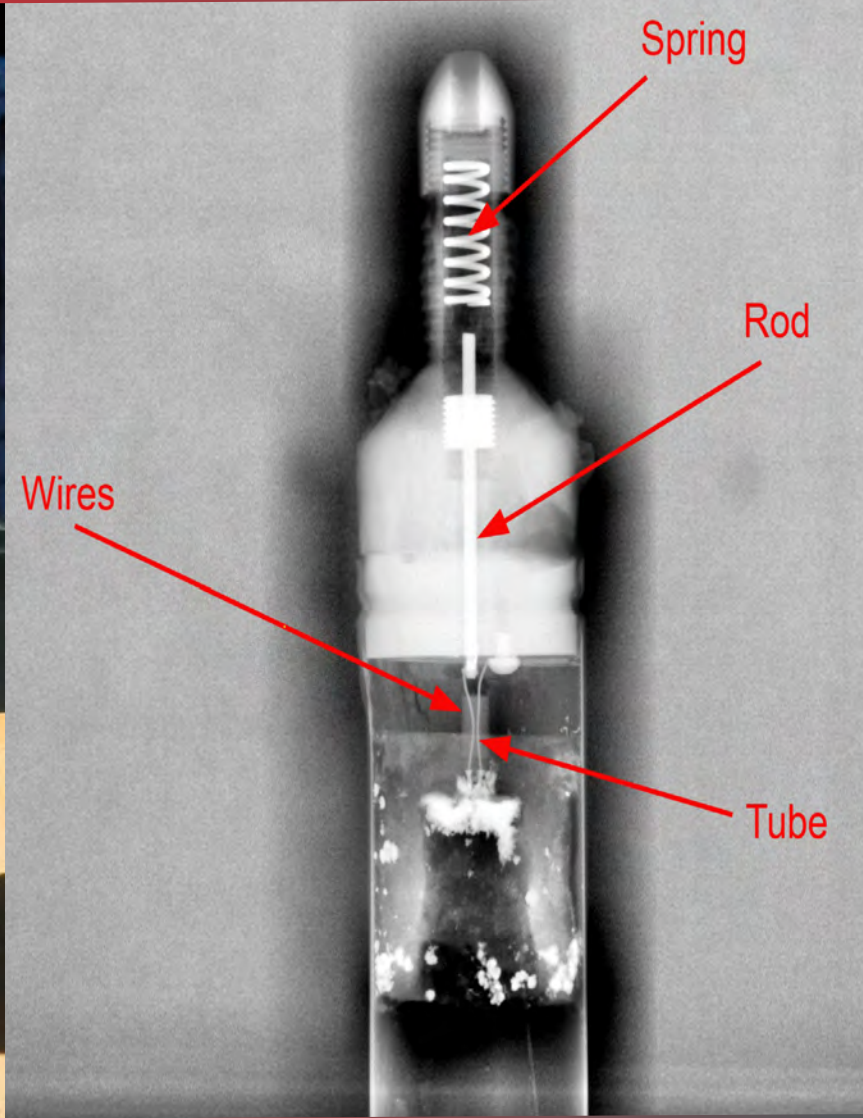


Render Safe Operations



Explosive Recovery -- Abandon Test Well

ENGAGEMENT DETAILS

Client: Confidential

Site: Decommissioned Oil Drilling Research Center, Oklahoma

Task: Locate An Abandon Test Well where Experimental Explosives were Abandon 40 Years Before

Date: Summer 2013

SITUATION

On the 11th of November 1970 nine oil field workers were killed conducting experiments with explosives at an adjacent research facility 20 miles away. A former employee's recollection, was that in the aftermath, at this research site — *"They dropped down the well one at a time an assorted variety of explosive items; two or three tubes of 60% dynamite of 2 inches in diameter by 2 ft. long packaged in cardboard wrappers, three or four screw together cans of 2 inch diameter by 6 inches long accompanied by two or three experimental explosive charges packaged in 1 ½ inch diameter by 2 ft. long steel containers. He did not remember putting any blasting caps or detonators in the well..."*



ENGINEERING CONTROLS

THE CHALLENGE

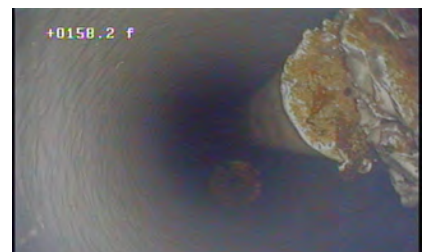
First the abandon well (8 to 10-inch diameter), which was located on a 40 acres site that over the years had been turned into a grazing pasture for cattle, had to be located. Being on a site that was peppered with holes from years drilling research any located hole would also have to be verified cleared of explosives, until the correct hole was located. Over the years the properties surrounding the site had been developed into high-end residential areas. The Client, expecting potential legal issues related to the site, also required that forensics samples be collected and archived with chain-of-custody records.



RECOVERED DEBRIS

THE APPROACH

By using Ground Probing Radar and Magnetometer Survey equipment the abandon well was located. Several false positives were inspected and cleared of being the suspected well. The engineering controls were designed and implemented to protect nearby residences from an accidental detonation. **The well location was located 93-feet from the nearest residence.** An outer blast barrier consisting of 500 bbl frac-tanks, filled with water, were installed and then a surface well casing and control-head were installed. Over the well-head a blast shield and blasting mats were installed, to direct any explosive ejections and air-blast down-range from the residences, from un-planned detonation..



EXPERIMENTAL WELL STIMULATION TORPEDOES

Next a remote-controlled system using water and compressed air was built to flush out the backfill (sand/rock) and explosive debris from the well in 2-foot increments. All the water and debris recovered was captured, inspected, and tested for the presence of explosive residue.

Remote cameras were installed and continuously recorded all operations for several different points of view. A lighting prediction system was installed with automated warning sirens and lights so work could be immediately stopped.



RECOVERED DETONATOR - FUNCTIONAL

RESULT

No explosive remains of anything that the former employee described were ever found. However, 8 oil-field stimulation charges and two with live igniter's, were recovered from the well. After 6 months of recovery work the well bottom was reached at 167 ft. The well was flushed three-times with clean water and then grouted. All explosive residual found on-site was render-safe and properly disposed.

Render Safe -- Abandoned Dynamite

ENGAGEMENT DETAILS

Client: West Virginia Department of Environmental Protection
Site: Spring Ridge Coal Site, Bolair, WV
Task: Render Safe and Dispose of Abandon & Deteriorated Dynamite
Date: Summer 2018

SITUATION

The West Virginia State Police, acting on a tip from an informant, located two abandoned explosive magazines on the former Spring Ridge Coal Site. Both magazines were unlocked with one containing approximately 200 lbs of deteriorated dynamite and the other containing approximately 350 detonators. It was estimated that the explosives were at least 35 years old. West Virginia's State Bomb Squad determined that the explosives were too unstable to move and counter-charging in-place was too risky with near-by residences.



ABANDONED DYNAMITE & DENONATORS

THE CHALLENGE

The explosives had to be render-safe in a residential area in a manner that would be protective of the general public. The explosives and detonators were found in a complexly deteriorated state with nitroglycerin leached out of the dynamite and pooled on the bottom of the boxes, seeped into the shelving and floor. Detonator were found un-shunted, with shells deteriorated with explosives elements exposed.

THE APPROACH

RAM proposed to render safe the deteriorated explosives through chemically neutralize (MuniRem®) in-place while the detonators would be moved into a containment vessel and counter-charged in small batches. Before work in the magazines would begin, engineering controls would be built to minimize air-blast and shrapnel damage due to an unplanned detonation.

The trees and brush located around the magazines were removed and the entrances to the magazines cleared and leveled for safe ingress and egress. A blast barrier was constructed to surround and enclose the Powder Magazine. Using salvaged timbers the magazine's roof was covered leaving a 1-foot air-gap. On the top of the logs a layer of soils and then blasting mats were placed.

With engineering controls in place, technicians applied a water based MuniRem solution to the deteriorated explosives. On surface contact, MuniRem® chemically reacted with the explosives breaking them down into non-explosive by-products (N_2 , CO_2 , SO_4^{2-} , NO_2 , formate, acetate). MuniRem was applied until explosive wipe test indicated there was no explosive residue remaining. Paper-wrappers, plastic packaging and wood-pallets was collected and disposed. Water and spent MuniRem solutions were collected, filtered, and then disposed as gray-water at the local sewage treatment plant.

RESULT

RAM successfully completed rendering safe 338 pounds of explosives, 2109 electric and 217 non-electric detonators. The Powder Magazine's interior, after cleaning, was tested for trace explosive residue and none were found. The Cap Magazine was cleaned of all debris (e.g. wires, boxes, wrappers).



OCCUPIED STRUCTURES



ENGINEERING CONTROLS



MUNI REM® BEING APPLIED

Render Safe -- Abandoned Dynamite

ENGAGEMENT DETAILS

Client: West Virginia Department of Environmental Protection

Site: Venus (Kinder) Site, Venus, WV

Task: Render Safe and Dispose of Abandon & Deteriorated Dynamite

Date: Summer 2019

SITUATION

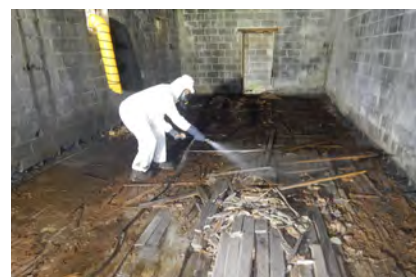
A West Virginia DEP Inspector for the Abandon Mine Lands Program discovered that dynamite had been left unsecured in an old powder magazine while preparing plans for the building's demolition. One of several buildings on a several hundred acre abandoned coal underground and surface operation, the magazine was hidden from view by heavy woods and undergrowth. The old mine site was heavily used by ATVs, fishermen, and hunters. The community of Venus, WV was located 2,000 feet away for the magazine.



ABANDONED DYNAMITE

THE CHALLENGE

The explosives had to be render-safe in a residential area in a manner that would be protective of the general public. The explosives were found in a complexly deteriorated state with nitroglycerin leached out of the dynamite and pooled on the bottom of the boxes, and had seeped into the collapsed wood shelving and wood flooring. Over the years, a near-by stream had flooded and filled the magazine with a layer of mud, which buried potential explosive products and would have to be removed by hand and screened for the presence of explosives.

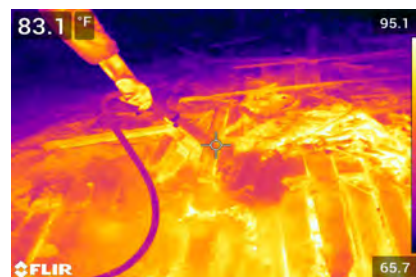


INITIAL SATURATION W/ MUNIREM

THE APPROACH

RAM was contacted by WV DEP to render safe the deteriorated explosives through chemical neutralization (MuniRem®) so the building could be safely demolished.

The heavy woods and brush located around the magazines were removed and the entrances to the magazines cleared and leveled for safe ingress and egress. With engineering controls in place, technicians applied the water based MuniRem solution to the deteriorated explosives. On surface contact, MuniRem® chemically reacted with the explosives breaking them down into non-explosive by-products (N₂, CO₂, SO₄²⁻, NO₂, formate, acetate). MuniRem was applied until explosive wipe test indicated there was no explosive residue remaining.



MUNIREM® BEING APPLIED (INFRA RED)

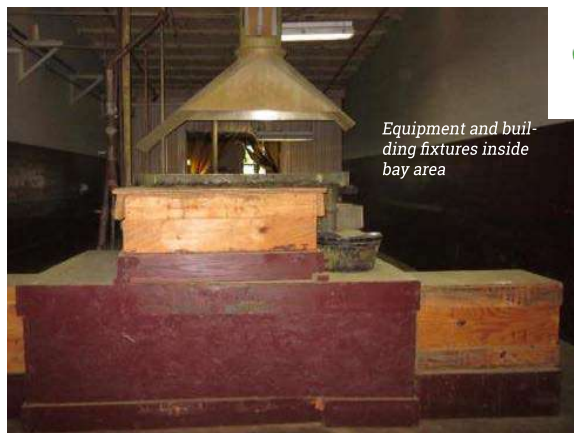
RESULT

RAM rendering safe 1000 to 1350 pounds of dynamite from within the magazine. The powder magazine's interior, after cleaning, was tested for trace explosive residue and then sealed to prevent future trespassing. Soils from the floor after screening and testing for explosives was stockpiled within the magazine. The wood shelving and flooring after treatment and testing for trace explosive was also stockpiled within the magazine. The soils and wood are to be disposed along with the building during demolish and clean-up of the site.

Effluent water from the treatment process, about 825 gallons, was collected, filtered to remove suspended solids, and passed through a MuniRem® BioChar filter medium to reduce the nitrate levels in the water for disposed as gray-water at the local sewage treatment plant. Paper-wrappers, plastic packaging and cardboard boxes were collected and disposed.



PROCESSING DYNAMITE STICKS



Equipment and building fixtures inside bay area



Decontamination of explosives contaminated equipment and building walls by MuniRem

Situation

H-6 (1.1D) explosives contamination was present in bulk and residual form on a Melter/Flaker machine within a building, as well as all fixtures within the building. After review of multiple solutions, the client specified the use of MuniRem Reagent for safe recovery and neutralization of the bulk explosives to remove the explosion hazard for safe disassembly of all equipment and decontamination of the Bay area building fixtures. The photo below shows the small footprint of MRE's decontamination set-up next to the building of interest.

Solution

An initial spray application of MuniRem solution in hallways and the Bay containing the Melter/Flaker machine neutralized H-6 contaminated surfaces and provided safe ingress/egress for staff. The sprayed MuniRem solution successfully neutralized, soaked, and cleaned loose materials in the Bay. The sprayed walls, ceiling, hood, and all equipment surfaces were rinsed after confirmation of complete explosives neutralization and destruction. Applied MuniRem solution on the floor progressively dissolved and destroyed the explosives in cracks during equipment and Bay decontamination.

Result

The project team decontaminated walls, floors, ceilings and disassembled equipment as well as achieved regulatory level compliance in the final disposition of waste streams (liquids and solids) for characteristics of ignitability, corrosivity, reactivity, explosivity, and toxicity. The equipment was decontaminated to US DoD level 5x, certified by a UXOSO/QCS. This allowed for safe dismantling and shipping off-site for recycling. According to regulatory and explosive safety qualified professionals, "the Bay work area is now the cleanest and safest place within the Building." The project team successfully adapted MuniRem application practices to overcome inclement weather conditions that were unusual for the Camp Minden region; two days of snow, freezing rain, and multiple days with temperatures below freezing.

Engagement details

Client

Confidential private industry client

Site

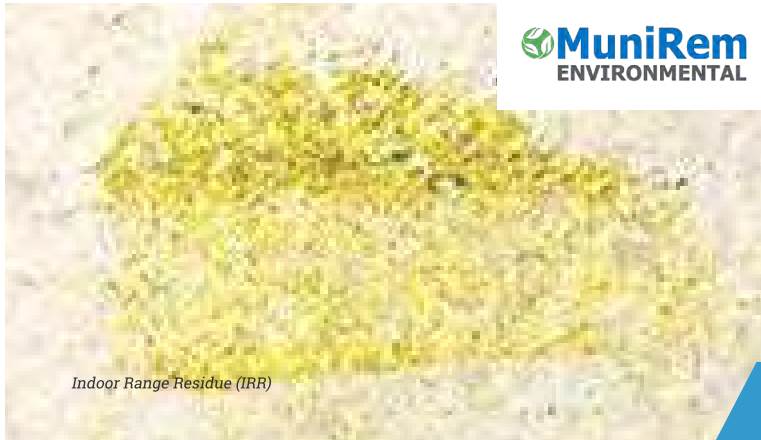
Explo Systems, Inc. Site.
Former Louisiana Army Ammunition Plant, Camp Minden, Louisiana, USA

Task

Decontamination of equipment and building

Date

Jan – Feb, 2015



Indoor Range Residue (IRR)



MuniRem powder
shipped via air,
land and sea

Application of MuniRem as a solution for management of energetic residues in indoor training ranges

Situation

The increased use of fragile ammunition in military training ranges in order to limit lead exposure results in increased generation of residues as well as a color change in the residue. The range residue is generated in multiple indoor ranges from fired small arms ammunition made from propellants. The propellant/gun powder material in bulk form is considered a hazardous material with 1.3 classification. Interim analytical results indicate that the propellant residue collected from the floor of some indoor ranges consists of approximately 90% unburnt double base propellant. Therefore, the propellant residue may be considered as a reactive hazardous waste with a DOT classification of 1.1 to 1.3.

To enable the DoD to continue with its use of the fragile ammunition in its indoor range training exercises, a management solution for the energetic residue deposited on the range floors is desired.

Solution

The development of cleaning and management procedures for the energetic residues in the indoor ranges was preceded by bench scale tests. The tests confirmed that MuniRem is an effective reagent for the rapid neutralization and destruction of the neat propellant and the range residues. During routine range cleaning events, the MuniRem powder is sprinkled over the propellant residues then sprayed with water to stimulate a rapid energetic neutralization reaction. The residue is collected from the floor after 1 - 2 hours, placed in drums and labeled as a non-hazardous waste after confirmatory sampling. For self performing military sites and range management contractors, MuniRem Environmental (MRE) offers on-site training to the staff. The MuniRem powder is purchased from MRE and shipped to the military installation in United States Department of Transportation approved containers. MRE has developed standard operation protocols for cleaning of energetic indoor range residue on the floor and other surfaces.

Result

The MuniRem reagent is effective for cleaning energetic waste in indoor ranges. The energetics are neutralized and destroyed, while the metals are stabilized as the insoluble metal sulfides. Thus, the MuniRem cleaning procedure generates a Non-Hazardous waste. Our MuniRem solution is flexible and scalable with a "pay-as-you-go" model, requires NO material upfront costs.

Engagement details

Client

United States
Department of Defense

Site

Multiple Indoor Training
Ranges, USA

Task

Alternative Solution for
Cleaning Indoor Range
Propellant Residues

Date

Ongoing

RAPID CHEMICAL NEUTRALIZATION OF EXPLOSIVES IN MULTIPLE MEDIA

MuniRem

MuniRem is a chemical formulation invented in the US by MuniRem Environmental's founder over a ten-year period of laboratory and field testing:

- Proven, rapid, in-situ or ex-situ chemical solution for munitions constituents (organic pollutants, heavy & toxic metals, pesticides) in soils and groundwater
- Proprietary, patented and exclusively licensed chemical formulation that can meet and exceed the most stringent remediation

MuniRem consists of selected bulk reductants that:

- Degrades PCBs and explosives into nitrogen gas, formate and non-hazardous trace elements
- Reacts with toxic and heavy metals into insoluble metal sulfides

MuniRem formulation and application is tailored to each site to ensure optimum performance and desired results:

- It can be applied as a solid or aqueous solution to achieve optimal and desirable results
- **Contaminated soils treatment** involves mixing MuniRem into the soils and adding water to achieve in-situ or ex-situ remediation.
- **Groundwater remediation** involves injection of the MuniRem solution into the site groundwater to instantly degrade the dissolved contaminants and create permeable reactive aquifer solids for long-term treatment of the plume.
- **Decontamination applications** involve spraying the MuniRem solution on building walls, large equipment and scrap metals (including bombs shells, bomb components, projectiles); and soaking small sized equipment in MuniRem baths.
- **Range Management and Remediation** involves applying MuniRem-BC (Biochar reinforced with MuniRem reagent). The sorption of MCs by biochar and proven degradation of bulk explosives and MCs by MuniRem reagent are realized in range soils over many months from a single application.

MuniRem was voted a 2010 Better World Technology by the Association of University Technology Managers.

Proven Capabilities & Field Success

MuniRem has successfully neutralized recovered munitions fillers (bulk explosives) and decontaminated explosive residues on bomb casings, demilitarization equipment, building walls, open burn open detonation (OBOD) ash and contaminated soils including:

i. US Army:

Multiple 10-lbs batches of explosives (Composition D) recovered from Navy projectiles neutralized within 20 minutes

ii. US DoD Demilitarization Facilities:

Contaminated equipment (kettles, autoclaves, & conveyor belts), building walls, gaskets, bomb casings, OBOD ash, pink water & Granular Activated Carbon (GAC) were rapidly decontaminated to nondetect levels (US DoD level 5x decontamination) with no hazardous by-product and discharge to clean up.

iii. Ravenna Army Ammunitions Plant:

In-situ treatment of field soils with high concentrations (>20%) of TNT, RDX and HMX and achieved cleanup goal for energetics in less than 2 weeks.

IV. Active US DoD Munitions Manufacturing Plant:

The MuniRem solution is applied to neutralize energetics and decontaminate building fixtures, removing explosive hazard before maintenance and renovation work by construction contractors.



MuniRem onsite remediation on contaminated soil



R.A. McClure Inc. (RAM) is an international blast engineering and consulting firm that focuses on improving productivity and safety through blast optimization, advanced technical and turn-key remediation services.

- Ecofriendly and Rapid Neutralization of Explosives
- Field Explosive Detection Kits
- Portable X-Ray Systems
- Remote Video and Close Circuit TV
- High speed cameras 1,000 fps
- Borehole Cameras (1500' depth)
- Lightning Prediction & Detection Systems
- Blast Mitigation Technology
- Explosive Containment Trailers
- FLIR Cameras

RAM in partnership with MuniRem Environmental LLC provides **MuniRem®** as a cost effective green solution for the remediation of soil and groundwater, buildings and equipment that are contaminated with explosives residues. **RAM** distributes **MuniRem®** through-out **North & South America, Africa, Australia** and **Europe**.

Robert McClure, President

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MuniRem® Products are patented and trademarked by MuniRem Environmental LLC

MuniRem Environmental is a pioneer in the application of a portfolio of innovative green remediation technologies for metals, explosives, radiation, petroleum and perchlorate in various media. Our team of experienced scientist and professionals are dedicated to making a difference by providing our clients and partners with demonstrably superior cost-effective green remediation technologies and solutions.