and then excavate the area and transport the contaminated soils to the landfill site for disposal and replace the area with sanitized soil or crushed gravel followed by restoration of vegetation. Excavation of contaminated soils and replacement with sanitized soil may not be very difficult, but rejuvenation and restoration of the impacted soil is more difficult as the toxicity of the hydrocarbons is more lasting.

Road transportation services are employed for shipments of oils and fuels in the USA and other countries because of easy accessibility of gas stations and terminals. Bulk transportation of fuels is still carried out by rail roads and Kirton & Beaulieu (2005) have reported their experiences on bioremediation of spill in a rail yard in Massachusetts. Both highways and rail road services are prone to accidental spills and are critical for the emergency response bodies. However, it is road transport that is used for supplying fuel oils to distant places and is more critical from the point of view of seriousness of accidents as it affects local populations and damage to the vegetation along the edge of the road.

The cause of such accidents may be many including the age of these tankers as even today some of the tankers on the road may be more than 20 years old and may be structurally weak (Anonymous, 2003). Complete statistical information of roadways spills of fuel oil are not available in the USA but a recent report (Weyls, 2003) indicates that the number of incidents involving roadway spills has doubled from 7,297 in 1990 to 14,443 in 1999 in just 10 years. A similar study was carried out in the UK identifying the types of releases in England and Wales by Lee & Fitzsimons (2005) who reported that soil receives the greatest impact of these spills as seen from their data. Spills of diesel also affect the structure of asphalt pavement (Balwin et al, 2005)

This paper describes results of two case studies on the use of AgroRemed a bioremediation product for cleanup of diesel oil spills along the roadside in Virginia. In both these cases application of bioremediation products was carried out with the approval from State Department of Transportations and also with the concurrence from the State Department of Environment.

Results show that use of AgroRemed not only reduced the costs of cleanup but also rejuvenated the soil for healthy growth of vegetation through detoxifying the effects of hydrocarbons.

1.1.1 Case Study 1. Restoration of Vegetation Affected By Diesel Spill

A tractor/trailer was involved in a highway accident, resulting in the release of approximately 100 gallons of diesel fuel from a ruptured saddle tank and ten gallons of motor oil from the truck engine. The wreckage ended at the bottom of the embankment, immediately adjacent the opening of the subsurface storm piping. Diesel fuel, released from the truck, flowed into soil immediate the wreckage and the open ditch. Several hundred feet of guardrail was destroyed in the accident, causing engine oil to disperse over approximately 100 feet of vegetation at the pavement edge. GEC Environmental Contracting Corp. (GEC) was contacted to provide clean up of the release. The wreckage and the site are seen in Figure 1.

Figure 1. The accident site and the wreckage of the truck.

Discussions were held with representatives of the Virginia Department of Transportation (VDOT) and implications of soil removal in this area were reviewed. The spill site was on a slope and it would be difficult to use mechanized cleanup vehicles for the cleanup. Excavation of the soil was not considered as an option for the cleanup.

It was agreed that this site is suitable for evaluation of on-site (in situ) bioremediation cleanup of highway spills. AgroRemed manufactured by Sarva Bio Remed, LLC was selected for direct application to the release point and affected soil and vegetation. AgroRemed has a track record for successful cleanup of contaminated soils after spills of diesel or heating oil both in residential and industrial facilities. AgroRemed has shown reduction in TPH values by 90% in

three weeks in a pilot study. In one case the TPH of the impacted soil was reduced from 25,000 ppm to 93 ppm. Advantages of AgroRemed and benefits of bioremediation are listed below.

- Treats the spill at the source and rejuvenates the soil
- Reduces the fumes produced by the spill almost instantly
- Available in easily spray able liquid form
- Easy to apply and environmentally safe
- Generally a one time application under favorable conditions
- Fast remediation time and reduces the TPH by more than 95% in 3 weeks time
- AgroRemed is a complete solution
- No waste for disposal

The conditions essential are the availability of moisture and easy permeability in soil. AgroRemed has cleaned up petroleum contaminated soils even with a history of contaminant more than 10 years. Under availability of moist soil conditions, the bacteria in the product continue to consume hydrocarbons as long as the source of hydrocarbon is available. Minimum supervision is required after application to the soil and does not need periodical additions of nutrients or products. Addition of these microbes and natural attenuation would provide a practical and cost effective method with little or no post-restoration efforts. The diesel fuel release and surface staining caused by engine oil would both be addressed in this manor. Multiple applications were anticipated for significant decrease of petroleum content in the saturated area.

Figure 2. Application of AgroRemed to impacted soils

A soil sample was collected from the center of the diesel staining, approximately 2" below the surface. It showed a concentration of 65,000 parts per million (ppm). Impacted soil saturated with diesel was manually turned/ tilled to allow natural oxygenation before application of AgroRemed as seen in Figure 2.

A soil sample was collected after 20 days of application from this location and analyzed for TPH/DRO values and the results of hydrocarbon range C-5 to C-30 showed a value of 26,000

ppm or more than 40% reduction in the value. Application of AgroRemed was continued at regular intervals; it was noticed that the TPH/DRO was reduced from 26,000 ppm to 11,800 ppm because of drought conditions, and the soil was very dry. The conditions became favorable in September before the final application, and this time soil was sprayed with water from a tanker immediately before application of AgroRemed. In addition to the wetting, the surface of the soil was also covered with straw mulch to prevent excessive evaporation. The TPH of the soil was examined after 15 days and the levels of TPH were reduced to 650 ppm with no signs of tainting of the grass and interestingly no diesel odor. Further, the area was found to support healthy growth of grass and other vegetation indicating no residual toxicity and restoration of the soil to its condition before the spill. The DEQ agreed that there was no further action required. The total time required for the cleanup was a total of 103 days for reaching the accepted levels of contaminant.

1.1.2 Case Study 2: Diesel Fuel Release after a Vehicle Accident

A tractor/trailer was involved in a highway accident, resulting in the release of approximately 75 gallons of diesel fuel from a ruptured saddle tank. Free petroleum product flowed into the gravel road shoulder and adjacent embankment. The site is a single lane, north/south highway of typical asphalt paved construction (Figure 3). Road shoulders are intermittent gravel, grass, and embankments. Potential receptors are humans, wildlife, and groundwater. Multiple major underground communication utilities lines were present in the accident area making it difficult to excavate.

Figure 3. Accident site showing the asphalted road affected by spill.

Diesel fuel had released on the pavement edge and gravel shoulder causing surface staining. Debris on the pavement was pushed to the gravel to allow normal traffic patterns for evening hours. Petroleum-absorbent booms were placed along the down-gradient edges of the spill area to prevent further migration during anticipated storm events. Anti-slip absorbent media was

applied to the impacted pavement and scrubbed to remove residual phase petroleum. As this material was spent, it was removed, and the process repeated until practical recovery was achieved. An additional application was then made as a slip preventative measure for traffic.

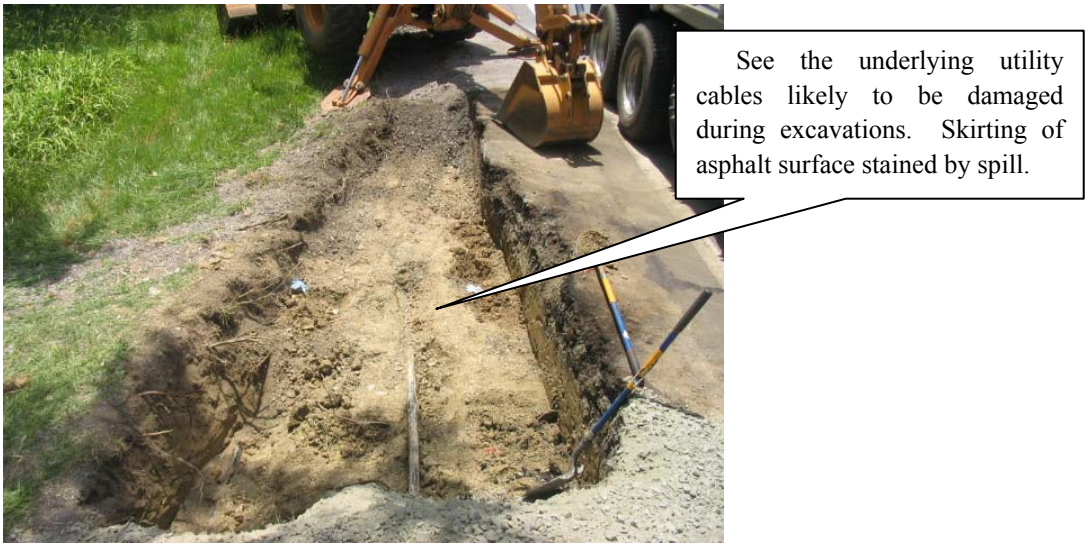

Figure 4. Showing underlying cables and stained skirting of pavement.

Soil excavation/disposal would be conducted in the petroleum stained areas under the supervision of the state environment protection agency. The West Virginia Department of Environmental Protection (DEP) supervised the cleanup. Several ground communication pedestals were present both north and south of the incident site, indicating buried utilities in the area; the cleanup had to be coordinated with the concerned utility agencies. A soil sample was collected from the center of the surface staining to provide waste characterization and analysis of the petroleum concentrations showed TPH at 47,000 parts per million (ppm).

As the excavation continued along the embankment towards the open side ditch, depth was increased once equipment progressed beyond the exposed cable (Figure 4). At the east side of the excavation, a depth of 48" was achieved when a third unknown communication cable was damaged by the backhoe. Awaiting repair technicians, it was determined further soil removal is not practical or even possible by conventional means due to the position of buried cables. With cables significantly reducing the area of excavation accessibility and time constraints of two-way traffic closure, the decision to apply petroleum degrading microbes was made.

In situ bioremediation using AgroRemed was considered a less disruptive and safe method for cleanup. Repair technicians had not arrived at this time, and AgroRemed was readily available on site. Areas of the excavation bottom and depths were measured for sampling locations. Four locations were determined necessary to observe soil conditions. These locations

were monitored several times in the future to observe microbial activity and decrease of petroleum concentrations during bioremediation. Two pine trees located along the east bank of the right-of-way were identified as bench marks for future sampling events. Soil samples were collected from these two west locations at the pit bottom showed 2,500 ppm and 4,000 ppm respectively after 20 days of treatment.

Individual tests of the soil samples did not indicate vapor levels above background readings of 2.3 for Photo-ionization Detector (PID). Laboratory results for soil samples collected on July 26th showed the results as follows; Sample 1 showed values below laboratory detection limits of 50 ppm, Sample 2 showed 570 ppm, Sample 3 showed 830 ppm, and Sample 4 showed 290 ppm. These results indicated an aggressive degradation of petroleum hydrocarbons within seven days of the previous application. An additional application was conducted after these samples were collected. Application of bioremediation product under such situation was justified. As seen from the results, total remediation of diesel fuel was completed in 35 days and no further action (NFA) was decided by the state DEP and the project was closed.

2. CONCLUSIONS

The average amount of fuel spilled in a saddle tank release is 104 gallons while the average cost to clean it up is $9,200 nationwide. Costs for on-site cleanup using AgroRemed for similar size of spill are considerably less, and for less than $ 2,000.00 the soil is cleaned and rejuvenated, supporting healthy vegetation. In fact, reuse of the same soil also reduces costs of transportation with minimum disturbance to the local ecosystems.

The two case studies indicate that application of AgroRemed remediated the adverse effects of diesel oil in a very short time. Advantage of bioremediation is evident in both the cases. It has been seen that the immediate effect of AgroRemed is to detoxify the toxic nature of the hydrocarbon and then consume the contaminant in a shortest period of time provided all the conditions favoring the growth of bacteria are available. Restoration of the fertility of the soil was noticed by the regular growth of grass and weeds in the denuded area near the accident site. The time for bioremediation was longer in the first test case due to severe drought conditions coupled with high summer temperatures that did not allow growth of bacteria. In the second test case since the moisture was available in plenty, the complete bioremediation was achieved in 35 days with minimum supervision.

Accidents on the highways are often away from city, so it is difficult to monitor these situations. Excavation of soil though is considered a preferred method for cleanup, it is not always convenient or feasible and AgroRemed delivers a clean and efficient cleanup solution. Application of AgroRemed to the accident site immediately after a spill will reduce the damage to the asphalt surface and also reduce the damage to the roadside vegetation. It is a solution that is safe, easy to use, and a non-invasive, and it should form an important part a of spill cleanup kit for the emergency response operations.

3. ACKNOWLEDGEMENTS

Authors wish to acknowledge thanks to Jeff Boyer and Brett Waller of Virginia Department of Transportation (VDOT) for their support and encouragement in implementing for the first time a bioremediation solution for cleanup of highway oil spills.

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