Summary of Prior Sampling Workshops

Trace Explosives Sampling for Security Applications (TESSA) Workshop Series 01

August 13, 2014

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High Tech Approach

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- Title: **Obliterating Animal Carcasses with Explosives**

Jim Tour, Project Leader, and Mike Knodel, Northern Region Blaster Examiner

Recreation, Engineering Tech Tips

United States Department of Agriculture
Forest Service
Technology & Development Program

January1995

2300/7100 9523-2315–MTDC

Obliterating Animal Carcasses with Explosives

Jim Tour, Project Leader, and Mike Knodel, Northern Region Blaster Examiner

There are times when it is important to remove or obliterate an animal carcass from locations such as recreation areas where a carcass might attract bears, at a popular picnic area where the public might object, or along the side of roads or trails. Large animal carcasses can be particularly difficult to remove, especially if they are located below a steep cut slope or in remote areas.

Explosives have successfully been used by qualified blasters to partially or totally obliterate large animal carcasses (horses, mules, moose, etc.). It is important to consider location, time of year, and size of the carcass when selecting the quantity and type of explosive to accomplish the obliteration task. Consult a qualified blaster when explosives are to be used.

The following examples illustrate partial obliteration (dispersion) for a horse that weighs about 1,100 pounds (453.6 kilograms). In the first example, urgency is not a factor. Perhaps a few days are expected before the public is to visit the area, or perhaps bears will not be attracted to the carcass. In any case, in this example,dispersion is acceptable.

- Place 3 pounds (1.36 kilograms) of explosives under the carcass in four locations (Figure 1). The carcass can then be rolled onto the explosives if necessary.
- Place 1 pound (.45 kilograms) of explosives in two locations on each leg.
- Use detonator cord to tie the explosives charges together.
- Use water bags to hold the explosives close to the carcass if it is impractical to place charges under the carcass, for example when the carcass is laying in water.
- Horseshoes should be removed to minimize dangerous flying debris.

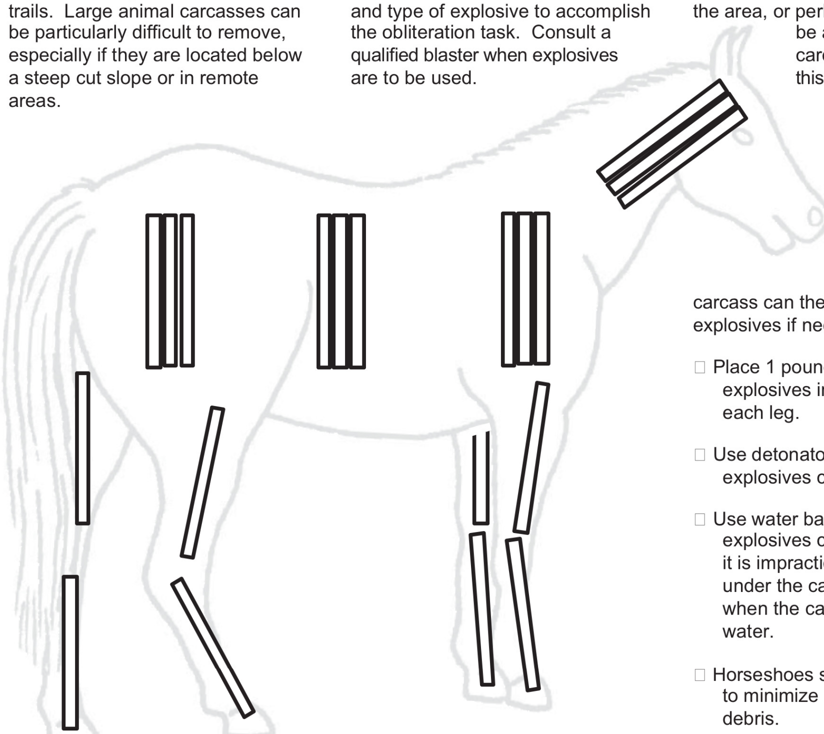

Figure 1—Partial obliteration using 20 pounds (9.1 kilograms) of explosives under the carcass.

For additional Information contact: *Dennis Davis, Missoula Technology & Development Center; 5785 Hwy. 10 West; Missoula, MT 59808-9361. Phone: 406-329-3929; fax: 406-329-3719; e-mail: ddavis02@fs.fed.us.*

Figure 2 shows a similar example where it is not practical to move the carcass onto the explosive charges. For example, when the carcass is laying in water or frozen into the ground. In this case, 55 pounds (25 kilograms) of linear (one box of fireline) explosives are simply draped over the carcass. Use of the entire 55 pounds (25 kilograms) of explosives will provide more obliteration than shown in the first example.

In situations where total animal obliteration is necessary, it is advisable to double the amount of explosives used in the first two examples. Use 20 pounds (9 kilograms) on top of and 20 pounds (9 kilograms) underneath the carcass, depending on the type of explosives used. Total obliteration might be preferred in situations where the public is expected in the area the next day, or where bears are particularly prolific.

Here are some rules of thumb for carcass obliteration:

- Use more explosives than shown in the examples on larger animals like moose, especially if total obliteration is desired.
- One-by-sixteen (1-inch diameter by 16 inches long = 2.54 centimeters by 40.6 centimeters) stick powder generally weighs about 1 pound (.45 kilograms) per stick.
- One box of linear explosives (fireline) weighs about 55 pounds (25 kilograms).
- Most large animal carcasses can be adequately disbursed with 20 pounds (9 kilograms) explosives. However, 40 to 55 pounds (18 to 25 kilograms) are recommended to ensure total obliteration.
- The water gel explosives are acceptable for use when the temperature is above freezing (32° Fahrenheit or 0° Centigrade). Emulsions will detonate at temperatures as low as 0° F (-18° C). Use PETN or TNT type explosives when temperatures are near or below 0° F (-18° C).
- Carcasses that have been dispersed will generally be totally gone within a few days.
- Carcasses that have been partially obliterated will generally not show any trace of existence the next day.

For further information on using explosives for animal removal, contact a blaster on your Forest, or Jim Tour at the Missoula Technology and Development Center.

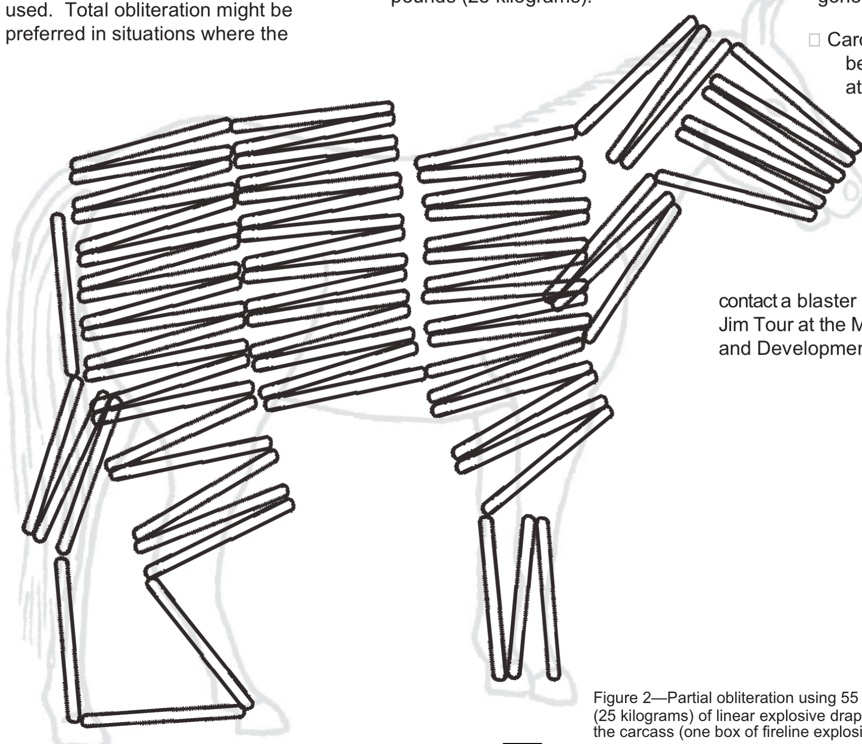

Figure 2—Partial obliteration using 55 pounds (25 kilograms) of linear explosive draped over the carcass (one box of fireline explosive).

Overview

- Overview of past Sampling Workshops
  - Roadmap/Action Items from each
  - Technology push
- What’s different with this new CoE Alert2 approach?
- Summary

2004 Trace Standards/Sampling Workshop

- One day meeting, Government attendees only; Goal; to address current status and issues with Trace Contamination Studies, Standards, QC processes and Sampling.
- Representatives from TSA (included TSL), TSWG, NIST, INNEL, and SNL.
- From workshop notes: “Dr. Lyle Malotky of TSA was the next speaker, first discussing the sample collection problems in trace detection.” Discussed sampling issues, unknown collection efficiency, variability in performance with a variety of COTS wipes used, etc.

2004 Trace Standards/Sampling Workshop

- **Action List from Trace Standards Workshop, May 19, 2004**

{Agency names / POC removed to protect the person!}

1. Examine the potential use of masking agents.
2. Investigate project on efforts to clean up/remove contamination.
3. Simulants (trace and bulk) - verification and pedigree.
4. Particle/fingerprint characterization work.
5. Training standards among agencies.
6. Characterize the background explosive contamination in the transportation system.

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2004 Trace Standards/Sampling Workshop

- **Action List from Trace Standards Workshop *CONTINUED***

7. Standards development/automating production of standards – NIST inkjet (TSA, Hallowell as a customer, and NIST as a supplier).

8. TSA Quality Control products are available to other agencies for evaluation from TSA.

Outcome from workshop - ???

2004 Trace Standards/Sampling Workshop

1. ***Examine the potential use of masking agents.***
2. **Investigate project on efforts to clean up/remove contamination.**
3. Simulants (trace and bulk) - verification and pedigree.
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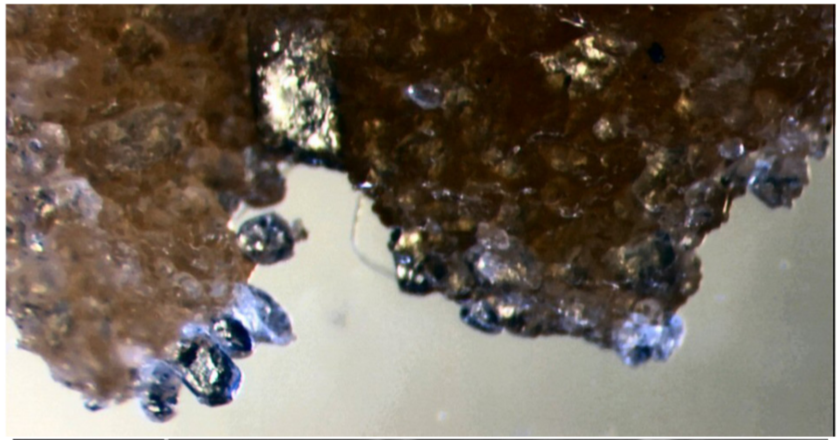

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2008 Trace Sampling Workshop

- Approximately 45 attendees; Academia, Industry and Government

- **GOAL**: The goals of the focus group are to gain a better understanding of where the problems lie and how to best move forward to bring about an enhanced explosive detection capability through improved trace sampling. We are soliciting your participation to develop a 5 year roadmap that will define the path by which we will work towards improvements in sampling technologies and methodologies.

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Questions to answer and issues to discuss:

1. Do we currently know enough basic science concerning the properties of trace explosive particles (including binders and skin oils) and vapors (and their interactions with various surface materials) to make sound plans for a next-generation sampling system? If not, what critical information is missing, in priority, for doing so? Also, who is performing the basic science that is relevant and accessible?

2. Do we presently have knowledge of all past and present attempts for trace sampling? Which worked, and which didn't? Why did these fail? Are there gaps in our knowledge of sampling and can they be identified?

3. Can we list the top three technology candidates for a next-generation trace sampler? Should we aim our efforts at near term advances/success in sampling technologies (12-18 months) or long-term advances/success (2-3 yrs, or maybe even out to 3-5 yrs), or both?

4. **Do we currently have the proper standards to test and measure both sampling efficiency and overall sampling and detection performance? If not, what areas of research need to be performed to provide better standards and testing methods?**

5. Can we adapt advanced sampling approaches to other detection venues/con-ops and what technology requirements are known? Do we have sufficient operational technology requirements for existing operations?

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- Presentations on past and present sampling efforts; particle, swipe-based, as well as, non-contact type particle and vapor based collection.

- *Example presentation: Dr. Steve Bunker, ISC/retired . . . →*

Mechanical Contact with a brush

The Good	The Bad
Depends a lot on the choice of brush material	Requires separate collection system, typically a vacuum and trap
Easy to automate	Interferences depend on trap material
Brush is cheap and reusable	Still a surface contact system
Best with flat surfaces	Can push light targets around; target may get caught in brush
Easily scaled to very large areas	Reproducibility
Off patent	Efficiency depends on target surface and explosive type
Cheap design for large areas	Trap may be a consumable

- The Future
  - Worth considering if only for the automation, large area, and low cost

Non-contact air jet

The Good	The Bad
Easy to implement	Requires separate collection system, typically a vacuum and trap
Easy to automate	Interferences depend on trap material
Cheap and reusable	Problem with large area coverage
Cost is linear with area covered	Reproducibility – emphasizes larger particles
Can be scaled to large areas	Can push light targets around
Best with cloth target	Efficiency depends on target surface and explosive type - poor with rigid surfaces
No patent	Jet can blow particles away
Acceptable in most environments	Efficiency rapidly declines with distance and lower pressure
	Trap may be a consumable

- The Future
  - May be limited to cloth or highly focused jets on other surfaces

Non-contact Dry Ice Aerosol

The Good	The Bad
Easy to implement	Requires separate collection system, typically a vacuum and trap
Easy to automate	Interferences depend on trap material
Fairly cheap and reusable	Problem with large area coverage
	Reproducibility – makes small particles
	Can push light targets around
Works with most target surfaces and explosives	Jet can blow particles away
Cost is linear with area covered	Needs pressurized consumable CO_2 tank
	Efficiency rapidly declines with distance
	Problem with high ambient temperature
	Patent pending
	Trap may be a consumable

- The Future
  - Most useful for short distance, automated and manual applications

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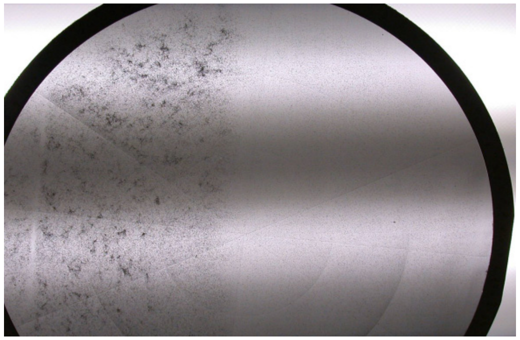
SS Single Layer Collection Trap



The Good	The Bad
Relatively inexpensive	Collects >10μ particles
High air flow throughput; good for very high volume sampling	Limited efficiency for nitrates & TATP
Reusable with automatic cleaning	Automatic cleaning is complex, needing thermal and mechanical cleans
Very fast oven desorption possible (<3 sec for RDX)	
6" dia. traps demonstrated	
No self-contamination	
Low sensitivity to background vapor	
Very rugged	

- The Future
  - Potential for low cost, high throughput automated systems

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Roadmap for Trace Explosive Sampling

Sampling Workshop – Particle Sampling Sub-Group meeting (2/26-27/09)

Technique	***Comments on Technique***
Non Contact Approaches	
1. Applied energy	
a. Radio Frequency	
b. Ultrasound	- Discussed with Tom Curl of Agiltron for the FY07 SBIR Phase I, but not implemented
c. Subsonics	- Discussed with Tom Curl of Agiltron for the FY07 SBIR Phase I, but not implemented
d. Infrared	
e. Air Jets/Knives	- GE, Smiths, Implant Sciences, and to a lesser extent Syagen have implemented air jets in their trace portals. Air knives have yet to be successfully applied to sampling people – they may have potential for other smaller items.
f. CO_2 jets	- Implant Sciences FY07 SBIR (currently in Phase II) has shown much promise in combination with a "vortex" attractor. ISC has also developed an airjet with HCO_3.
g. Smart Dust - Dislodging - Collecting particles	
i. Either in an air stream or physically engaging (polishing) surface	
h. Physical vibration (shake and bake)	- Multiple vendors have tried this with various levels success both in US and internationally. Generally accepted that this is not an ideal method.
i. Electrical (or magnetic?) field	
j. Local heating	- does this cover all thermal desorption methods?
k. Solvent (steam) displacement	
l. Combinations of any of the above	
i. Are there ideal combinations?	
2. Adhesion Forces – are they due to…	
a. Van Der Waals	
b. Electrostatics	
i. What force plays the greatest role under what circumstance?	
c. Physical entanglement	
d. Binder or finger oil "glue"	
e. Capillary forces	
f. Particle (elastic) properties (i.e. deformation, fracture, size etc.)	
g. Chemical bonds to substrate (might be relevant to nano-particles) including hydrogen bonding, charge transfer and dissociative adsorption type interaction.	

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1. Other variables	
a. Humidity	
b. Electrostatics	
c. Surface morphology (micro to nanoscale)	
d. Surface morphology (macroscale) – uneven vs. even/flat surfaces	
e. Surface hardness, i.e. plastic vs cloth vs skin	
f. Surface susceptibility to charge transfer formation (i.e. TNT on hydrated silica)	
g. Temperature and exposure to UV-VIS light (environmental variables)	
h. Particle size distribution	
i. Particle shape (is stimulant is used)	
j. Others?	
2. Collection Systems	
a. Vacuum samplers – collection once particles dislodged	
b. Active systems – mimic of canine (exhale followed by inhale)	
c. Fluid dynamic concerns and considerations	
d.	
3. Look at total system efficiency that is dislodge – transport-capture and desorb/detect	
Contact Approaches	
1. Materials for physical contact sampling	
a. Brush (macroscopic as well as microscopic based on polymers)	Implant Sciences performed preliminary work with positive results. TSL has also conducted initial research with encouraging results.
b. Tacky adhesive materials as swabs – mimic forensic tape pulls	NIST will be investigating these materials
i. What are the best properties of the adhesive?	Adhesive should have no interfering peaks in IMS plasmagram, no outgassing, high level of durability, adequate adhesion properties to effectively sample explosive particles etc.
ii. Viscosity, surface tension, solubility parameter, volatility	
c. What is the best surface engagement? Rolling or wiping	
d. Nanofeatured/nanostructured materials (Gecko feet)	Should be examined as a possible route to enhanced sampling
e. Nonwoven fabrics and other hydroentangled structures	Swiffer and other carbon nonwovens are under investigation by TSL and NIST
f. Can electrostatics be utilized to benefit	From the data presented, the answer appears to be

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1. Finger oil/sebum detection and characterization	
a. Capillarity	
b. General properties	
c. Can the chemistry of it be exploited?	
i. Does it dissolve some of the explosive	
d. Does it help or hinder sampling	
2. Metrics for sampling	
a. Procedures - we need both laboratory and field	
i. How do we ensure precise field sampling?	
1. Location, pressure and orientation of sampling device	
2. Need for covert field test items	
b. Standards	
i. Field testing of effectiveness	
c. Sampling efficiency determinations	
d. How do we make the transition from the lab to the field	
e. How far can we wipe before the target explosive is removed	
f. Treat sampling and desorption as a total process - Optimize the system	
3. Dynamics of particle deformation	
a. Failure modes – how/why/where do particles break	
b. Effect of binder or finger goo on particle fracture	
c. Does particle fracture help or hinder detection?	
i. How small do they get, are they collected and detected?	
d. Can we relate ideal sphere to true explosive particle morphology?	
4. Measurement Standardization	
a. Type of substrate: materials, surface roughness, size (the list should be dynamic and changed according to end user findings)	
b. Protocol of sample preparation (for different experiments performed in various labs, i.e. swipe, air jets, AFM etc.) – amount of explosive and the procedure of its deposition	
c. Standardization of analytical measurements (determination of amount of explosive collected etc.)	

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a. Modeling adhesion – AFM measurements, relative importance of various types of forces etc.	
b. Aerodynamics of gas jets interacting with various surfaces	
c. Statistical approaches to treat non-uniform large ensemble of non-uniform shape particles (based on more accurate modeling of single well defined particle-substrate contact area)	
d. Analysis of air jets usefulness in gates	
e. Modeling active collection procedures (per canine use)	
2. Other topics?	

Summary

- Past workshops provided useful review/discussions, and produced a sampling roadmap that provided areas for future initiatives, direction, and potential government funding.
- Some of the items have been accomplished, but not all.
- We still do NOT have a complete data set for sample efficiency of COTS sampling swipes against real surfaces and real threats (i.e., C4, Semtex, TNT, etc.), hence this CoE new thrust area.

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