



When Cleanup is ROCKET SCIENCE

Remediation technology spares sensitive underground infrastructure and cleanup dollars at the Kennedy Space Center.

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In Florida, not far from the grand stage upon which was launched America's first voyage to the stars, rests the Launch Equipment Shop (LES), located within the vehicle assembly building area at NASA's Kennedy Space Center. The LES used fuel oil for various mission critical purposes and required an underground storage tank (UST) for the convenient dispensing of adequate fuel quantities. As with most if not all USTs, leaks are not uncommon and can result in significant contamination of soil and/or groundwater. A leak occurred at the LES UST prompting its decommissioning and removal. At the time of the tank's removal, only a limited volume of contaminated soil removal was permitted due to the presence of a significant number of sensitive subsurface utilities in the area. As a result, highly impacted soil and groundwater remained.

Investigations at the site identified total petroleum hydrocarbon (TPH) contamination in the soil at concentrations approaching 20,000 ppm, and in groundwater at concentrations up to 42 ppm. In

addition, a light non-aqueous phase liquid (LNAPL) free-product layer of up to 1.2 feet in thickness was identified. Soil contamination that was associated with the former tank pit extended from 5 to 11 feet below ground surface, within an area of approximately 10,000 sq. feet. Groundwater impacts also extended across the site, with the highest contaminant concentrations in the vicinity of the former tank pit.

All about chemistry

Tetra Tech, NASA's environmental consultant, proposed the use of in-situ chemical oxidation (ISCO), a process by which powerful chemical oxidation reactions are facilitated by combining two or more reactive chemicals. The resulting chemical mixture is then injected or mixed into soil and/or groundwater, where it makes contact with contaminants and destroys them. Unfortunately many commonly used ISCO agents produce reactions that can be highly exothermic, generating problematic heat and pressure

– highly undesirable conditions for maintaining the integrity of sensitive underground infrastructure.

Being aware of such issues, the consultant recommended a widely-used chemical oxidant manufactured by Regenesis Inc., San Clemente, Calif., as an alternative.

The two-part chemical oxidant known as RegenOx, is a multi-catalytic formula consisting of a sodium percarbonate complex and an activator. These two chemicals are combined on-site and further mixed with water.

One chance at this

Part of the treatment goal was to eliminate the potential for free product reoccurrence by targeting soil total recoverable petroleum hydrocarbon (TRPH) contamination exceeding 5,000 ppm. In addition, the initial excavation treatment was designed to include a more costly LNAPL (free-product) removal effort. However, after further investigation, the additional free-product removal was not implemented but was slated for chemical oxidation and appropriately accounted for in the oxidant dosing.

A total of nine injection events took place over a 10-month period, systematically applying approximately 49,500 lbs. (136,000 gallons) of the chemical oxidant into 52 re-injectable wells. Performance sampling was conducted following the third, sixth and ninth



A multi-catalytic formula was injected into the injection points to treat the contaminated soil and groundwater in place.

injection events to assess the effectiveness of the treatment. Delineation of soil contamination after each event indicated a significant reduction in the area of impacts as compared to baseline observations. After the ninth injection event, the two highly contaminated shallow soil areas (10,000 ppm TRPH) were reduced in size by 75 percent, from a baseline

footprint area of 480 sq. feet to an area of 120 sq. feet. The relatively less contaminated soil area (2,000 ppm TRPH) was reduced in size by 79 percent, from a baseline footprint area of 3,953 sq. feet to an area of 858 sq. feet. Overall, the area of impacted soil was reduced to one-fourth of its original size using chemical oxidation. Groundwater concentrations were substantially reduced and the more challenging free-product was also effectively treated from a baseline of 0.05 feet to less than 0.01 feet. **PE**

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The product used in this project was RegenOx™, a trademarked product from Regenesis.

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A total of nine injection events over 10 months reduced the remediation costs by about 75 percent.