

Blast Protection for UXO Operations Including Demining

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To protect the safety of those working to defuse mines and UXO, the mine action community spends considerable time and effort on research and development of protective equipment and neutralization products that mitigate the effects of explosions. The author introduces a new technology in the form of a wrapping material that could be used in everything from safe transportation of explosives to blast-resistant garbage bins. Inspired by some good experiences Lockheed Martin UK INSYS Ltd. has had with a particular blast mitigation product, this article has been written to expand on these experiences into an important area, namely the management of unexploded ordnance.

Mines, UXO and improvised explosive devices are explosive hazards that have proliferated for many decades. In a post-conflict scenario, these are sometimes known collectively as explosive remnants of war.¹ While global initiatives have limited the spread of certain types of devices (especially anti-personnel mines), a considerable problem still exists and will continue for many years to come.

Even where loss of life is avoided, remediation activities such as soil and water decontamination and the replacement of habitation and infrastructure are subjected to unnecessary risk, delay and additional costs due to the presence (suspected or actual) of ERW.

Technologies for the detection of explosive blast hazards are numerous and range from rakes to multi-spectral sensor arrays on autonomous vehicles. Technologies for the protection of structures, materiel and personnel from blast are considerably less numerous. For such technologies to be attractive they must be simple-to-use, quick-to-deploy and fulfill several key functions:

- Serve as a means to mitigate the blast from a single explosive hazard *in situ*
- Provide blast mitigation for a storage area for explosive hazards
- Protect materiel, buildings and their occupants in areas close to the site of the explosive hazard or an explosive hazard storage area

In order to fulfill these functions, any workable solution must have the following essential characteristics:

- Flexibility and ease of use
- Low cost
- High, scalable performance
- Low density
- Very low environmental impact
- Longevity

Here, we show that BlastWrapTM performs exceptionally well against these parameters.



Figure 1: BlastWrap. *Photo by Glen Miles*

BlastWrap Introduction

BlastWrap is a generic blast-mitigation technology product based on a combination of a compressible mineral and a flame-quenching salt.² This mixture is commonly encapsulated within a semi-continuous panel made from two layers of formed thermoplastic comprising a uniform array of sealed compartments. The result is an adaptable and robust blast-mitigating wrapping constructed from lightweight, inexpensive materials (see Figure 1).

BlastWrap has been used to mitigate against blast in a variety of applications. Military applications have focused on accident prevention in storage and during transport. Work has recently demonstrated the effectiveness of BlastWrap to prevent sympathetic detonation between artillery shells, and work is currently underway to design a BlastWrap retrofit container for large-calibre ammunition.³ In the oil and gas industries, BlastWrap has been proven to prevent blast damage to oil pipelines.⁴ Civil-sector applications have focused on developing blast-proof litterbins (such as the BlastGard MTR range of trash receptacles⁵) and on the protection of buildings within Iraq.⁶

Essential Characteristics	Description
Flexibility and ease of use	The core technology is a granular material that can be used to fill any void and so conforms to any shape. The standard product (see Figure 1) can easily create flat and cylindrical barriers.
Low cost	Raw material costs are quoted as \$16 (U.S.) per square foot for a 1-inch-thick layer (â, -140 per square meter for a 25-mm-thick layer)
High, scalable performance	Reduction of overpressure of 50 percent or more has been demonstrated. Multiple layers can be used for large explosive devices or stores.
Low density	A 1-inch (25-mm) layer has an areal density of 0.6 lbs per square feet (3 kilograms per square meter).
Very low environmental impact	Materials are non-toxic, as are the combustion products.
Longevity	Will retain performance for more than 20 years.

Table 1: The characteristics of BlastWrap.⁷

BlastWrap's pedigree is predicated on its applicability nature, such that existing structures can be transformed into blast-resistant structures via retrofit.

Table 1 describes how BlastWrap fares in terms of the essential characteristics listed above.

Civilian Safety

The development of the MTR litterbin has generated a performance curve for BlastWrap. The data is summarised in Figure 2. It is conceived that such a device might find use in the transport and storage of ERW.

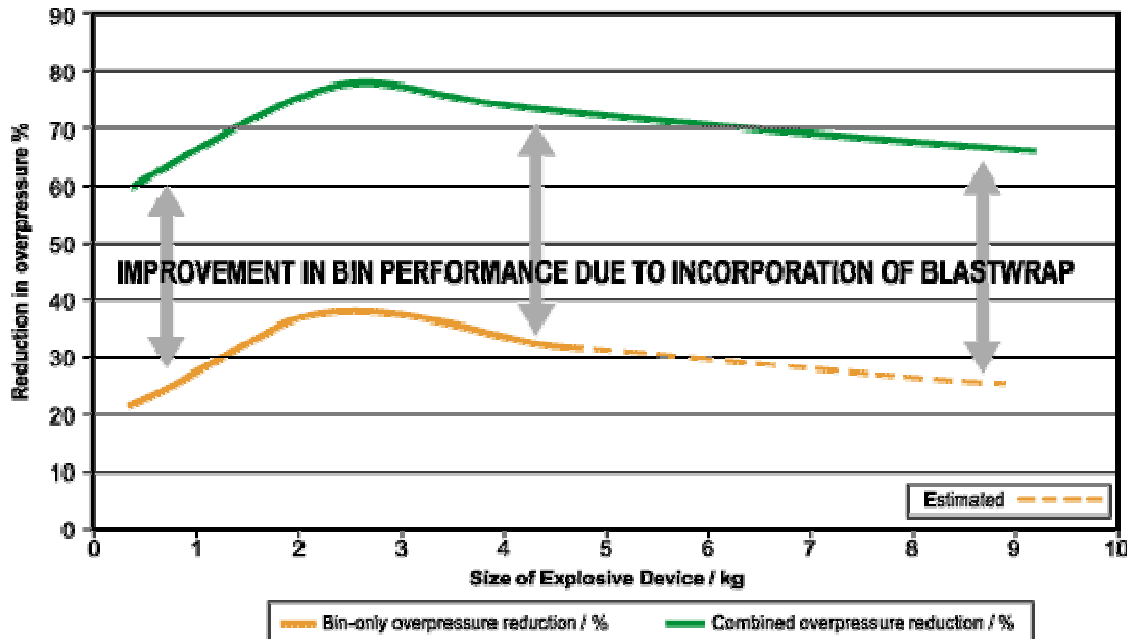


Figure 2: BlastWrap litterbin data summary.

Figure by Glen Miles

EOD Safety

A temporary three-man shelter for protection of explosive ordnance disposal personnel has been proposed. This structure is designed to be positioned as near as 100 feet from a 2,000-pound (900-kilogram) device. The shelter has the capability to prevent fragment penetration and eliminate lethal overpressure within the survival area. The possibilities for EOD usage have subsequently been extended (see below).

Building Protection

Two diverging approaches can be taken when protecting buildings. The most effective is to provide a barrier between the building and the source of the blast. The effect of the blast on the building is minimised. Alternatively, blast mitigation that is light and flexible enough to be used inside the building can be used to reduce the invasiveness of the blast wave. Although this approach is more discreet and controllable, it still leaves the structure vulnerable to damage that

may lead to partial or complete collapse of the building, depending on the situation. With this in mind, BlastWrap is considered to be part of a necessarily more complex solution. This type of application has been proposed for use in Iraq to protect buildings associated with infrastructure.



Figure 3: Lockheed Martin UK INSYS testing of BlastWrap with artillery shells.
Photo by Glen Miles

Munitions Safety

The prevention of sympathetic detonation between artillery shells by BlastWrap suggests a considerable capacity to transmute blast-wave energy over very short distances (see Figure 3). This is borne out by the measurement taken from the litterbin trials (see Figure 2). The reduction in blast-wave energy has two benefits. First, it reduces the range of lethality of the blast. Second, it reduces the likelihood and extent of secondary reactions of nearby explosive devices. Hence the same function can be used in dividing walls within magazines or other explosives storage areas to reduce sympathetic or secondary reaction, as well as around the periphery of the storage area to reduce the effect of any explosion on the surrounding area.

UXO Operations with BlastWrap

The operational view of handling ERW is drawn down into distinct phases, from planning through reconnaissance and identification to render safe and disposal operations. Removal and storage of ERW is also an option. To perform these functions, certain physical processes must be performed:

- Establishment and maintenance of safe areas
- Establishment and maintenance of demolition and/or storage areas
- Provision and maintenance of the associated logistical chain
- Provision and management of the requisite personnel and equipment
- Break-down and close-out procedures

The objective of BlastWrap deployment is to provide a portable blast barrier solution that is capable of considerable service life and operation in the widest possible operational situations. These might include the following:

- An ERW location marker that has blast-suppressing properties, particularly useful for managing multiple ERW in close proximity
- A mitigant to minimise the damage to equipment resulting from an explosion during demining
- A blast tent to protect the surroundings during render-safe operations
- A semi-permanent blast shield to protect safe areas and buildings where an explosive event is possible



Figure 4: Explosive trial of BlastWrap-lined container.
Photo courtesy of BlastGard International

- A lagging layer to transform a normal building into a safe explosive device storage area
- A sacrificial blast-damping device to the impact of noise and flash associated with the neutralisation of ERW
- Packaging for stored explosive devices

An example is illustrated in Figure 4. This trial is associated with the characterisation of the MTR litterbin. It is conceived that a similar approach can be used mitigate the effects of an IED on the surroundings where there is a damage issue, e.g., in a built-up area, in a multi-story building, in the vicinity of a treasured landmark or building.

Biography



Dr. Glenn Miles was educated at Leeds and Cranfield Universities and studied energetic materials at the Royal Military College of Science to obtain a Ph.D. His first job was at the Atomic Weapons Establishment in the United Kingdom, where his responsibilities included all of the mechanical testing of polymer-bonded explosives. He moved to Hunting Engineering Ltd. (now Lockheed Martin UK INSYS Ltd.) in 2000.

Endnotes

1. *Explosive Remnants of War (ERW): A Threat Analysis*, CCW/GGE/I/WP.5, Geneva International Centre for Humanitarian Demining, 23 April 2002.
2. For more information see http://www.blastgardinternational.com/bp_blastwrap.asp. Accessed 12 Dec. 2005.
3. In collaboration with INSYS Ltd. in the United Kingdom.
4. For more information see http://www.blastgardinternational.com/pdfs/pipeline_test_results.pdf. Accessed 12 Dec. 2005.
5. For more information see http://www.blastgardinternational.com/bp_mtr.asp. Accessed 12 Dec. 2005.
6. "Proposal for the Protection of Public Buildings in Iraq." KJ Sharpe. 22 July 2004.
7. As of June 2005.

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