

Fertilizers & Chemistry: The Homemade Explosive Problem

“It is becoming increasingly clear that industry should take greater responsibility not only for how its products are produced, but also for how they are developed, sourced, stored, transported and used.”

*International Fertilizer Association, “What is product stewardship?”
(<http://www.protectandsustain.org/principles>)*

Improvised Explosive Devices (IEDs) have become the terrorist’s weapon of choice and are proliferating around the world (see the figure in following section). It is known that many of these IEDs contain Homemade Explosives (HME) in the main charge or in improvised initiators. Some of these HMEs are derived from fertilizers because they are readily available, low cost, and simple to convert to explosive compounds.

Nitrogen fertilizers are essential to produce high crop yields. The Joint Improvised Explosive Device Defeat Organization’s (JIEDDO) challenge, to reduce or eliminate the illicit use of fertilizer-based explosives, is directly linked to the International Fertilizer Association’s (IFA’s) Safety, Health and Environment Principles and the IFA’s recognition that some fertilizer products require handling above and beyond even these principles.ⁱ It can be a “win-win” proposition for both groups. New products may be developed that could help IFA membership reduce manufacturing, storage and transportation hazards and also limit terrorist organizations use of one of their most powerful weapons.

JIEDDO envisions four Focus Areas to reduce or eliminate the illicit use of Ammonium Nitrate (AN)-based fertilizers in HME:

- Increased Ability to Detect as an Explosive
- Detonation Prevention
- Standardization and Regulation
- Education

This paper, after establishing the global context of illicit Ammonium Nitrate use as HME, will concentrate on the two more technical Focus Areas of Detectability and Detonation Prevention. While the overall solution must be balanced (and in alignment with the IFA’s goals and visions), the less technical Focus Areas of Standardization and Regulation as well as Education will only be summarized.

The Global Problem

HME is any explosive that can be chemically or physically produced in an ad hoc laboratory or household, requiring little or no special industrial tools or processes, and with precursors easily available from market sources.ⁱⁱ The popularity of AN-based fertilizers is due in part to:

- Widely available, inexpensive precursors
- Well known preparation “recipes”
- Easy and inexpensive conversion to a detonable product
- Produces desired blast effects

- Relative safety in preparation, device assembly and emplacement

Every month, more than 500 improvised explosive device incidents occur around the world (excluding Iraq and Afghanistan).ⁱⁱⁱ These devices are used in an effort to influence both governments and populations through the loss of lives, limbs, eyesight, and property destruction, as well as creating secondary effects such as psychological damage and spurring of economic uncertainty. The explosive used in the vast majority of these incidents goes unreported or is not reported in a manner allowing accurate identification of the explosive used. But when considering the factors identified in the preceding paragraph, there is high confidence that a large amount of the events utilize HME.



Figure: Global IEDs, April 2011 – March 2012

It is critical for both industry and government partners to understand the gravity and size of this situation; this is a global problem. Two AN-centric events from 2011 highlight this problem: attacks in Oslo and Mumbai. In Oslo, Norway, approximately 6 tons of AN and Calcium Ammonium Nitrate (CAN) was used as a vehicle-borne bomb killing 8 people, wounding hundreds and closed down the entire city center. The bomber was able to acquire and stockpile the massive amount of fertilizer via a fake farming business and create his bomb with little difficulty.^{iv} The 2011 Mumbai, India, bombings consisted of three AN-based bombs^v claiming the lives of some 27 people and injuring more.^{vi} Of course, there are many more incidents around the world: the Revolutionary Armed Forces of Colombia (FARC) has

been known to use AN-based HME within land mines^{vii} and Boko Haram in Nigeria has killed many people utilizing AN-based fertilizer.^{viii}

The Way Ahead

JIEDDO has convened several conferences and issued Requests for Proposals specifically focused on potential solutions. Experts from international laboratories, academia, industry and government agencies that represent many scientific disciplines including: Chemistry, Engineering, Agronomy and Energetics have participated. Several promising concepts which have been proposed are summarized in the table below. Specific details of individual approaches cannot be disclosed to protect intellectual property rights. This paper does not intend to list or exclude any method or mechanism to achieve the goals of these areas. JIEDDO is interested in any concepts which may achieve our shared goals while keeping the AN-based fertilizer a viable product in the marketplace.

Focus	Rationale	Approach
Increased Ability to Detect as an Explosive	Additives to facilitate the detection and identification of AN HME	<ul style="list-style-type: none"> • Colorants • Odorants • Taggants
Detonation Prevention	Reduce explosive potential or prevent conversion to an explosive	<ul style="list-style-type: none"> • Non-detonable formulations • Use of dilutants • Additives to prevent mixing of liquid fuels • Additives to prevent crushing or grinding • Formulations that prevent purification
Standardization and Regulation	Control and track access to prevent illicit use	<ul style="list-style-type: none"> • Tracking agents • Imposing limits on AN content • Regulated sales to identified buyers • Technical tracking of shipments
Education	Increase awareness of illicit use	<ul style="list-style-type: none"> • Stewardship • “Know Your Customer” Campaigns

Table: Suggested Approaches

Detectability

In the context of this paper, “detectability” is the ability to identify and recognize associated materials being used to produce HME. An example of this is the addition of a colorant or other substance that makes the presence of AN obvious to nearby individuals. Dyes, especially those which are biodegradable and brightly colored, could be ideal for AN detection efforts. Candidate dyes should be scrutinized in terms of toxicity, detection efficiency, environmental fate, cost and availability. Other non-dye additives that could potentially be used to enhance the detection of illicit AN use are odorant, bioluminescence, or taggants.

Detonation Prevention

Nitrate based nitrogen has a specific role in agricultural production and few will argue that removing it from fertilizers would not have a profound effect on agricultural production. Ammonium Nitrate is normally considered a strong oxidizer and becomes an effective homemade explosive when enhanced with the addition of fuels. For many years the community has considered adding diluents to reduce the explosive potential of AN and CAN formulations, some of which have been adopted by many manufacturers.

Terrorists have developed several easy techniques to defeat this approach. New techniques must be developed to counter the evolving terrorist threat. JIEDDO has identified three promising areas with a potential for reducing AN explosive potential that need to be investigated: developing alternative non-detonable formulations, developing additives that will prevent or complicate the conversion to HME, and developing formulations that are easier to neutralize after HMEs are produced.

Standardization and Regulation

Many countries have rules and regulations in existence to inhibit those who would divert HME precursors such as AN-based fertilizer for illicit purposes. While rules and regulations by individual governments can work, regional and global efforts increase the likelihood of success significantly. Porous borders, corruption and complicity only exacerbate the problem and much work needs to be accomplished to reduce these factors where they exist. The industry must develop and pursue technical means to track distribution of AN-based products from the factory to the field.

Education

JIEDDO believes that an industry-backed education program, focused on re-sellers and distributors of AN-based fertilizer would not only increase awareness at all levels, from wholesale to retail, about potential illicit activity involving the product, but also create a feedback from the customer base which could lead to product improvements.

Conclusions

A myriad of solutions are available to properly manage the illicit use of HME, some of which have been proposed and examined over the years. Unfortunately, most have been unfeasible due to the very nature of fertilizer being used to grow crops and the vast majority of the product being used for legitimate means. JIEDDO would like to continue the exchange of ideas – balancing IFA's goals and visions with our four proposed areas for industry emphasis, leading to industry actions beneficial to all parties. Under IFA's leadership, and working together in a "whole of industry" concept, we believe the fertilizer industry can institute feasible and effective detectability programs, develop a non-detonable substitute for ammonium nitrate, and create acceptable international standards and regulations. These actions supplement and propel forward the IFA's stewardship program and achievement of the Safety, Health and Environment principles. The benefits serve the membership of the IFA, policy makers, farmers, the scientific community and the interests of the general public to have safe and secure fertilizer products.

Wayne Stanbery, Dustin Bade, Shelley Bennett, and Richard Hottell
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ⁱ International Fertilizer Association, IFA Homepage: "Fertilizer Products and Human Health and Safety", Available online at: (<http://www.fertilizer.org/ifa/HomePage/SUSTAINABILITY/Human-health/Fertilizer-products.html>)

ⁱⁱ US Department of Defense, Department of the Navy, Navy Explosives Ordinance Disposal Technical Division, "Afghanistan IED Identification Guide", January 2010. Pg. EXP-1.

ⁱⁱⁱ Institute for Defense Analysis, Global IED Database, queried for Apr 2011 – Mar 2012

^{iv} *The New York Times*, "Oslo Suspect Cultivated Parallel Life to Disguise 'Martyrdom Operation'", 25 July, 2011. Available online at: (http://www.nytimes.com/2011/07/25/world/europe/25breivik.html?pagewanted=1&_r=1&src=un&feedurl=http://json8.nytimes.com/pages/world/europe/index.jsonp)

^v *The Times of India*, "India Set to Regulate Use of Ammonium Nitrate", 16 July, 2011. Available online at: (http://articles.timesofindia.indiatimes.com/2011-07-16/india/29781559_1_ammonium-nitrate-terror-attacks-fertilizer)

^{vi} *The New York Times*, "India: 2 Arrested in July Terrorist Attack on Mumbai", 23 January 2012, Available online at: (<http://www.nytimes.com/2012/01/24/world/asia/india-2-arrested-in-july-terrorist-attack-on-mumbai.html?ref=terrorism>)

^{vii} Colombia Reports, "Army Discovers FARC Landmine Cache Hidden in Cans of Tuna", 25 November 2011. Available online at: (<http://colombiareports.com/colombia-news/news/20701-farc-landmines-found-in-southwest-colombia.html>)

^{viii} Reuters, "Explosives-Laden Truck Seized in Nigeria", 11 March 2011. Available online at: (<http://www.nytimes.com/2011/03/12/world/africa/12nigeria.html?ref=nigeria>)