Effects of Range Fires on Surface Distributed Comp-B Explosive

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INTRODUCTION

Historically, most fires that occurred on artillery impact areas were allowed to burn within the impact area boundaries due to hazards associated with unexploded ordnance (UXO). These frequent fires were determined partly responsible for the high quality native plant eco system in the Fort McCoy artillery impact area (Simmers, et al. 1997) and similar effects have been seen at other artillery impact areas across the U.S. While incidental and controlled burns provide significant benefits to habitat quality, these processes may also significantly reduce particulate residues of munitions compounds (MC), particularly Comp-B explosive residues from low-order detonations. Understanding the effects of fire on the persistence of residual MC on training ranges can provide a remedial alternative that is also a critical component currently being used for sustaining native plant ecosystems on military lands.

The overall objective of this project is to determine the efficacy of incidental and managed burns for destruction of particulate Comp-B explosives and to provide guidance on fire behavior properties necessary for maximum benefit.

PREVIOUS LABORATORY TESTS

Proof of Concept:

Particles of Comp-B explosive were placed on a specially designed combustion chamber and exposed to heat and flame (Figure 1). These tests determined that Comp-B particles would begin to melt at approximately 200 deg F and combust at approximately 340 deg F. Exposure of Comp-B particles to flame or spark resulted in rapid combustion.

Figure 1. Effects of Heat/Flame on Combustion

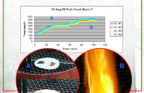
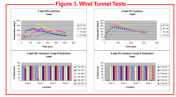


Figure 3. Wind Tunnel Tests



Wind Tunnel Tests:

(Figure 2) were conducted on plots of *Schizachyrium scoparium* (Little bluestem) on 3 soil types at wind speeds of 1 and 4 mph and two vegetation moisture conditions. Particles of Comp-B weighing 0.5, 1 and 2 grams were placed on the soil surface of test chambers containing dormant vegetation. Vegetation was ignited and temperature at the point of Comp-B placement and other fire behavior was monitored. Recoverable particles of Comp-B were reweighed to determine loss of mass and soil beneath the combusted particles was collected and chemically analyzed to determine any residual explosive compounds and their degradation products.

Figure 2. Wind Tunnel Burning Process

An example of results is shown in Figure 3. Reduction of Comp-B due to combustion ranged from 47 to 92%. Peak temperatures generally did not exceed 350 deg F at the soil surface indicating combustion of Comp-B was mostly initiated by direct contact with flame or embers from burning vegetation.

FIELD TEST RESULTS

ERDC BIG BLACK EXPLOSION TEST SITE

- Three field plots measuring 12.2 x12.2 m
- Vegetation indigenous (mostly *Paspalum notatum*) and pine litter
- Three 0.5 g particles of Comp-B placed at each of 8 sample points
- Climatic and vegetation (fuel) conditions varied
- Soil surface temperature, flame height monitored
- Determined occurrence of Comp-B combustion

Results are shown in Figure 4. Conditions at the time of each test varied as shown. Higher soil surface temperatures were produced in the pine straw plots resulting in longer burn times and higher peak temperatures and a more complete burning of vegetative fuel. This resulted in 100% reduction of Com-B in 2 Of 3 burns. Figure 4A shows the incomplete burn in the grassland burn compared to a complete burn of the pine litter (Figure 4B). Higher relative humidity and fuel moisture generally resulted in less burning efficiency and lower reduction of Comp-B.

CAMP SHELBY TEST SITE

- Two controlled burns performed by Camp Shelby personnel
- Site 1 – grassland
- Site 2 – pine forest (insufficient ground litter – burn failed)
- 8 sample points per location, three 0.5 g particles Comp-B for each

Results from Camp Shelby are shown in Figure 5. Climatic and fuel conditions were optimum for prescribed burning providing complete combustion of dry vegetation. Peak soil surface temperatures ranged from 500-800 deg F and resulted in 100% reduction of Comp-B.

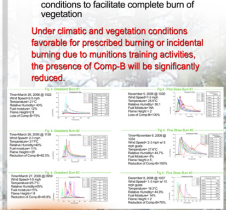
SUMMARY

Comp-B explosive readily combusts when exposed to heat above 350 deg F or in contact with flame or embers from burning vegetation

Efficiency is dependent on multiple factors:

- Sufficient litter (fuel) biomass in immediate proximity
- Favorable climatic and fuel moisture conditions to facilitate complete burn of vegetation

Under climatic and vegetation conditions favorable for prescribed burning or incidental burning due to munitions training activities, the presence of Comp-B will be significantly reduced.



References: JW Simmers, RA Price, KF Myers, RA Kiehl, RD Kress, H Tatem, KC Jensen, GS Wilkerm and DS Cleveland. 1997. Vegetation Containment Inventory. Fort McCoy, Miscellaneous Paper EL-97-4. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Determining the efficacy of incidental and managed burns for destruction of particulate Comp-B explosives and providing guidance on fire behavior properties necessary for maximum benefit