Military Evaluations of the Performance of Outdoor Bullet Traps

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Small arms training is a requirement to maintain readiness in all branches of the military. The United States military operates more than 1,800 outdoor small arms training ranges. These training activities typically consume more than 300 million rounds yearly, depositing between 1 and 2 million pounds of lead bullet debris. As a result, Department of Defense (DOD) small-arms ranges accumulate significant amounts of lead in the soil. The migration of lead and heavy metals at elevated levels can present a health hazard prompting training restrictions by environmental regulators. Restrictions ultimately reduce the operational readiness of the military. The U.S. Army Environmental Center (USAEC) investigated the possibility of utilizing bullet traps on outdoor small arms ranges as a means to reduce or control lead contamination.

Commercial manufacturers promote bullet traps as an economical technology for lead management of small arms ranges. USAEC assessed the feasibility of utilizing commercially available bullet traps on U.S. Army ranges. The assessment culminated in USAEC publishing a feasibility study and user's guide in 1996. Both documents were based solely on manufacturers' performance claims and observations of the traps installed on indoor ranges. At that time, use of the traps on outdoor ranges was limited and no data were available on their performance.

To determine the effectiveness of the commercial traps on outdoor ranges, USAEC completed an accelerated field demonstration of three of the most popular designs of commercially available traps (granular rubber, steel decelerator and rubber block type bullet traps). The Environmental Security Technology Certification Program (ESTCP) also funded testing of Shock-Absorbing Concrete (SACON) as bullet trapping material on small arms ranges. These traps were tested using standard M16 M855 rounds (no tracer rounds were used). Generally, none of the traps completely met the manufacturers' performance claims.

Some of the bullet traps provided a means of effectively capturing and containing lead on small arms ranges. However, most available bullet traps do not contain or control 100 percent of the lead captured by the trap. During the testing and demonstration process, significant problems were noted with airborne releases of lead dust, the potential for storm water transport and the flammability of bullet trap materials.

During testing of the deceleration trap, 5,000 rounds were fired at the trap. Firing was concentrated within a 12-inch diameter area near the deceleration chamber opening. This was believed to provide for optimum containment ability of the trap. A dust cloud was present at the

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trap entrance during firing. The mass of 5,000 M855 bullets is approximately 20,088 grams. A total of 16,059 grams of material was contained within the deceleration chamber and ventilation unit of the trap. The metal containment percentage was 79.9 percent. The optimum containment scenario resulted in 80-percent containment of bullet debris, with the majority of debris emissions being dust. Lead levels were measured at the deceleration chamber ventilation exhaust port, the sides of the trap entrance, 12.5 meters in front of the firing line and at the firing line. The results are presented below.

Monitor location	*Eight-hour time weighted average (mg/m^3)*	*Action level exceeded ($0.03\ mg/m^3$)*	*Sampling period (minutes)*
Firing position	*0.019*	*No*	*299*
Right side of trap	*1.45*	*Yes*	*355*
Left side of trap	*0.198*	*Yes*	*84*
Mid-range	*0.0095*	*No*	*350*
Ventilation exhaust port	*4.76*	*Yes*	*359*

Table 1. Firing operation air samples for lead.

As a result of the less-than-desired lead containment, USAEC halted any further live-fire testing of the deceleration trap.

A rubber trap used on an outdoor range may be damaged significantly during its life on the range. Range impact areas generally are maintained in a grassed-over condition to minimize erosion and range run-off. During hot, dry weather, the grass dries out, and fires become a potential problem. Range fires can be caused by a number of mechanisms, including tracer rounds, muzzle flash and lightning. Rubber bullet traps on the range are susceptible to consumption by fire. Burning rubber complicates fighting range fires by creating a hot, smoky fire that produces complex hydrocarbons containing carcinogens. Rubber fires also produce a thick, black smoke visible for miles, and can generate nuisance complaints from neighbors and inquiries from the regulatory community.

With the exception of SACON, none of the bullet traps exhibited the ability to inhibit leaching of lead corrosion products. Most bullet traps require hazardous waste classification and disposal at the end of their useful life. SACON debris, when analyzed for leachable lead content, was consistently non-hazardous (less than 5 parts per million Toxicity Characteristic Leaching Procedure (TCLP) lead). Debris samples taken from rubber traps consistently failed the TCLP criterion for a characteristic hazardous waste. The hazardous classification results in more expensive handling and disposal requirements for range debris generated from the use of traps using rubber as the friction media.

Bullet traps, when used in a backstop-type application, compare directly with the traditional soil berm. Estimated costs associated with installation, maintenance, and disposal or remediation for a 20-lane, 25-meter range application are presented below for both bullet traps and conventional berms.

Technology	Start-up	Annual operation and maintenance	Annual environmental activity costs	Disposal
Deceleration	*$316,270*	*No estimate*	*No estimate*	*$340,500*
Granular rubber	*$229,035*	*$18,224*	*$2,505*	*$50,050*
Block rubber	*$132,895*	*$30,664*	*$4,440*	*$30,123*
SACON	*$33,331*	*$74,471*	*$3,900*	*$17,664*
Conventional berm	*$58,920*	*$2,600*	*$480*	*$1,176,000*

Table 2. Bullet trap technology costs.

Using the estimated costs above, an Annual Net Equivalent Value (ANEV) can be calculated to make direct comparisons. The following table presents ANEVs for the bullet traps and berms with respect to an assumed risk of lead migration. On ranges that exhibit a low risk for lead transport, the soil berm provides the lowest cost method of capturing rounds. However, as the risk of lead transport from the range increases (lead transport risk should be determined prior to implementing any form of corrective action), the use of bullet traps becomes economically feasible when compared with the prospect of periodically removing the lead from the soil.

Technology	*Low risk*	*Medium risk*	*High risk*
Conventional berm	*$14,237*[a]	*$68,525*[b]	*$406,266*[c]
SACON	*$82,201*		
Deceleration	*No estimate*		
Block rubber	*$48,309*		
Granular rubber	*$47,707*		

[a]*Based on a 50-year berm life.*
[b]*Based on a 15-year berm life.*
[c]*Based on a 5-year berm life.*

Table 3. Annual Net Equivalent Value cost comparison.

Bullet traps are an expensive last-resort solution for keeping outdoor small arms ranges environmentally compliant. Prior to selecting a bullet trap, other alternatives should be investigated, such as establishing vegetative cover and redesigning berms to reduce erosion, or the addition of soil stabilizing additives to reduce lead leaching. New methods of stabilizing lead on ranges and mitigating physical lead transport in storm water runoff are being developed and may provide more cost effective means of reducing lead transport risk and bioavailability.

If an installation determines that a bullet trap is the only option to control the migration of lead contaminants on a range, further investigation must be conducted to ensure the bullet trap will contain the lead. Even if a trap stops the bullet, lead can leach or wash out of the trap into the environment. In order to benefit the range, the trap's performance must continue long after the initial bullet impact. Questions to consider before the application of bullet traps on an outdoor range include:

- *Will the trap contain all bullet debris within the trap?*
- *Will the metal wash or leach out of the trap over a period of time?*
- *How will wastes generated by the trap be handled? All material from a trap will not be recyclable.*
- *What are the maintenance requirements? This includes hazardous material handling and safety requirements. Training and proper personnel protection equipment also will be needed. Bullet traps will require maintenance.*
- *How will the bullet trap impact the use of the range? Bullet traps are designed to accept a certain range or type of ammunition. If the range mission changes, the bullet trap may not be suitable for the new ammunition. Significant damage and environmental impacts can be created if the trap is not properly designed for the ammunition being used on the range.*
- *How will exposure to the outdoor environment affect the trap? Today's commercial traps originally were designed for indoor use. Currently, they are being marketed for outdoor use with little or no consideration for the effects that climate, precipitation, temperature change or weather have on their durability, maintenance or capability to contain lead.*

For more information on bullet traps or to download copies of the reports mentioned, review the USAEC Range XXI Homepage at: http://aec.army.mil, or call USAEC's hotline at (800) USA-3845.