Neutralizing RDX in Surface Soils at Two Navy Air-To-Ground Ranges

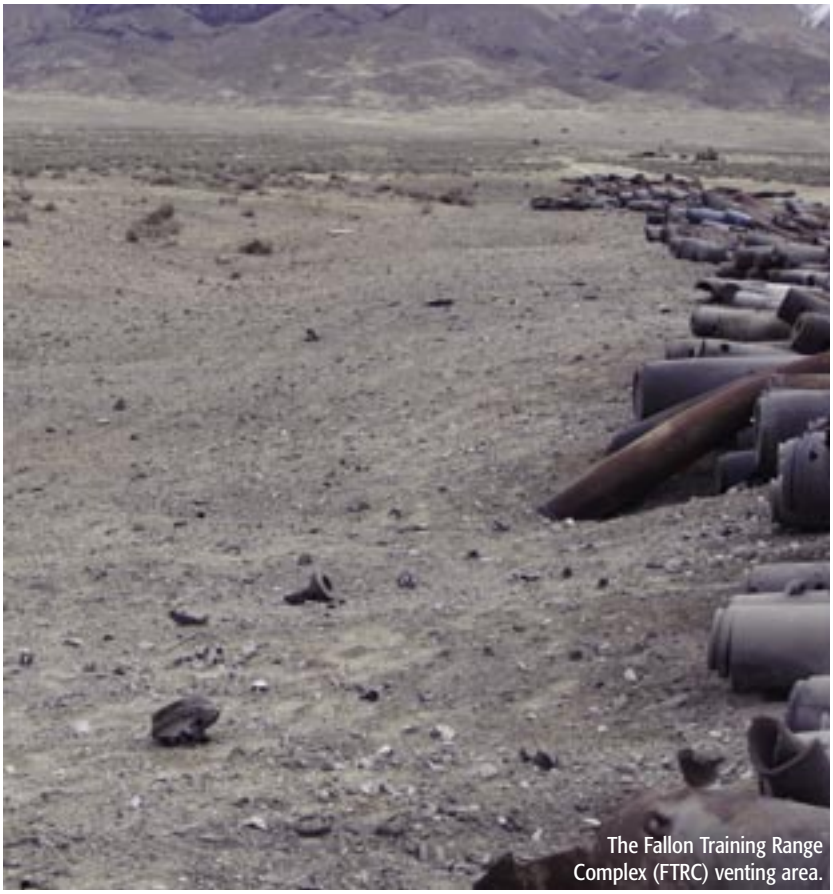
NESDI Project Demonstrates Hydrated Lime is an Effective Agent

A RECENTLY COMPLETED effort by the Navy Environmental Sustainability Development to Integration (NESDI) program has performed demonstrations and treatability studies to:

- Demonstrate and validate that applying hydrated lime ensures that there is no residual Royal Demolition Explosive (RDX) remaining in the surface soils of venting sites at two of the Navy's largest air-to-ground ranges.
- Show range managers firsthand how the hydrated lime is properly applied.
- Produce guidance on how to apply hydrated lime effectively.

The Navy uses full-scale practice bombs extensively at most of its land-based test and training ranges. During range clearance operations, these bombs are brought and consolidated in a designated area where they are lined up for venting. Venting of practice bombs consists of using composition C4 explosives on the bomb to ensure the bomb is inert, verify the signal cartridge has fired, and open the casing so pressure does not build up during subsequent demilitarization operations.

The primary constituent in composition C4 is the explosive, which makes up approximately 91 percent of composition C4 by weight. The Army observed using composition C4 explosives, alone and in venting operations, releases RDX to surface soils at Army and Air Force ranges.



The Fallon Training Range Complex (FTRC) venting area.

Raking in lime at FTRC.

This project demonstrated the application of hydrated lime to Navy venting areas as a best management practice to destroy any RDX that may potentially reside in surface soils. This effort supports the Navy's Operational Range Clearance (ORC) program.

The Navy has performed range assessments under the Range Sustainability Environmental Program Assessment program and has concluded that there is no evidence to indicate munitions constituents are migrating off any Navy range.

The Army has extensively studied the application of hydrated lime ($Ca(OH)_2$) on range soils to increase the pH of the soil, causing an alkaline hydrolysis reaction to destroy RDX and produce an environmentally friendly end result. This method is being used successfully on hand grenade ranges at Fort Jackson, South Carolina, the U.S. Military Academy at West Point, and at open detonation areas on Camp Edwards, Massachusetts and Aberdeen Proving Ground, Maryland.

The Test Sites

The test site locations were the Fallon Training Range Complex, Nevada and the Pinecastle Range Complex, Florida.

The two locations have very different climates and soil types, which afforded an opportunity to compare and contrast methodologies.

The Basics About the NESDI Program

THE NESDI PROGRAM seeks to provide solutions by demonstrating, validating and integrating innovative technologies, processes, materials, and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness. The program accomplishes this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

The NESDI program is sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities Engineering Command at the Naval Facilities Engineering and Expeditionary Warfare Center in Port Hueneme, California. The program is the Navy's complement to the Department of Defense's Environmental Security Technology Certification Program which conducts demonstration and validation of technologies important to the tri-Services, U.S. Environmental Protection Agency, and U.S. Department of Energy.

For more information, visit the NESDI program web site at www.nesdi.navy.mil or contact Leslie Karr, the NESDI Program Manager at 805-982-1618, DSN: 551-1618 or leslie.karr@navy.mil.

Because soil geochemistry is the single most important factor in determining success of the alkaline hydrolysis of RDX in soil, a treatability study was performed for each demonstration site. These tests allowed team members to determine how much lime would be needed and how often lime should be reapplied. The studies, performed by the Engineer Research and Development Center Environmental Laboratory (ERDC/EL), also verified what the team had learned in a literature review—that a pH of 10.5 or greater was necessary to destroy any RDX in the soil taken from the demonstration sites. Because of the differences in soil geochemistry, different amounts of lime were required to achieve the desired results in each location.

So as not to disrupt regular range operations, the demonstration was performed at a nearby location on each range, using identical soil. The demonstration was performed first at Pinecastle in July 2011. The range manager was able to see firsthand how to apply the lime and take pH readings. An expert in this technology from ERDC/EL was also on hand to demonstrate the most efficient way to apply the lime.

The range manager measured the pH of the soil for the next few days. The pH levels at Pinecastle exceeded the goal of maintaining a pH of less than or equal to 10.5 for three to seven days. At the 23-day mark, the pH level was 12 and at the 34-day mark, the pH was measured at 10.5, despite 7.5 inches of rain.

"The lime was a very effective neutralizing agent," said Arthur "Lee" Shults, ORC program manager at the Pinecastle Range Complex. "The pH level of the soil remained longer than I expected. This lime application process is an inexpensive means of controlling the residual RDX from C-4 venting operations."

Lessons learned from the demonstration at the Pinecastle site include:

- A rake is sufficient for distributing lime. There is no need to till the lime into the soil.
- Small berms were used to help keep the lime in place.
- The pH levels don't rapidly diminish in the heavy rain.

In March 2012, a second demonstration was conducted at FTRC. While the pH levels met the target level of 10.5 or higher for three to seven days, the results were not quite as impressive as those at Pinecastle. After eight days, the soil measured 12 pH, but after 22 days, the pH level had dropped to 9.

The venting area at the Pinecastle Range Complex.

Raking in lime at the Pinecastle Range Complex.

The lessons learned from this demonstration included:

- High winds can blow the lime away.
- Water is needed to prevent the lime from escaping.
- A wider rake with shorter tines worked better on hard packed soil.

Final Report

The final report includes a description of the treatability studies, demonstrations, and cost analysis. The report also lists the necessary equipment and techniques for applying the lime, and a Material Safety Data Sheet. Members of the Department of Defense range community may request a copy of the final report from Joey Trotsky at the information provided below.

Conclusion

No other prominent alternative technology has been identified that can quickly, effectively, inexpensively, and safely destroy RDX as well as hydrated lime. As a result of these demonstrations, range managers now have a very inexpensive method to significantly reduce the potential buildup of RDX in areas where the venting of practice bombs is being performed. This will ensure that human health will not be compromised and range operations will not be interrupted due to RDX contamination of groundwater. ⚓

Photos by Joey Trotsky.

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Two New NESDI Projects to Address Ongoing Challenges on Navy Ranges

THE NESDI PROGRAM has recently initiated two more projects to address ongoing challenges on Navy ranges.

1. **NESDI Project #483** (Transportable Field Melter for Recycling of Bombing Range Material Potentially Presenting An Explosive Hazard) will demonstrate and validate that a transportable field melter is capable of melting range scrap in an economically feasible and environmentally conscious way.
2. **NESDI Project #482** (Innovative Drilling Process to Vent Full Scale Non-Explosive Practice Munitions) will demonstrate at the Pinecastle Range Complex a remotely operated bomb drilling system that will eliminate the need for using explosives to vent practice bombs. Venting practice bombs by using a drill will eliminate the need to use composition C4 and prevent RDX residue from potentially being released to surface soils.